A CANADIAN VIEW ON ANADROMOUS FISHERIES SCIENCE ACTIVITIES IN THE NORTH PACIFIC

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1. INTRODUCTION

The purpose of this paper is to describe and promote a process for collaboration between two organizations with interests in the fisheries resources of the North Pacific. One of these organizations, the North Pacific Anadromous Fish Commission (NPAFC), is primarily concerned with the conservation and management of anadromous fish stocks while the other, the Pacific Marine Science Organization (PICES), is primarily concerned with scientific investigation of the North Pacific Ocean, including its fishery resources.

The paper describes how a process of collaboration, similar to that being proposed for the North Pacific functions in the North Atlantic. The Atlantic partners are the North Atlantic Salmon Conservation Organization (NASCO), an organization created by a treaty to manage and conserve Atlantic salmon, and the International Council for Exploration of the Seas (ICES), an organization created by a treaty to study marine resources.

2. PICES GOALS AND OBJECTIVES

The Parties to the Convention for a North Pacific Marine Science Organization PICES) are Canada, the People's Republic of China, Japan and the United States. This Convention entered into force on 24 March, 1992. The Union of Soviet Socialist Republics was also involved in the negotiation of this treaty but did not submit their instruments of ratification within the agreed timeframe; it is expected that Russia will join PICES in the future. The main thrust of the treaty is that scientific understanding of the North Pacific Ocean can best be achieved through a spirit of international scientific cooperation on a mutually beneficial basis. The Convention establishes an Organization to carry out its functions and this organization is based in Sidney, British Columbia.

The purpose of the Organization is to:

(a) promote and coordinate marine scientific research in order to advance scientific knowledge of the area concerned and of its living resources..., its flora, fauna and ecosystems, its uses and resources, and impacts upon it from human activities; and

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

At its first annual meeting, the Governing Council of PICES affirmed, in accordance with Article V 1. (d) of its Convention, that the Organization

"will consider requests to develop scientific advice pertaining to the Convention Area."

The Organization consists of a Governing Council, a Secretariat and such committees or scientific groups as the Council may wish to establish. Currently, the scientific work of PICES is organized under a Science Board with 4 different committees reporting to it; they are Biological Oceanography, Fishery Science, Marine Environmental Quality, and Physical Oceanography and Climate. Six scientific working groups were also established at the first Annual meeting of PICES, including 2 directly related to the interests of NPAFC, namely a working group on the dynamics of small pelagics in coastal ecosystems and a data collection and quality control working group.

As previously mentioned, PICES will consider requests to develop scientific advice pertaining to the Convention Area. PICES also "*recognizes the need to clarify the respective roles of PICES and various other international organizations, existing or new, with a view towards avoiding duplication and overlap in the activities of these organizations.*" In a formal Resolution approved by the Parties to the Convention, the Governing Council authorized the Chairman of PICES to respond to requests from other organizations, if initiated, and to enter into discussions to clarify respective roles, including maintenance and continuation of INPFC databases and scientific records.

3.NPAFC GOALS AND OBJECTIVES

The Parties to the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean (Canada, Japan, Russia and the United States) completed their ratification procedures on November 18, 1992. The Convention entered into force on February 16, 1993. The Convention replaces the International North Pacific Fisheries Commission (INPFC) whose members were Canada, Japan and the United States. Under the Convention, directed fishing for anadromous stocks is prohibited on the high seas of the North Pacific Ocean. Bycatches of these fish are to be subjected to international control and such bycatches cannot be retained. The Convention establishes the North Pacific Anadromous Fish Commission (NPAFC) which is based in Vancouver, British Columbia.

In the preamble to the NPAFC convention, the Parties agreed to the following statements:

emphasizing the importance of scientific research for the conservation of anadromous stocks in the North Pacific Ocean.

desiring to promote the acquisition, analysis, and dissemination of scientific information pertaining to anadromous stocks and ecologically related species in the North Pacific Ocean

Articles VII and IX of the NPAFC Convention refer to scientific research, paraphrased below,

parties shall cooperate in the conduct of scientific research ... for the conservation of anadromous stocks including, as appropriate, scientific research on other ecologically related species.

parties shall cooperate, as appropriate, in collecting, reporting and exchanging biostatistical information, fisheries data, including catch and fishing effort statistics, biological samples and other relevant data...

parties shall provide...catch information, enhancement information...related to anadromous stocks and ecologically related species, pertaining to areas adjacent to the Convention Area(that is, from within national jurisdictions)...

parties shall develop appropriate cooperation programs, including scientific observer programs, to collect fishing information...

parties shall endeavour to cooperate in scientific exchanges such as seminars, workshops and ... exchanges of scientific personnel...

parties shall submit...their scientific research programs...involving directed fishing for, or incidental takes of significant levels of, anadromous fish in the Convention area...to allow appropriate scientific review by all Parties...

It was agreed within the Treaty (Article IX para 8) that the Commission (the NPAFC) could make recommendations to any Party with respect to scientific research activities within the Convention Area related to anadromous stocks and, as appropriate, ecologically related species. As well, the Commission in Article IX para 9 was given the authority to cooperate, as appropriate, with relevant international organizations, inter alia, to obtain the best available scientific advice, to further the attainment of the objectives of this Convention.

In the Final Act adopting the Convention, the four delegations noted that the activities of the NPAFC should be coordinated as appropriate with PICES.

4. WHY THE NPAFC WILL NEED TO SEEK ADVICE FROM PICES

PICES is the only international organization with a clear mandate for the development of scientific understanding of the North Pacific. Through a combination of its 4 committees dealing with oceanography, environmental quality and fisheries science and its working groups , especially those dealing with data collection and data quality control, it provides the multidisciplinary focus for consideration of questions on the abundance of fish stocks and factors controlling this abundance. The NPAFC will not be in a position to provide such an intensive investigation of major questions of concern such as carrying capacity for salmonids and the potential influence of ocean climate so inevitably they will have to request such advice from PICES. PICES however will not be able to readily answer such complex questions without having had regular exposure to the more routine questions of origin and migration routes of the various salmonid stocks in the North Pacific and of the predator-prey relations between salmonids and other organisms. PICES also could benefit from involvement in anadromous fish research plans, by perhaps suggesting alternatives for data collection or methodology that could provide further insight into ecological mechanisms.

5. POSSIBLE NPAFC/PICES COLLABORATION

It is Canada's view that PICES should be the primary organization from which the NPAFC and other existing or future multilateral marine fisheries management and conservation organizations seek scientific services including, where appropriate, scientific advice on stock status. It is important to ensure that both the NPAFC and PICES fulfil their fundamental objectives, work together efficiently and effectively and avoid duplication and overlap of activities, services and overhead in the area of scientific research in the North Pacific. A harmonization of the roles of the two organizations is important to all member countries of both organizations given fiscal constraints. While it would be possible for the 2 organizations to work independently of each other for a short time, it is inevitable that the NPAFC would require the assistance of PICES to consider such fundamental questions as the carrying capacity of the North Pacific for salmonids , as well as for other species. It would seem prudent to develop close working relationships now , at the beginning of each organization's existence, rather than wait for processes within each organization to become so entrenched that change would be difficult. There could quite possibly be differing memberships in the two Organizations; this should not however be considered a rationale for not proceeding cooperatively. As noted in the following section, membership can be different in the science organization compared to the fisheries management organization and effective results are still achievable.

The PICES organization could provide advice on the status of fish stocks, stock productivity and trends, as an extension of its work in fishery science.

In Canada's view, the NPAFC should not duplicate this activity but confine the work of its scientific committee to the formulation of its requests for advice to PICES and working with PICES to ensure that objectives of Article VII of the NPAFC are attained. Obviously, when one seeks advice from someone else, such advice does not always have to be followed. The Scientific Research and Statistics Committee of the NPAFC would obviously be the forum for review of advice from PICES and would be responsible for providing its own recommendations to the Commission. One function of the Commission that would obviously come under the review by the SR&S committee of NPAFC would be the review of scientific research programs in relation to their potential catch of anadromous stocks (Article VII para 6). The relative factions of the two organizations are discussed further in Section 7.

Some of the advantages of having PICES as the mechanism for developing advice on status of stocks are:

A. capability of a multidisciplinary review

B. independent of fishery management politics

C. cost effective since it would avoid duplication

D. timeframe would probably allow greater time for review of scientific advice rather than having back-to-back scientific/commission meetings as in INPFC

E. receiving funding from organizations such as NPAFC would allow PICES to grow thereby developing its capacity to provide advice to other organizations, perhaps yet to be formed, dealing with pollock, squid, etc.

As an aside, PICES would require detailed knowledge on fishery catches and effort to advise on the status of any fish stock. PICES would therefore be the logical depository and source for fishing statistics for the North Pacific. This would imply that PICES should assume the publication of a statistical yearbook on all fishery catches in the North Pacific, similar to the one previously published by INPFC but expanded to include all North Pacific fishing countries.

At its Inaugural Meeting, the NPAFC directed the newly-formed committee on Scientific Research and Statistics(CSRS) under the direction of the Committee Chairperson (Dr. L. Margolis) to review the Interim Terms of Reference and to

prepare a workplan for itself based on these interim terms of reference. A NPAFC Working Group will subsequently review this work plan and make recommendations to the Commission, and the Commission will consider how to coordinate the work of the CSRS with PICES, where appropriate. Parties to the NPAFC also agreed that the Commission will arrange a meeting with PICES representatives to discuss coordination at the First Annual NPAFC Meeting, if appropriate.

6. THE NASCO/ICES EXAMPLE

The North Atlantic Salmon Conservation Organization (NASCO) is an international organization established under a Convention of March 2 ,1982 for the conservation of Atlantic salmon in the North Atlantic. The Convention entered into force on 1 October 1983. Current membership includes all North Atlantic nations with salmon interests (Canada, Denmark in respect of Greenland and the Faroe Islands, the European Economic Community, Finland, Iceland, Norway, Russia, Sweden and the United States of America). The secretariat is based in Edinburgh, Scotland.

The preamble to the NASCO Convention notes the following:

desiring to promote the acquisition, analysis and dissemination of scientific information pertaining to salmon stocks in the North Atlantic Ocean
and

desiring to promote the conservation, restoration, enhancement and rational management of salmon stocks in the North Atlantic Ocean through international cooperation.

The NASCO Convention prohibits the fishing for salmon beyond areas of fisheries jurisdiction of coastal states and prohibits the fishing for salmon within the jurisdictions of coastal states beyond 12 nautical miles, with 2 exceptions: prohibition beyond 40 nautical miles in the West Greenland area and in the Faroe Islands, fishing is allowed up to the limit of its fisheries jurisdiction.

Some functions of the NASCO Council, related to the topic of research are:

-to provide a forum for the study, analysis and exchange of information among the Parties on matters concerning the salmon stocks subject to the Convention

-to provide a forum for consultation and cooperation on matters concerning the salmon stocks in the North Atlantic Ocean beyond Commission Areas

-to establish working arrangements with the International Council for the Exploration of the Sea and other appropriate fisheries and scientific organizations

-to make recommendations to the Parties, the International Council for the Exploration of the Sea or other appropriate fisheries or scientific organizations concerning the undertaking of scientific research.

The NASCO treaty, through its 3 geographical commissions, provides an opportunity for members to propose regulatory measures for salmon fisheries of another member where there is evidence of interceptions of salmon stocks occurring. Note that this is a complexity not considered in the NPAFC Convention. In proposing regulatory measures, Commissions are obligated to consider "the best available information, including advice from the International Council for the Exploration of the Sea and other appropriate scientific organizations."

The International Council for the Exploration of the Sea (ICES) was established at Copenhagen Denmark in 1902. Article 2 of its Convention notes that the ICES Council shall be concerned with the Atlantic Ocean and its adjacent seas and primarily concerned with the North Atlantic. There are currently 17 members of ICES; they are Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, The Netherlands, Norway, Poland, Portugal, Spain, Sweden, United Kingdom, United States of America, and Russia.The main duties of its Council were reiterated in its Constitution of 1974,namely:

to promote and encourage research and investigations for the study of the sea particularly related to the living resources thereof

to draw up programs for this purpose and to organize, in agreement with the contracting Parties, such research and investigations as may appear necessary

to publish ... results of research and investigations carried out under its auspices or to encourage the publication thereof

Article 4 of the ICES constitution says that the Council shall seek to establish and maintain working arrangements with other international organizations that have related objectives and cooperate, as far as possible, with them, in particular in the supply of scientific information requested.

A useful summary of the activities of ICES was published in 1991, titled "A Brief review of ICES on the Occasion of the Formation of the North Pacific Marine Science Organization" by J.E.Stewart and is attached to this document as Appendix B.

Besides providing scientific advice to its member parties, ICES provides scientific advice for fisheries through its Advisory Committee on Fisheries Management (ACFM) to NASCO, the International Baltic Sea Fisheries Commission (IBSFC), and the Northeast Atlantic Fisheries Commission (NEAF). Advice is also provided to at

least three international environmental organizations (the Oslo, Paris and Helsinki commissions) through the ICES Advisory Committee on the Marine Environment (ACME).

The process by which NASCO seeks and receives advice from ICES for Atlantic salmon matters is as follows:

A. At the annual meeting in June of NASCO, the 3 Commissions, after hearing the previous year's advice from ICES and after negotiation of fisheries regulatory measures, agree on a set of questions that they feel is appropriate to ask of ICES for the coming year. Many of these questions are routine and stay the same from one year to the next while others may be new because of new information or changing regulations or unusual conditions. Each Commission provides their questions to the Council from where they are sent to ICES. ICES representatives (at least the chairperson of ACFM and the Fisheries Secretary) participate at the NASCO meeting and can provide some assistance in the wording of the questions and some judgement if ICES is the appropriate body to consider certain questions. In past years, it was decided that other scientific groups might consider very regional questions; for example, a bilateral scientific working group on Salmonid Introductions and Transfers was created by the North American Commission (Canada and USA) to deal with a solely North American issue. In 1992, as a trial measure, the NASCO Council decided to create a separate Standing Scientific Committee composed of 2 representatives from each Commission (for a total of 6 people) to help in the formulation of questions to be asked of ICES.

B. At its Annual meeting, NASCO also agrees, as part of its budget, on the payment that will be made to ICES for its activities in the preparation of the scientific advice. This payment is meant to cover the cost of the typing, printing and distribution of the Working Group Report and the ACFM advice, partial costs for attendance at the 2nd level peer review(ACFM) of the advice, and the attendance of ICES representatives,as required, to the NASCO meeting. These costs would be borne by NASCO----- it to hold the equivalent meetings.

C. The NASCO request is considered at the time of the ICES Annual Meeting in October and its components assigned to the most appropriate specialist working group for consideration. Usually the Working Group on North Atlantic Salmon (NASWG) is asked to address most of the questions although, in the past, other working groups were involved in questions of disease and acid rain.

D. The NASWG is advised of their terms of reference in the fall and normally meets in March to consider their response to the questions and to prepare their report; the meeting usually lasts up to 2 weeks. Attendance at the Working Group usually only involves scientists from countries having interests in Atlantic salmon therefore there is usually little involvement from Poland, Germany, Spain, Portugal and the Netherlands. Their attendance is not prohibited however. Usually a portion (about 1/2) of the scientists involved have been at the previous NASCO meeting as scientific advisors to their respective delegations. Individual countries pay the expenses of sending scientists to the meeting; similarly, ICES itself does not conduct its own research but is dependent on the individual member parties for the conduct and collaboration on scientific studies.

E. The Working Group report is reviewed in May by the ACFM of ICES at which scientific advice to NASCO is formulated, agreed and sent to NASCO before their June meeting. ACFM usually provides the detailed NASWG report as well as their more concise advice to NASCO. Examples of the 1992 request from NASCO and extracts from the 1993 NASWG report are attached as Appendix 3 and 4 respectively. Complete copies of the 210 page NASWG report, as well as the ACFM advice when available in late May, can be made available by Canada, if requested.

The costs to NASCO of obtaining advice from ICES were estimated to be about £26000 in 1993 or less than 10% of the NASCO budget(Appendix 5); the amount has been discussed with ICES and there is some possibility of it decreasing in the future. It should be reiterated that it it were not for ICES, NASCO would incur these costs itself in organizing the relevant scientific meetings and in disseminating the advice.

As a proportion of the ICES budget, the NASCO contribution represents about 2% (Appendix 6).

7. DEVELOPMENT OF CSRS TERMS OF REFERENCE AND POSSIBLE PICES REQUEST.

Everything in the Interim Terms of Reference (Appendix Ai, except items h, j, k, and l) could be considered, with minor wording changes, to be addressable to PICES for consideration by their Fisheries Science Committee. Item h refers to approval of research plans and is an explicit NPAFC function; this would not prevent however questions being posed to PICES on the merits of certain lines of research. The remaining items are mostly administrative and relate to communication to the Commission and to the public.

A proposal for the Terms of Reference for the Committee on Scientific Research and Statistics with respect to scientific matters is provided as Appendix A.ii, while an example of a possible request to PICES is provided as Appendix Aiii.

8.CONCLUSION

The NPAFC should use the services of PICES much as NASCO has used ICES in the development of scientific advice on salmon stocks. Such a process has proven to be efficient and effective and makes the best use of fiscal and human resources. Most importantly it separates the scientific process from the fisheries management structure and provides an independent voice for science.

The changes made in the Doc. 8 (Rev. 1) are as follows:

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(c) ensure the availability of scientific information and views on ecologically-related species, in particular the impact of bycatches of species of concern designated by the Commission.

Revised Doc. 8

(c) ensure the availability of scientific information and views on ecologically-related species, including the impact of by-catches in related fisheries of species of concern designated by the Commission.

APPENDIX Ai

Committee on Scientific Research and Statistics

Interim Terms of Reference of the Committee

The terms of reference for the Committee are pursuant to Articles VII, VIII and IX of the Convention. Other matters may be referred to it by the Commission. In particular, the Committee shall, on an interim basis,:

(a) review and coordinate the collection and exchange of scientific data and collection of specimens of anadromous species;

(b) coordinate and assess scientific studies to ensure the identification of the location of the origin of anadromous stocks migrating in the Convention area and areas adjacent to it;

(c) ensure the availability of scientific information and views on ecologically-related species, including the impact of by-catches in related fisheries of species of concern designated by the Commission.

(d) develop appropriate observer programs to collect fishing information in the Convention area for the purpose of scientific research on anadromous stocks and, as appropriate, ecologically-related species;

(e) coordinate scientific exchanges, seminars, workshops, field research, and data analyses;

(f) make recommendations to the Commission for the conservation in the Convention area of anadromous stocks and ecologically-related species of concern designated by the Commission;

(g) make recommendations to the Commission to avoid or reduce incidental taking of anadromous fish in the Convention area;

(h) review proposed scientific research programs in accordance with Article VII paragraph 6 of the Convention;

(i) identify ecologically-related species which may be designated by the Commission as being of concern;

(j) create subcommittees necessary to carry out the functions of the Committee;

(k) review and approve reports submitted for publication and make recommendations regarding other reports to be published; and

(l) prepare a report annually for the Commission.

APPENDIX Aii

CANADIAN PROPOSAL FOR TERMS OF REFERENCE FOR THE COMMITTEE ON SCIENTIFIC RESEARCH AND STATISTICS (CSRS)

The terms of reference for the Committee are pursuant to Articles VII, VIII and IX of the Convention. Other matters may be referred to it by the Commission. In particular, the Committee shall:

(a) make recommendations to the Commission on the scientific advice which should be sought from PICES, on an annual basis;

(b) make recommendations to the Commission for the conservation in the Convention area of anadromous stocks and ecologically-related species of concern designated by the Commission;

(c) make recommendations to the Commission to avoid or reduce incidental taking of anadromous fish in the Convention area;

(d) review proposed scientific research programs in accordance with Article VII paragraph 6 of the Convention;

(e) make recommendations to the Commission on which ecologically-related species may be designated by the Commission as being of concern;

(f) create subcommittees necessary to carry out the functions of the Committee;

(g) review and approve reports submitted for publication and make recommendations regarding other reports to be published; and

(h) prepare a report annually for the Commission.

APPENDIX Aiii

DRAFT REQUEST TO PICES FROM NPAFC FOR 1993:

PICES is requested to provide a report to NPAFC containing scientific advice on the following:

(a) review and coordinate the collection and exchange of scientific data and collection of specimens of anadromous species ;

(b) coordinate and assess scientific studies to ensure the identification of the location of the origin of anadromous stocks migrating in the Convention area and areas adjacent to it;

(c) report annually on the harvest of anadromous stocks taken in fisheries for ecologically-related species in the Convention Area as to their location, timing, probable origin and the magnitude of the harvest;

(d) advise on appropriate observer programs to collect fishing information in the Convention area for the purpose of scientific research on anadromous stocks and, as appropriate, ecologically-related species;

(e)coordinate and report on scientific exchanges, seminars, workshops, field research, and data analyses relevant to the mandate of the NPAFC;

(f) provide scientific advice on the need for, and ways to achieve, conservation in the NPAFC Convention Area of anadromous stocks and ecologically-related species of concern designated by the NPAFC;

(g) suggest ways to avoid or reduce incidental taking of anadromous fish in the NPAFC Convention Area.

(h) advise on the expected harvest levels of anadromous stocks and their probable origins which would result from scientific research programs being proposed by Parties to the NPAFC in accordance with Article VII paragraph 6 of the NPAFC Convention.

(i) identify which species in the NPAFC Convention Area that could be considered to be ecologically-related to anadromous stocks in 2 categories: those which are prey of anadromous stocks and those that are commercially fished with gear that will also catch anadromous stocks.

(j) describe the status of the stocks migrating into the Convention Area and identify areas of concern in the Convention Area as to their carrying capacity for anadromous stocks;

(k) advise annually on data deficiences and research needs to more completely address questions posed by the NPAFC.

APP.
B

RETROSPECTIVE/RÉTROSPECTIF

A Brief Review of the International Council for the Exploration of the Sea (ICES) on the Occasion of the Formation of the North Pacific Marine Science Organization

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Stewart, J. E. 1991. A brief review of the International Council for the Exploration of the Sea (ICES) on the occasion of the formation of the North Pacific Marine Science Organization. Can. J. Fish. Aquat. Sci. 48: 2543–2550.

Elements of the first 90 years of the North Atlantic organization the International Council for the Exploration of the Sea (ICES) have been examined to illustrate its functions and some of its achievements. The 17-nation Council, founded in 1902 to deal with overfishing in northern European marine areas, now represents countries on both sides of the Atlantic. Its mandate is to promote marine science and provide advice on the rational use of marine living resources. To accomplish this it stimulates and coordinates cooperative research programmes in the biology of marine, anadromous, and catadromous species, mariculture, fisheries assessment, pollution, and physical and chemical oceanography.

L'auteur examine certains faits survenus au cours des 90 premières années du Conseil international pour l'exploration de la mer (CIEM), un organisme dont l'aire d'intérêt est l'Atlantique Nord, afin d'illustrer ses fonctions et certaines de ses réalisations. Le Conseil, que a été fondé en 1902 dans le but de lutter contre la surpêche dans les mers de l'Europe du Nord, regroupe maintenant 17 États répartis des deux cotés de l'Atlantique. Il a pour mandat de promouvoir les sciences de la mer et de fournir des conseils relatifs à l'utilisation rationnelle des ressources marines vivantes. Pour ce faire, il favorise et coordonne des programmes de recherche coopératifs en biologie des espèces marines, anadromes et catadromes, en mariculture, en évaluation des pêches, en étude de la pollution et en océanographie physique et chimique.

Received August 6, 1991
Accepted September 18, 1991
(JB188)

Reçu le 6 août 1991
Accepté le 18 septembre 1991

The general belief that a North Pacific international organization devoted to the marine sciences would be valuable received impetus when informal discussions of the concept were held in Vancouver in 1973. Further meetings, informal and formal, culminated in a 1986 gathering at Anchorage where participants from Canada, the Peoples Republic of China, Japan, the Union of Soviet Socialist Republics, and the United States of America endorsed the concept of establishing an organization to promote and coordinate marine scientific investigations in the North Pacific Ocean (north of 30°N) and its adjacent seas and facilitate the exchange of scientific information; it was recommended further that the organization not have responsibility for allocation of marine resources. The consensus and opinions expressed at Anchorage indicated that the need for such an organization was widely recognized in the scientific community and that it was time to refer the concept to the five governments. Canada was asked to take the lead in drafting a concept paper. The draft articles were discussed in 1988 in Sidney, British Columbia (B.C.), and refined at a working group meeting in Seattle in 1989. The Draft Convention for a North Pacific Marine Science Organization was considered in Ottawa in 1990 and approved as an adequate instrument by representatives of the five countries who recommended it to their respective governments for signature and ratification. Ratification by at least three of the five countries is required to bring the convention into force; this was expected to occur by the fall of 1991 at which point other interested nations would be invited to participate. The organization was expected to be operational by late 1991 with its headquarters in Canada, at the Institute of Ocean Sciences, Sidney, B.C. This new body is the Pacific counterpart of the 17-member International Council for the Exploration of the Sea (ICES), the oldest intergovernmental organization dealing with marine sciences (its current membership is listed in the appendix). Since ICES was a partial model for the new organization and has been discharging its responsibilities for the North Atlantic for almost a century, it was considered appropriate to mark the inauguration of the North Pacific Marine Science Organization by presenting a brief review of salient features of the history of ICES.

ICES: The Beginning

Two quotations from Went's (1972) history of ICES succinctly describe the scene which led directly to its formation:

In the middle of the last century there was a firm belief in the inexhaustibility of the seas. So great were the resources of the seas, many people believed that with his existing methods of capture, MAN could hardly make any impression on them. However, with the great expansion in the trawling fleet and the introduction of steam propulsion and the otter trawl, many thinking scientists had other views. In fact, some were satisfied that overfishing was taking place.

Organized fisheries research as such was unknown but individual scientists were working on many marine problems. These men were, however, scattered, often isolated, with little contact with their fellow scientists. This is not surprising since communications were slow and there was little money for science and scientists.

By the "nineties" of the last century, scientific investigations into many marine problems were being conducted in the Atlantic, the North Sea, and the Baltic. But scientists were beginning to realize that isolated investigations in limited areas of the sea were really of little value and that cooperation in the international field was highly desirable.

There had been a degree of cooperation in certain areas of fisheries, largely in their regulation and reduction of conflicting interests; witness the signing of the North Sea Convention of 1882. This, however, was insufficient and an initiative was taken by the British National Sea Fisheries Protection Association to organize a conference to consider the state of the fisheries in the North Sea. This conference, held in London in 1892, was attended by representatives from nations around the North Sea (Belgium, Denmark, France, Germany, The Netherlands, and the United Kingdom). Apparently, it was not a success, since it was described by a senior German representative, Walther Herwig, as characterized by "strong sentiment but little basic knowledge" (Went 1972). Herwig returned from the meeting convinced of the need for cooperative international research into the biology of the important fish species.

Since a number of leading marine scientists from northern European coastal states held similar views, a course developed which led more or less directly to the formation of ICES. Two organizing and founding conferences, one in Stockholm in 1899 and the other in Kristiania (now named Oslo) in 1901, determined the form and function of ICES. These were followed by the inaugural meeting, which began July 22, 1902, in Copenhagen, and was attended by representatives of Denmark, Finland, Germany, The Netherlands, Norway, Sweden, Russia, and the United Kingdom; Herwig was elected the first President. Over the years, membership in the Council has varied in keeping with events and changing circumstances. For example, the United States of America first adhered July 22, 1912, but did not return to the Council following the dislocation in Council affairs imposed by the First World War. Canada's interest in joining was sounded by the Council as early as 1912, but Canada did not join until 1967; the United States of America rejoined in 1973.

In the earlier organizational meetings, a program for oceanographic (or hydrographic work as it was then termed) and biological work had been planned. The policy statement which preceded the recommendations for this program, quoted in full by Went (1972), is included here as well, since it has proved to contain the guiding principles for the Council and is characteristic of the practical approach adopted by the Council from its very beginning:

Considering that a rational exploitation of the sea should rest as far as possible on scientific enquiry, and considering that international cooperation is the best way of arriving at satisfactory results in this direction, especially if in the execution of the investigations, it be left constantly in view that their primary object is to promote and improve the fisheries through international agreements, this International Conference resolved to recommend to the States concerned the following scheme of investigations which should be carried out for a period of at least five years.

The initial program, although precisely planned, was far larger than could be carried out immediately with the resources available. Thus, a degree of selection was necessary. To aid in making choices aimed at furthering the purposes for which ICES had been formed, Johan Hjort of Norway, one of the prime movers, suggested that effort should be focused on a few problems of greatest practical importance. These were (Went 1972) "The migrations of herring and cod and the influence of these migrations on fisheries in the northern part of the North Sea and also the biology of these and other allied fishes, and the question of overfishing, particularly in the southern part of the North Sea, and in connection with this the special study of flat fish." To initiate and carry this program forward, three committees were formed: A. Committee on Migration of Food Fishes, B. Committee on Overfishing, and C. Committee for the Baltic.

Arrangements were also made for hydrographic (oceanographic) programs which were to be integral and important dimensions of all work. The Central Laboratory (1902–08) was set up in Kristiania (Oslo) under Fridtjof Nansen for the purpose of testing and improving instruments and methods and setting standards for physical and chemical measurements. Thus, the general approach to obtaining international collaboration in the marine sciences with emphasis on results of practical importance to fisheries was set. This approach, with suitable additions and variations, has been followed with success by ICES over the years. With the exception of the brief, but successful 6-year experiment with the Central Laboratory, it has not been considered necessary for the Council to operate its own experimental facilities. The activities of the Central Laboratory, which filled an important gap at the time, have been met since by national laboratories working alone or in conjunction with one another. The topics chosen, migration of food fishes (which, initially, was believed to be the cause of interannual variability in landings), concern for flatfish, especially plaice, and the influence of hydrographic (oceanographic) factors, would remain central to the Council's activities.

In this regard, it is interesting to read the analysis of the Council's early history prepared by Sinclair et al. (1987) as a background for a study to define the needs of fisheries for physical oceanographic information within the Canadian Atlantic Zone. This analysis placed considerable emphasis on the hydrographic (oceanographic) interest of various of the early ICES scientists (Nansen, Ekman, Pettersson, Hjort, among others) and especially the statement by Sverdrup (1955) that ICES ". . . was founded primarily for the purpose of applying oceanographic research to fisheries problems. . . ." Although this is probably something of an overstatement, the interest in oceanographic studies was high and was heightened by the fact that the Kristiania founding conference (1901) recommended that each member state should provide a steamer specially constructed for scientific fisheries research. This resolution was accepted and resulted in the building of a number of fisheries

research vessels in different countries. Given the high cost and the crucial importance of specialized vessels dedicated to marine research, this has to be considered as one of the Council's major achievements and one which made possible the establishment of fisheries research as a serious activity.

Sinclair et al. (1987) also drew attention to the fact that in the early days of the Council's history, the specific links between research in physical oceanography and fisheries questions were not obvious. Generally, it was considered that increases in the understanding of the physical characteristics of the ocean, including circulation and mixing, would be relevant not only to physical oceanography, but to fisheries as well. Part of the problem which existed then, and to a considerable extent still exists, has been reemphasized by Sinclair et al. (1987) as ". . . the inability given the respective states of art in oceanography and fisheries biology to define joint tractable questions." Incidentally, the study by Sinclair et al. was a determined and largely successful attempt to offset the past failures in this direction by providing for the Canadian Atlantic region, at least, clear identification of questions which could be tackled jointly. This is not to suggest that in the early days of ICES there was no progress, but rather that the oceanographic studies carried out by the member countries were not focused on specific fisheries questions. Progress came because the oceanographers, plankton specialists, and fisheries biologists frequently shared laboratories and vessels as well as participating in the same committees and, thus, were familiar with each others' concerns.

It is significant to note that ICES was formed in response to the need to deal with fisheries problems believed to be caused by overfishing. In its approach, it chose to concentrate on developing a comprehensive understanding of the behaviour, needs, and biology of food fishes in relation to oceanographic influences. Other choices could have been made in response to the same perception and, in fact, one other major course (stock enhancement) was pursued in parallel in the late nineteenth and the first half of the twentieth centuries. In that period, fisheries biologists of the United States, Great Britain, and Norway, in particular, released billions of larval marine fish, annually, in attempts to maintain or increase fisheries resources.

According to Shelbourne (1964), the marine fish hatchery and stocking programs appealed to governments because, he felt, they are inherently reluctant to impose controls to curb overexploitation. The underlying principle of the enhancement programs was the belief that the annual broodstock strength was a direct linear result of the number of eggs released by the adult fish. To compensate for the depletion of eggs through heavy fishing of spawning aggregations, the salvaged spawn was protected in hatcheries through the embryonic stages and the fry released to capitalize on food supplies believed made surplus through overfishing. The first commercial marine fish hatchery was built in the United States, at Woods Hole, and was complemented by two others in New England at Boothbay Harbor, Maine, and Gloucester, Massachusetts. The Norwegians had hatcheries at Flodevigen and Trondheimsfiord; the British established hatcheries at Dunbar, Aberdeen, Fleetwood, and Port Erin on the Isle of Man. These massive efforts were concentrated mainly on the Gadidae (cod, pollock, and haddock) and the Pleuronectidae (flounder, plaice, and sole) and released many millions of each of these species into the Atlantic Ocean and adjoining seas each year. According to Nash (1977) and Shelbourne (1964), by World War II or shortly after, the lack of evidence of positive results led to the termination of virtually all of these attempts to expand the marine food fish resources. Interestingly, Canada's extensive hatchery system for producing lobster larvae for release to bolster Atlantic coast lobster populations was terminated in 1917 for approximately the same reasons of high cost and lack of apparent results. Subsequent analyses suggest that these efforts had little likelihood of success, since the finfish and lobster larvae were released without much regard for their biology or food sources. These attempts, however, were not a total loss, since the marine fish hatcheries had become focal points for marine biologists to conduct in-depth studies of the various species. Some of the finfish hatcheries subsequently became famous marine research laboratories of today.

The Development of Modern Fisheries Research Concepts

Hjort was instrumental in bringing problems into better perspective and defining the issues so that cooperation amongst all groups would be more fruitful. In1913 and 1914 he undertook, through a set of lectures, to reiterate the proposition, formulated earlier, that the paramount need was for an explanation of the causes of the marked interannual variability in the quantity and quality of landings at given locations in northern Europe. The interannual variability was shown to result from year-class variability of geographically persistent age-structured populations. Although as Sinclair et al. (1987) stated, this interpretation is accepted as a fundamental concept today, it was reached only after a decade of systematic international research by fisheries biologists. The examples used by Hjort were herring and cod. Unfortunately, the herring aging technique using the scales became the subject of prolonged and acrimonious debate between Hjort and United Kingdom scientists led by D'Arcy Thompson. This debate continued for some 10 years and was considered by some to have been a major setback to fisheries research, since considerable additional effort had to be expended by the Norwegians to prove the validity of the scale aging technique in order to demonstrate clearly the age structure of the herring populations (Went 1972).

Notwithstanding the debate, the hypothesis shifted attention to discrete populations rather than focusing on the species alone and to Hjort's further contention that variability in landings resulted from fluctuations of abundance in individual year-classes, the relative abundance of which, he believed, was determined in the early life history stages. Two hypotheses followed from this: Critical Period Concept (e.g. food limitation for larvae) and Variable Role of Currents in advecting the early life history stages away from the appropriate distributional area for the population. To test these hypotheses, in particular the Critical Period Hypothesis, plans were drawn for joint studies to be carried out by the hydrographers, plankton specialists, and fisheries biologists. These ambitious plans, unfortunately, were overtaken by the outbreak of World War I. Attempts in 1938, again led by Hjort, to institute rather similar joint studies were again overtaken by war and the topic languished until 1951. In the meantime, the main thrust in physical oceanography was the investigation of the large-scale mean circulation of the deep ocean with limited emphasis on the variability in the continental shelf processes, thereby effectively removing the oceanographers from the fisheries scene and diverting their attention full-time to another major issue.

Modern Times: 1951 to Present

A special scientific meeting on Fisheries Hydrography, held in Amsterdam in 1951, came to the conclusion that a combination of biological, hydrographical (oceanographic), meteorological, physiological, and statistical researches had furthered knowledge of biological productivity, the habits of the fish stocks, and also the fisheries themselves. As a result, it recommended that a close association of disciplines be maintained and recommended a lengthy set of activities relating to oceanography and planktonology including definitions of problems the other committees wished the hydrographers (oceanographers) to attack. Sinclair et al. (1987) concluded that although much had been done, the goal of linking hydrography and fisheries, for which overall thrusts were taken by Hjort and his colleagues in ICES initially and advanced by Sverdrup, had not been realized fully. The two disciplines, oceanography and fisheries research, still intermingle in ICES and, thus, the opportunities and the needs still exist; the task remains to define the key questions jointly in terms on which both can agree and to work jointly toward a common objective.

In the main, ICES has provided the international forum for work in marine sciences aimed at providing a solid underpinning for North Atlantic fisheries. Since there were few people and resources to support marine science, and the problems usually transcended national areas, a system for international collaboration was the most efficient way to make progress. The Council did not operate by dictating courses of action, but rather, through consideration and discussion of the assembled data, attempted to define the issues more and more closely. Once it received concurrence that the choices were right, it then provided machinery to organize international assaults on these through joint experiments, working groups, a revised and comprehensive committee structure, special meetings, symposia, and its various publications. In 1959, the working groups became of major importance; since then they have proliferated to cover every topic of interest to ICES member countries. Much, if not most, of the intersessional work is carried by the flexible system of working groups composed of experts from all countries, working under the direction of one or more of the standing scientific committees, concentrating on topics from development of methods for measuring fish and shellfish populations, blooms of algae harmful to fish and shellfish stocks, mariculture, disease, and genetics to marine pollution and applied assessment groups preparing the formal advice to be reviewed by and passed through the two advisory committees for action by the responsible intergovernmental bodies such as the Northeast Atlantic Fisheries Commission, the International Baltic Sea Fisheries Commission, the North Atlantic Salmon Conservation Organization, the Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft (Oslo Commission), the Convention for the Prevention of Marine Pollution from Land Based Sources (Paris Commission), and the Convention for the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Commission). In 1990, for example, ICES conducted most of its work through the annual Statutory Meeting of the Council (the 78th), the two advisory committees (the Advisory Committee on Fishery Management (ACFM) and the Advisory Committee on Marine Pollution (ACMP)), 12 standing scientific committees (listed in the appendix), and 83 working, study, or planning groups plus seven workshops and two symposia held during the year. The work of the North Atlantic Salmon Working Group is typical.

An Example of Working Group Activities: The North Atlantic Salmon Working Group

Because of the increased catches of Atlantic salmon at west Greenland, in particular the spectacularly large catch in 1964, the International Commission for the Northwest Atlantic Fisheries (ICNAF) joined with ICES to organize a scientific appraisal of this fishery (Horsted 1988). The resultant ICES/ICNAF Joint Working Party on North Atlantic Salmon representing North Atlantic countries with Atlantic salmon interests began in 1966 its work which continued through the 1970s (Parrish and Horsted 1980). After ICNAF was succeeded by the Northwest Atlantic Fisheries Organization (NAFO) in 1979, this Joint Working Party was continued as the ICES Working Group on North Atlantic Salmon and under this new title held its first meeting also in 1979 (Horsted 1988). Tag recoveries had shown that salmon caught at Greenland originated in rivers and hatcheries of ICES member states from both sides of the Atlantic and not in Greenland rivers. Thus, ICES was a natural scientific forum in which to continue the discussions of the impact of the Greenland fishery on returns to home waters. In later years, the work expanded to include analyses of other salmon fisheries and, since 1984, to develop responses to scientific questions posed by the North Atlantic Salmon Conservation Organization (NASCO).

Driven by specific questions to ICES for practical advice, the Working Group brought together salmon biologists from both sides of the Atlantic to present and debate the results of their research. As in almost all working groups, consensus was achieved on precisely worded responses to potentially controversial questions. In addition, the meetings led to development and acceptance of assessment models and to the identification and international coordination of research projects for Atlantic salmon. As with other working groups, research recommendations were reviewed by the parent committee, in this case the Anadromous and Catadromous Fish Committee (ANACAT). In recent years, Working Group meetings have been seen, increasingly, as appropriate fora for presentation and review of biological research and now compete with the annual ANACAT meetings in this respect.

The North Atlantic Salmon Working Group, as with all stock assessment working groups, reports to the ACFM, which is the only body empowered by the Council to advise on fishery management questions. It is composed of a Chairman, one representative from each ICES member country, the Chairmen of the Demersal Fish Committee, the Pelagic Fish Committee, and the Baltic Fish Committee, and the ICES Statistician, together with an observer from the European Community (EC), and an observer for the Faeroe Islands and Greenland. Twice a year the ACFM reviews working group reports and formulates advice for the appropriate bodies; it also provides feedback to working groups on the methodology used, helping to achieve a consistent standard and approach across the many species and stocks considered.

Another example of the important and excellent work done by ICES working groups has been illustrated by Thurberg (1988) in an article on studies of biological effects of contaminants.

Special Meetings and Symposia

One device used by ICES to discuss emergent, controversial, or important issues is the series of Special Meetings or Sym-

posia which ICES sponsors, events which are two to four days in duration, often convened prior to an annual statutory meeting and are open to all interested in an in-depth treatment of the selected topic. Attempts are made to draw definite conclusions which will aid in guiding future work. These have been extremely successful in defining more closely the issues and are held at a time when it appears possible to clarify and crystallize perceptions or concepts which hitherto have been rather hazy or unorganized. A few chosen more or less at random indicate something of their scope:

(1) Conference on North Sea Plaice (1925)
(2) Second Special Meeting on Racial Investigations (1928)
(3) Special Meeting on the Fluctuations in the Abundance of the Various Year-classes of Food Fishes (1929)
(4) Special Meeting on Size Limits for Fish and Regulation of Meshes of Fishing Nets (1934)
(5a) Special Scientific Meeting on Fisheries Hydrography (1951)
(5b) Special Scientific Meeting on Overfishing (1951)
(6a) Problems and Methods of Sampling Fish Populations (1954)
(6b) Herring Tagging Techniques and Results (1954)
(6c) Oyster and Mussel Culture (1954)
(7) Symposium on North Sea Fish Stocks — Recent Changes and Their Causes (1975)
(8a) ICES/EIFAC Symposium on Eel Research and Management (1976)
(8b) Special Meeting on Population Assessments of Shellfish Stocks (1976)
(9) Symposium on the Assessment and Management of Pelagic Fish Stocks (1978)
(10) Special Meeting on Diseases of Commercially Important Marine Fish and Shellfish (1980)
(11) Symposium on North Sea Dynamics (oceanography) (the Council assisted in an organizational role) (1981)
(12a) Special Meeting on Causes, Dynamics and Effects of Exceptional Marine Blooms and Related Events (1984)
(12b) Symposium and Workshop on Contaminant Fluxes Through the Coastal Zone (1984)
(13) Symposium on Marine Sciences of the Arctic and Sub-Arctic Regions (1987)
(14a) Symposium on Early Life History of Fish (1988) (the third on this topic)
(14b) Symposium on Baltic Sea Fishery Resources (1988)
(15a) Symposium on the Ecology and Management Aspects of Extensive Mariculture (1989)
(15b) Symposium on Multispecies Models Relevant to Management of Living Resources (1989)
(16a) Symposium on Case Histories of the Effects of Introductions and Transfers on Aquatic Resources and Ecosystems (1990)
(16b) Symposium on Shellfish Life Histories and Shellfishery Models (1990).

When the special meetings, symposia, or projects are examined in detail, it is apparent that the Council's current activities are consistent with its origins and the foresight shown by its founders; a few accounts developed further illustrate this.

The Symposium on North Sea Fish Stocks — Recent Changes and Their Causes, held in 1975 (Hempel 1978), is a particularly good example, since questions about causes of changes in fish stocks in the North Sea were prime factors leading to the formation of ICES originally. This symposium focused on three main questions: what had happened to North Sea stocks and their environment in the past two decades, to what extent could those changes be explained, and what kind of data, experiments, and models would help to understand fluctuations and long-term trends. Briefly, the conclusions were as follows: catches had more than doubled since the 1960s; many changes in stocks were apparent, but the causes of the changes could not be ascribed with confidence; and biological background information was still insufficient for models of intra- and interspecific interactions (i.e. physiological regulation of growth, maturation, and reproduction; regulation of stock size by ecological factors such as cannibalism, competition for food and space, and thinning out by fishing; and the influence on these processes of physical or chemical variations in the environment). The recommendations specified, among others, the need for improved statistical information, studies on the question of replacement species, nutrient levels and larval food supplies, and increased international collaborative, multidisciplinary work among fishery biologists and "pure" biological and physical oceanographers.

Another excellent example is afforded by the Symposium on the assessment and Management of Pelagic Fish Stocks held in 1978 (Saville 1980). This too was a large meeting which attracted many of the scientists involved with pelagic fish. It was also timely, since many of the major pelagic stocks were overfished or had collapsed, i.e. Georges Bank herring, Atlanto-Scandian herring, North Sea herring, North Sea mackerel, Celtic Sea herring, California sardine, Peruvian anchoveta, and the Japanese sardine fishery to name some. Conclusions drawn were that pelagic stocks are more fragile than demersal fish stocks because of their behaviour (schooling) and the fact that they are usually characterized by large year-classes occurring at lengthy intervals with poor recruitment in between. In addition, there was evidence that as stock size decreased in pelagic fish, the catchability coefficient increased; thus, with modern communications and fish-finding aids, it was possible that reduced nominal effort could maintain or even increase exploitation rates on a reduced stock. In addition to the deficiencies in biological and ecological understanding of pelagic fish and their stocks, it was concluded that part of the reason for the collapse of the various stocks was that, commonly, abundance was overestimated and effort was underestimated. This resulted in a misunderstanding of the power of the fleet and its impact on schooling fish. Aiding and abetting the process were deficiencies in the scientific advice offered and a less than perfect resolve to apply effective management measures in time. Specific courses, following logically from these observed deficiencies, were recommended to improve the underlying science, scientific advice, and management mechanisms and action. Although many of the recommendations have been implemented, management improved, and positive results observed, one very clear lesson is that recovery of collapsed pelagic stocks, in particular, can be a long process.

In both of the symposia described above, as well as in other fora, it had become apparent that there were serious shortcomings in both biological knowledge and assessment methodologies. As a consequence, recognition of the limitations of the traditional single species assessments (i.e. it is not possible to vary only one element at a time) led in 1975 to a decision by the Council to initiate work to develop and test multispecies assessment models. Accordingly, the Ad Hoc Working Group on Multispecies Assessment Model Testing was formed and at its first meeting (1980) considered what information would be

needed to test appropriate models. They concluded that while in the past, assessment groups had chosen to assume that natural mortality was constant over the life span of the species and over large ranges of exploitation rates, it should be possible to improve on this assumption by means of new models incorporating species interactions. In the models proposed, the central feature was that natural mortality should not be a fixed input parameter, but, at least, partially modulated by inter- and intraspecific predation. Fishing mortality and natural mortality values were to be estimated simultaneously for each age group and year in a given catch array. The additional information required was a suitability index of each prey age group for each predator age group and the rate of total food consumption. Although this type of assessment was theoretically possible, application was hindered by a lack of knowledge of fish feeding habits and preferences. Thus the decision to concentrate on species interaction Virtual Population Analysis (VPA) models brought in its train the need to emphasize research on food consumption by major predators of commercially important fish species.

Accordingly, the Working Group recommended an intensive stomach-sampling scheme for cod, whiting, saithe, mackerel, and haddock from the North Sea. This recommendation was accepted by the Council and the "Stomach Sampling Project 1981" was undertaken with member countries making available extensive research vessel time and analytical capacity to carry out this extremely complex and expensive program, coordinated through ICES. Adjustments had to be made in the initial plan to produce adequate sampling intensities, and improved methods for recording and analyzing stomach contents; these then had to be related to ages, lengths, and weights. The handling of data and the many other aspects of a program as large and complex as this constituted major logistical challenges; it, of course, could not be completed in the single year but had to be extended past the mid-1980s to deal with the vast amounts of data. At its conclusion, the scientists involved in the Stomach Sampling Project stressed the need to repeat the exercise in some form, since there is a strong requirement to test the hypothesis that ecological vulnerability is constant from year to year and that although the project had shown considerably higher predation on harvested species than was formerly assumed, it is a narrow basis for completely revising general views of the level of predation mortalities.

Although improvements can be expected, the current methodology of multispecies assessments is considered by the Working Group as essentially complete, following absorption into the process of the results of the modified and extended Stomach Sampling Project. The Ad Hoc Working Group on Multispecies Assessments believes that although the Multi-Species Virtual Population Analysis (MSVPA) was specifically designed for the North Sea, it is potentially applicable for simultaneously assessing predation and fishing mortalities in a variety of situations in other areas such as the Baltic, Icelandic, or North American waters, thus once again offering compelling leadership to the whole fisheries research community on an extremely important issue. In addition, it is felt that this methodology should be used to provide *long-term advice* for the nine North Sea species included in the MSVPA, since this cannot be provided properly through single-species assessments. At this time, the consensus within ACFM is that although the preceding statement is largely correct, the methodology needs further development before it can be usefully applied.

Shellfish, Marine Pollution, and Mariculture

Although the stimuli which led to the formation of ICES initially were largely related to overfishing of finfish and the concomitant problems, it was recognized, at the time, that there were other problems and opportunities. Murawski (1988) in his review pointed out, "Even prior to the first meeting of ICES in 1902, European and North American researchers were pursuing shellfish related research along three relatively divergent paths: 1) mariculture (primarily of oysters and mussels, 2) effects of sewage and industrial pollutants on shellfish sanitation and abundance and 3) population dynamics and fishery regulation of natural stocks." In various guises, all of these are still very much a part of ICES activities. The shellfish research picture has been examined in depth by Murawski (1988) who in that context stated, "the challenge for the future is to conduct multidisciplinary studies aimed at understanding the impacts of management decisions regarding mariculture, pollution/contamination and harvesting of natural populations in the context of coastal ocean ecosystems. Current relationships among shellfish research programs within ICES will, by necessity, be modified to accommodate research of a more interdisciplinary nature."

Pollution, as noted above, was an early Council concern and at the meeting held in April 1912, plans were drawn concerning the effects of pollution on salmon and their spawning grounds (Pearce 1988). Pearce, in reviewing marine pollution work, mentioned that the question of oil pollution was raised as early as 1927 and that Odon de Buen of Spain was invited to prepare a paper on its ill effects on fish and fisheries. The concern with pollution persisted and increased through the years leading in 1966 to the formation of a new standing scientific committee, the Fisheries Improvement Committee. The responsibilities of this committee included, among other matters, pollution and mariculture. Within the next decade it became apparent that the increasing problems of pollution and the accelerating interests and opportunities in mariculture could no longer be accommodated within a single committee.

Accordingly, the bulk of the responsibilities of the Fisheries Improvement Committee were divided between two new committees, the Marine Environmental Quality Committee (MEQC) and the Mariculture Committee which met for the first time in 1978. The MEQC was concerned with "the scientific study of man-made impacts other than fishing on the sea and its living resources, in particular studies of pollution," a mandate which has required an extensive programme of work by the committee and its associated working groups as the problems caused by pollution continue to mount (Pearce 1988). The Mariculture Committee, to a large extent an enlargement and amplification of the by now disbanded Working Group on Mariculture, was charged with the review and coordination of "investigations relating to culture of marine organisms, including transplantation and introduction of new species."

Formation of the Mariculture Committee was a timely recognition of the significance of culture in the overall fisheries picture. At the turn of the century, as Murawski (1988) mentioned, mariculture was concerned largely with oyster and mussel culture to replace lost shellfish production. Since then, first through immense increases in molluscan shellfish production and then beginning in the 1970s, the burgeoning finfish production (mainly salmonids) made it apparent that mariculture was becoming a significant source of fishery products using methods quite different from traditional fisheries and also with

quite different needs, although much of the mariculture opportunities actually grew out of the "early life history studies" conducted earlier. Mariculture production in ICES countries now exceeds 0.5 million tonnes annually and in Norway, for instance, the cultured salmonid production is approximately equal in value to the traditional marine fisheries. The bulk of this activity takes place in the coastal zones where other fisheries, pollution, recreational activities, transportation, and many industrial activities are paramount. Thus the problems faced by mariculturists are not only those occasioned by intensive and extensive husbandry (nutritional, physiological, environmental, disease, genetics, seed, technological, etc.) but also stem from competition for space and the need to maintain or improve water conditions. Despite these constraints, mariculture is expanding substantially and appears to be on the verge of bringing into production other species such as cod, haddock, halibut, Arctic char, wolffish, and scallops. In all of this the ICES Mariculture Committee and its associated working groups have played an important and catalytic role.

International Cooperation

The Council, although first on the ground, is no longer alone. It has worked productively in the past and continues to do so with other organizations such as the International Commission for the Exploration of the Mediterranean Sea (ICEMS), ICNAF and its successor NAFO, the Intergovernmental Oceanographic Commission (IOC/UNESCO), the Scientific Committee on Ocean Research (SCOR/UNESCO), and the Food and Agriculture Organization of the United Nations (FAO) including certain subsidiary bodies such as the European Inland Fisheries Advisory Commission (EIFAC). Some of these have been heavily influenced in their composition and operations by the lead offered by ICES.

Those wishing a more detailed treatment of the structures and mechanisms that ICES has used over the years to accomplish its objectives are referred to the history of Went (1972) and to the succinct and comprehensive treatment of this topic by Pawlak (1988).

Summary

Today we believe that the conclusion drawn in the early years of the century was correct, that is the improvement (management) of fisheries should be attempted through the rational application of the results of scientific enquiries rather than by arbitrarily chosen empirical measures. Given the lengthy period required and the high cost of conducting scientific studies coupled with the always pressing or urgent need for solutions, the trick has been to select the key items or indices from a bewildering array of complex choices to determine how much information was enough, and to weave the results into practical measures which would permit rational exploitation of the sea, ie., "turning its resources to the best advantage in the present without prejudice to the future" (Went 1972) encapsulated in today's crisper, but somewhat less precise terminology "sustainable development" as enunciated in the Bruntland Commission Report (WCED 1987).

Any attempt to summarize the activities of ICES over the years and even to highlight its successes runs the risk of being a mere catalogue or of introducing distortion. A few statements, however, should be made. The Council, in its approaches, has not only initiated international collaboration in the marine sciences in direct response to the question of overfishing, but also laid the foundations which established fisheries research as a credible discipline. From the first, it has been successful in defining major issues and in providing the organizational machinery to mount relevant collaborative studies to acquire the scientific underpinning for rational management of the living resources of the sea. As a direct result of its cooperative approach aimed at practical results, it has been responsible for and influential in the provision by member countries of specialized ships for fisheries and oceanographic work, the institution of laboratories, and acquisition of staff trained in marine sciences. From the outset, it has specialized in breaking down generalized concerns such as overfishing into questions which can then be investigated in detail, e.g. migration and behaviour of food fishes which led rather directly to Hjort's hypotheses on age-structured populations and practical concepts and ways of getting at such issues as interannual variability. In the course of doing this, the influence of food plankton and other prey and oceanographic features (environmental influences on food and migration) became major parts of the Council's interests. All of these, of course, encompassed extremely practical and important studies on ways to age fish, standard methods to report data (age/length/weight), sampling of stomach contents to determine food choices and multispecies interactions, as well as major programs leading to commercial culture of fish and shellfish. Always there has been an insistence upon the goal of developing broad concepts which would improve the understanding of the living resources and the driving forces, as well as providing a forum for discussion of all fisheries research questions.

The Council recognized from the beginning that estimates of fish stocks and fishing efforts, to be soundly based, would require national statistical information collection systems. This element, crucial to assessment processes today, received early attention and encouragement over the years for nations to adopt compatible statistical systems and report fully on their commercial fisheries through ICES.

Understanding the life history of the various species has always been considered important by ICES as has the definition of stocks, the impact of various fishing gears on the fisheries, and ways to reduce their adverse effects. An illustration of the rudimentary state of knowledge of at least one species, the eel, at the time of the founding of ICES is provided by the report of Committee C (Baltic) in 1905. It stated that it was now convinced that eel did not spawn in freshwater or in the Baltic or Norwegian Sea. The early concern for marine mammals (seals as well as whales) resulted in a Whaling Committee, which predated the International Whaling Commission, and thus was the only body in a position to recommend international programs in 1927 on the major species for the purpose of conserving the stocks. The Council in 1929 and 1930 made a series of recommendations and drafted a convention on whaling responsibilities which was ultimately adopted by the International Whaling Commission. This is only one of the many instances where the work of the Council resulted in more formal arrangements to absorb and apply advice on fisheries and to guard against "overfishing," the underlying concern which originally brought ICES into existence.

In his opening address to the 68th Statutory Meeting of ICES, President Hempel (1980) offered this description: "ICES is a strange body with considerable diversity of structures and functions which can be summarized under two headings: a) Promotion of marine science, and b) Advice to governments on

the rational use of marine living resources and their protection against pollution." To achieve these functions cited by the President, ICES operates by stimulating and coordinating cooperative research programs in population biology and ecology of marine, anadromous, and catadromous species, mariculture, fisheries assessment, pollution studies, and physical and chemical oceanography relevant to the dynamics and productivity of marine resources. The results are reported in an ICES family of publications, the main ones being the *Journal of Marine Science* (formerly *Journal du Conseil*), the ICES *Marine Science Symposia* (previously *Rapports et Procès-Verbaux des Réunions*), the ICES *Cooperative Research Reports*, *Techniques in Marine Environmental Sciences*, and the ICES *Identification Leaflets*.

I hope that this brief discussion of ICES is useful to those engaged in organizing the North Pacific Marine Science Organization and that its first 90 years will be as successful and productive as the first 90 years have been for ICES.

Acknowledgements

I thank J. S. Beckett, W. G. Doubleday, D. J. Scarratt, and M. M. Sinclair for their contributions and constructive criticism of the manuscript at the various stages of its development and R. J. Beamish for supplying background information on the North Pacific Marine Science Organization.

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Appendix

Member Countries

Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, The Netherlands, Norway, Poland, Portugal, Spain, Sweden, United Kingdom, United States of America, Union of Soviet Socialist Republics.

ICES Headquarters and Permanent Secretariat

Palaegade 2-4, 1261 Copenhagen K, Denmark.

Current Standing Scientific Committees

Anadromous and Catadromous Fish, Baltic Fish, Biological Oceanography, Demersal Fish, Fish Capture, Hydrography, Mariculture, Marine Environmental Quality, Marine Mammals, Pelagic Fish, Shellfish, Statistics.

Advisory Committees

Advisory Committee on Fishery Management, Advisory Committee on Marine Pollution.

APP C

CNL(92)51

DECISION OF THE COUNCIL TO REQUEST SCIENTIFIC ADVICE FROM ICES

1. With respect to Atlantic salmon in each Commission area, where relevant:

   a. describe the events of the 1992 fisheries with respect to catches (including unreported catches), gear, effort, composition and origin of the catch (including escapees and sea-ranched fish), and rates of exploitation;
   b. describe the status of the stocks occurring in the Commission area, and where possible evaluate escapement against targets.
   c. evaluate causes of the apparent reduced survival of salmon in recent years;
   d. evaluate the by-catch and mortality of salmon in non-salmon directed fisheries.
   e. specify data deficiencies and research needs.

2. Evaluate the following management measures on the stocks and fisheries occurring in the respective Commission areas:

   a. quota management measures and closures implemented in 1991 and 1992 in the Newfoundland and Labrador commercial salmon fisheries;
   b. regulations introduced into the Norwegian salmon fisheries in 1989;
   c. evaluate the effects of cessation of fishing activity at Faroes.

3. With respect to the fishery in the West Greenland Commission area:

   a. describe which stocks make the greatest numerical contributions of salmon to the fishery and which stocks are most heavily exploited in the fishery;
   b. describe the relative importance to stocks of regulatory measures in the fishery and in home waters;
   c. describe the relationship between the abundance of grilse and multi-sea-winter salmon in returns to homewaters and the effects of this on the management of the fishery.
   d. continue the development of a model which could be used in the setting of catch quotas in relation to stock abundance and provide worked examples with an assessment of risks relative to the management objective of achieving adequate spawning biomass.
   e. estimate the pre-fishery abundance of non-maturing 1SW salmon at the time of the fishery.

4. Review biological indicators, if any, which would make it possible to assess trends in the abundance of salmon in the North-East Atlantic.

5. With respect to the assessment of fisheries in each Commission area, evaluate the effects of the NASCO tag return incentive scheme.

6. With respect to Atlantic salmon in the NASCO area, provide a compilation of microtag, finclip, and external tag releases by ICES Member Countries in 1992.

App
D

This report not to be quoted without prior reference to the Council*

International Council for the
Exploration of the Sea

C.M.1993/Assess:10
Ref.: M

REPORT OF THE NORTH ATLANTIC SALMON WORKING GROUP

Copenhagen, 5- 12 March 1993

*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

TABLE OF CONTENTS

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1 INTRODUCTION

1.1 Main Tasks

At its 1992 Statutory Meeting, ICES resolved (C.Res. 1992/2:8:5) that the Working Group on North Atlantic Salmon (Chairman: Dr. K. Friedland) should meet at ICES Headquarters from 5-12 March 1993 to consider questions which include those posed to ICES by NASCO (Appendix 1).

Two Study Groups met prior to the Working Group and submitted reports: The Study Group on North-East Atlantic Salmon Fisheries (C.M.1993/Assess:13, and the Study Group on the North American Salmon Fisheries (C.M.1993/Assess:9).

The Working Group considered a further 21 papers submitted by participants (Appendix 2). References cited in the report are given in Appendix 3.

1.2 Participants

Baum, E.T.	USA
Crozier, W.W.	UK (N. Ireland)
Dunkley, D.A.	UK (Scotland)
Friedland, K. (Chairman)	USA
Hansen, L.P.	Norway
Holm, M.	Norway
Isaksson, A.	Iceland
Karlsson, L.	Sweden
MacLean, J.C.	UK (Scotland)
Marsball, T.L.	Canada
Meerburg, D.J.	Canada
Møller Jensen, J.	Denmark
Niemelã, E.	Finland
O'Maoileidigh, N.S.	Ireland
Porter, T.R.	Canada
Potter, E.C.E.	UK (England & Wales)
Prévost, E.	France
Rago, P.	USA
Reddin, D.G.	Canada
Sharov, A.	Russia
Zubchenko, A.	Russia

2 CATCHES OF NORTH ATLANTIC SALMON

2.1 Nominal Catches of Salmon

Total nominal catches of salmon reported by country in all fisheries for 1960-1992 are given in Table 2.1.1, and nominal catches in homewater fisheries for 1960-1992 are given in Table 2.1.2.

Catch statistics in the North Atlantic area also include fish farm escapees and in the North-East area ranched fish. The updated total catch for 1991 of 4,124 t is 813 t less than the total catch in 1990 of 4,937 t. Total landings for 1991 were the lowest recorded and show decreases for several countries. Figures for 1992 (3,996 t) are provisional, but it appears likely that the final data will still show a decrease from 1991. This is the fifth year in which the total catch has decreased from the previous year. The decline in the catch of wild stocks may be greater than suggested by the catch statistics because of the inclusion in the statistics of increasing catches of fish farm escapees and ranched fish.

The lack of information on fishing effort presents major difficulties in interpreting the catch data of any one year and also in comparing catches of different years. Management plans in several countries are designed to decrease catches. The trends in catch data are discussed in Section 3.

2.2 Catches in Numbers by Sea Age and Weight

Reported nominal salmon catches for several countries by sea age and weight are summarised in Table 2.2.1. As in Tables 2.1.1 and 2.1.2, catches in some countries include both wild and reared salmon and fish farm escapees. Figures for 1992 are provisional. Different countries use different methods to partition their catches by sea age class. These methods are described in the footnotes to Table 2.2.1. A number of countries split catches on the basis of the results from scale reading a sample of the catch. Several others use a weight split, so that fish classed as MSW salmon are those weighing about 3 kg or more, the exact level varying between countries, during that part of the year when both 1SW and MSW salmon are present in catches. In many of these countries, this split is felt to be reasonably accurate. However, the results of analyses of catch sampling programmes in Scotland have shown that the use of a weight split in categorising fish there can lead to substantial mis-reporting errors with often large numbers of 1SW salmon being included in the MSW catch record. Moreover, the error increases throughout the season as larger 1SW salmon enter the fishery in the late summer and can vary greatly between years. Those years when large catches of 1SW salmon were recorded were characterised by the presence of large proportions of 1SW salmon exceeding the split weight in the catches, these fish being included as MSW salmon in the nominal catch figures.

2.3 Unreported Catches

2.3.1 Unreported catches within commission areas

Unreported catches by year and commission area, as estimated by the Working Group, are presented in Table 2.3.1 except for the West Greenland Commission Area for which estimates are unavailable. The total unreported catch in 1992 was estimated to be 1,962 t; a decrease of

APPENDIX 2

WORKING DOCUMENTS SUBMITTED TO THE WORKING GROUP ON NORTH ATLANTIC SALMON

Doc. No. 1 MacLean, J.C. and Milne, J.M.A.. The Effect on the reported Scottish Salmon Catch Statistics of the misreporting of grilse as salmon in 1991.

Doc. No. 2 Dunkely, D.A.. Mean weights of fish reported as salmon and grilse in catches in Scotland 1952-1991.

Doc. No. 3 Friedland, K.D., and Reddin, D.G. The use of otolith morphology in stock discriminations of Atlantic salmon (*Salmo salar* L.).

Doc. No. 4 Friedland, K.D., Stolte, L.W., Meyers, T.F., and Baum, E.T.. Estimated Harvest of USA-origin 1-SW salmon in Greenland in 1991.

Doc. No. 5 Friedland, K.D., Rago, P.J., and Spencer, R.C.. Carlin tag returns and harvest estimates of USA origin salmon in Greenland, 1967-1992.

Doc. No. 6 Potter, E.C.E. A sensitivity analysis on the national salmon run-reconstruction model.

Doc. No. 7 Part 1 and 2. Russell, I.C., Potter, E.C.E., Reddin, D.G., and Friedland, K.D.. Recoveries of coded wire microtags from salmon caught at West Greenland in 1992.

Doc. No. 8 Reddin, D.G., and Short, P.B. A new database for discrimination at Greenland in 1989.

Doc. No. 9 Reddin, D.G., and Short, P.B. Identification of North American and European Atlantic salmon (*Salmo salar* L.) caught at West Greenland in 1992.

Doc. No. 10 Møller Jensen, J. The salmon fishery at West Greenland 1992.

Doc. No. 11 Møller Jensen, J. Some information about effort.

Doc. No. 12 Kell, L., and Potter, E.C.E. The use of a genetic algorithm to discriminate salmon from Europe and North America on the basis of scales characteristics.

Doc. No. 13 Potter, E.C.E. Some details on the workings of neural networks.

Doc. No. 14 Report of the Study Group on North-East Atlantic Salmon Fisheries(ICES Doc. C.M. 1993/Assess:13).

Doc. No. 15 Report of the Study Group on the North American Salmon Fisheries (ICES Doc. C.M. 1993/M...)

Doc. No. 16 Zubchenko, A.G., Loenko, A.A., and Sharov, A.F. Estimate of the Norwegian drifnet fishery influence on salmon populations status in some rivers of Russia.

Doc. No. 17 Zubchenko, A.V., and Sharov, A.F. Status of Atlantic salmon stocks on Kolsky Peninsula.

Doc. No. 18 Isaksson, I. Reduction in marine survival in Icelandic salmon stocks in the 1988-1990 smolt classes.

Doc. No. 19 Hansen, L.P., Reddin, D.G., and Lund, R.A. The incidence of reared Atlantic salmon in the commercial fishery at West Greenland.

Doc. No. 20 Reddin, D.G., Short, P.B., and Downton, P.D. Length, weight, and age characteristics of Atlantic salmon (*Salmo salar* L.) of North American and European origin caught at West Greenland in 1992.

Doc. No. 21 Rago, P.J. A simple nonparametric test for comparing Atlantic salmon abundance indices.

APP E

SECTION	DESCRIPTION	EXPENDITURE	
		BUDGET 1993	FORECAST 1994
1	STAFF RELATED COSTS	148510	155920
2	TRAVEL AND SUBSISTENCE	23220	30380
3	CONTRIBUTION TO ICES	26140	27440
4	CONTRIBUTION TO WORKING CAPITAL FUND	0	0
5	MEETINGS	17320	7360
6	OFFICE SUPPLIES, PRINTING AND TRANSLATIONS	32550	34160
7	COMMUNICATIONS	9780	10250
8	HEADQUARTERS PROPERTY	23330	20630
9	OFFICE FURNITURE AND EQUIPMENT	8000	8390
10	AUDIT AND OTHER EXPENSES	8600	9020
	TOTAL	297450	303550
			REVENUE
11	CONTRIBUTIONS - CONTRACTING PARTIES	287484	296050
12	MISCELLANEOUS INCOME - INTEREST	10000	10000
13	STABILISATION	-2500	-2500
14	SURPLUS OR DEFICIT(-)FROM 1991	2466	0
	TOTAL	297450	303550

App F

DRAFT BUDGET FOR THE FINANCIAL YEAR 1992/1993

INCOME

Approved Budget 1991/1992 DKK (in '000s)			Draft Budget 1992/1993 DKK	Approved Forecast Budget 1992/1993 DKK
	1.	**National Contributions**		
464.8		Belgium	497,200	497,200
697.2		Canada	745,800	745,800
697.2		Denmark	745,800	745,800
348.6		Finland	372,900	372,900
929.6		France	994,400	994,400
929.6		Germany	994,400	994,400
464.8		Iceland	745,800	745,800
464.8		Ireland	497,200	497,200
697.2		Netherlands	745,800	745,800
929.6		Norway	994,400	994,400
697.2		Poland	745,800	745,800
464.8		Portugal	497,200	497,200
929.6		Russia	994,400	994,400
697.2		Spain	745,800	745,800
697.2		Sweden	745,800	745,800
929.6		United Kingdom	994,400	994,400
697.2		USA	745,800	745,800
11,736.2		**Total**	**12,802,900**	**12,802,900**
459.4	**2.**	**Interest**	528,650	528,650
110.0	**3.**	**Sale of Publications**	122,000	122,000
487.5	**4.**	**Contribution from NEAFC**	532,000	532,000
179.0	**5.**	**Contribution from IBSFC**	195,000	195,000
402.0	**6.**	**Contribution from Oslo and Paris Commissions**	455,000	455,000
108.9	**7.**	**Contribution from Helsinki Commission**	220,000	220,000
251.5	**8.**	**Contribution from NASCO**	274,500	274,500 *
467.0	**9.**	**Contribution from EC Commission**	1,333,900	1,333,900
223.5	**10.**	**Contribution from Faroe Islands and Greenland**	244,000	244,000
35.0	**11.**	**Transferred from Capital Reserve Fund**	75,000	0
464.8	**12.**	**Supplementary Budget**	0	0
14,924.8		**GRAND TOTAL**	**16,782,950**	**16,707,950**