

# **The History of Fisheries Management and Scientific Advice – the ICNAF/NAFO History from the End of World War II to the Present**

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## **Abstract**

Fisheries research and management in the Northwest Atlantic by Canada and the United States prior to 1949, as well as events which led to the establishment of the International Commission for the Northwest Atlantic Fisheries (ICNAF), are briefly reviewed. The mandates, structures and objectives of both ICNAF and its successor organization, the Northwest Atlantic Fisheries Organization (NAFO), are separately described. The principal achievements of ICNAF (1950–79) and NAFO (1979–present) relative to cooperative scientific endeavor culminating in advice for fisheries management and to regulatory measures adopted by the respective commissions are chronologically summarized. The successes and failures of ICNAF and NAFO are discussed and contrasted.

*Key words:* ICNAF, management, NAFO, regulatory measures, scientific advice

## **Introduction**

A review of fisheries research and management in the Northwest Atlantic under international auspices from 1945 to the present must be preceded by briefly recalling some of the historical events associated with harvesting, research and management of fisheries resources in Canada and the United States of America (USA).

Commercial fishing in Canadian waters dates back to the discovery of Newfoundland and the rich cod resources off its coast by John Cabot in 1497. Fishing was established on the Grand Banks off Newfoundland in the early-1500s by French and Portuguese fishermen (Innis, 1978). Commercial fishing in US waters began soon after the first colonists arrived in New England in the early-1600s, with fishing on Georges Bank beginning in the mid-1700s.

In the USA in the late-1860s, New England fishermen raised concerns about declines in the abundance of some of the near-shore species (Hennemuth and Rockwell, 1987). This led, in 1871, to the creation by Congress of the US Fish Commission. The first commissioner, Spencer Baird, who was given authority to investigate and recommend remedial measures, began his work at Woods Hole, Massachusetts in 1871, established the first US fisheries research station there in 1875 in temporary facilities, and in 1885 supervised construction of a permanent laboratory/hatchery (Galtsoff, 1962).

In Canada, Dr. E. E. Prince was appointed as the first Commissioner of Fisheries in 1893. A Board of Management and the first marine biological research station (on a scow which was towed from place to place) were established in 1898, with the first permanent facility on the Atlantic coast built in St. Andrews, New Brunswick in 1908 (Parsons, 1993).

Early attempts at fisheries management or enhancement in North America in the late-1800s and early-1900s were based largely on the use of hatcheries to maintain or increase commercially-exploited stocks. Eggs of cod and other species, including lobsters, were hatched and released as small fry. The lobster fishery was perhaps the first and most closely to be regulated in Canada, with measures first imposed in the late-1800s (Parsons, 1993). According to Halliday and Pinhorn (1996), a minimum mesh size was set

for netting in cod trap nets in Newfoundland in 1919 or possibly earlier. There were no regulations on other groundfish fisheries in Canadian waters until the 1940s (Needler, 1979), although there was a limit placed on the number of trawlers in the 1920s and 1930s in response to pressure from hook-and-line fishermen, which was relaxed towards the end of World War II. There had also been local closed areas in Canadian waters which served to minimize gear conflicts among gear types.

The first attempt at promoting and coordinating international marine fisheries research in the Northwest Atlantic was through the North American Council on Fishery Investigations (NACFI), established by an agreement of the governments of Canada, Newfoundland (independent then), and the USA. France joined in 1922. The first meeting of NACFI was held in 1921, but the Council was discontinued in 1938 (Royce, 1988).

Although federally funded fisheries research had begun in the USA in the late-1800s at Woods Hole and international cooperative research had been initiated in 1921 with the establishment of NACFI, concern over the conservation of haddock on Georges Bank led to an expansion in US fisheries research and the start, in the early-1930s, of a research program for haddock and other offshore commercially-exploited species for the purpose of analyzing catches to determine year-class abundance, growth and mortality rates, and fish movement and migration (Galtsoff, 1962). This program, initially located at Cambridge, Massachusetts and later transferred to Woods Hole in 1948 as the New England Banks Fishery Investigation, is viewed as the start of the era of US stock assessment research in the Northwest Atlantic. It was also in 1948 that the Woods Hole Laboratory acquired the R/V *Albatross III*, a former commercial side trawler, and began conducting surveys of groundfish resources in offshore New England waters.

Prior to, during, and immediately following World War II in response to concerns of reduced abundance and possible depletion of fisheries in the North Atlantic, three separate international conferences were convened in London. The first international conservation convention for North Atlantic fisheries was the *International Convention for the Regulation of the Meshes of Fishing Nets and the Size Limits of Fish* which was concluded in 1937 and applied to the area north of the equator from 80°E to 80°W longitude. The North American countries were not party to this convention and it never came into force. The *Draft Convention Relating to the Policing of Fisheries and Measures for the Protection of Immature Fish*, concluded in 1943, encompassed the area north of the Tropic of Cancer and west to 75°W longitude. It similarly failed to come into force because of World War II. The *Convention for the Regulation of Meshes of Fishing Nets and the Size Limits of Fish*, held in 1946 (also known as the "1946 Overfishing Convention" or the "International Fisheries Convention of London of 1946"), came into force in 1953 and led to the establishment of the Permanent Commission. At the request of the USA, the 1946 conference restricted its consideration to the area east of 42°W longitude in recognition of the need to separate the North Atlantic into eastern and western sections for conservation purposes.

A number of European nations had established fisheries in the Northwest Atlantic dating back several hundreds of years in some cases, primarily in the area of the Grand Banks east to West Greenland waters. Following the end of World War II, fishing intensified rapidly and, by the late-1940s and early-1950s, increasing numbers of large trawlers began operating on grounds off West Greenland, Labrador and Newfoundland. As a result of continued concern over declining abundance of stocks throughout the Northwest Atlantic, the USA convened a conference of ten countries in Washington, DC in January 1949 which led to the establishment of the *International Convention for the Northwest Atlantic Fisheries*.

The purpose of this paper is to review the mandate, structure and objectives of the regulatory body created by the 1949 Convention, and its successor body, and summarize the major challenges faced and achievements made by these two intergovernmental organizations in the context of fisheries management and the provision of scientific advice in the Northwest Atlantic.

## ICNAF

### Mandate, Structure and Objectives

The *International Convention for the Northwest Atlantic Fisheries* was agreed in Washington, DC in January 1949, was opened for signature on February 8, 1949, and came into force on July 3, 1950 following ratification by Canada (including Newfoundland), Iceland, the United Kingdom (UK) and the USA. The stated purpose of the Convention was "*the investigation, protection and conservation of the fisheries*". The first meeting of the International Commission for the Northwest Atlantic Fisheries (ICNAF) was held in April 1951 in Washington, DC and was attended by five signatory governments (Canada, Denmark, Iceland, UK and USA); five additional countries whose ratifications were pending (France, Italy, Norway, Portugal and Spain) and two observer organizations – United Nations Food and Agriculture Organization (FAO) and the International Council for the Exploration of the Sea (ICES) – also participated.

The Convention was designed to provide for the investigation, protection and conservation of the fisheries of the Northwest Atlantic in order to make possible the maintenance of a maximum sustained catch from those fisheries (ICNAF, 1951). Standing Committees on 1) Finance and Administration (STACFAD) and 2) Research and Statistics (STACRES) were established at the first meeting, with the latter to recommend the coordination of research programs in the various countries and advise the Commission on improvements deemed desirable in the collection of statistics and research programs. Research and statistical programs would be carried out by agencies of the various Contracting Parties. At the 17th Annual Meeting in June 1967, the Commission established a Standing Committee on Regulatory Measures (STACREM) whose function would be to consider the economic, administrative and scientific aspects of proposed regulatory measures (ICNAF, 1968).

The Convention Area was initially the area west of 42°W longitude and north of 39°N latitude and was divided into five subareas (1–5) (Fig. 1), but the southern boundary was extended in 1967 (ICNAF, 1967) to 35°N latitude, with the area between 35° and 39°N latitude defined as Statistical Area 6. A detailed and comprehensive review of the delineation and establishment of the geographic areas for collecting fisheries statistics in the Northwest Atlantic, initially by NACFI and later by ICNAF and NAFO, is provided by Halliday and Pinhorn (1990). Statistical Area 0 was created in 1974 (ICNAF, 1974) in the Baffin Island area (Fig. 2). Statistical Areas 0 and 6 later became Subareas 0 and 6, respectively, under NAFO. Later changes in the boundaries between some subareas, divisions and subdivisions were made by NAFO to coincide with boundaries between national exclusive economic zones (EEZs).

Article IV of the Convention stipulated the establishment of a Panel for each of the subareas to be responsible for keeping under review the fisheries of its subarea and the associated scientific and other information and, on the basis of scientific investigations, making recommendations to the Commission for adoption (e.g. regulatory measures, scientific studies and investigations) by Contracting Parties. Panel membership by Contracting Parties was contingent upon having current substantial exploitation in the subarea in question or having a coastline adjacent to the subarea. Article VIII of the Convention authorized the Commission to adopt regulatory measures including a) establishing open and closed seasons, b) closing particular areas because of spawning or small/immature fish, c) establishing size limits for fish, d) prohibiting particular fishing gear, and e) specifying an over-all catch limit for any species. Such measures would become effective four months after notifications of acceptance by Contracting Parties were received by the Depository Government (USA).

Adhering to the dictates of its Convention (i.e. Article VI), ICNAF established a number of publication series for scientific and statistical information relating to the fisheries of the Northwest Atlantic. Research contributions from scientists and others engaged in the work of the Commission for use at ICNAF scientific meetings were multigraphed (later photocopied) papers which were issued as "Meeting Documents" until 1964. During the period 1965–72, the research contributions were issued as "Research Documents". Beginning in 1973, a separate "Summary Document" series was initiated for national research

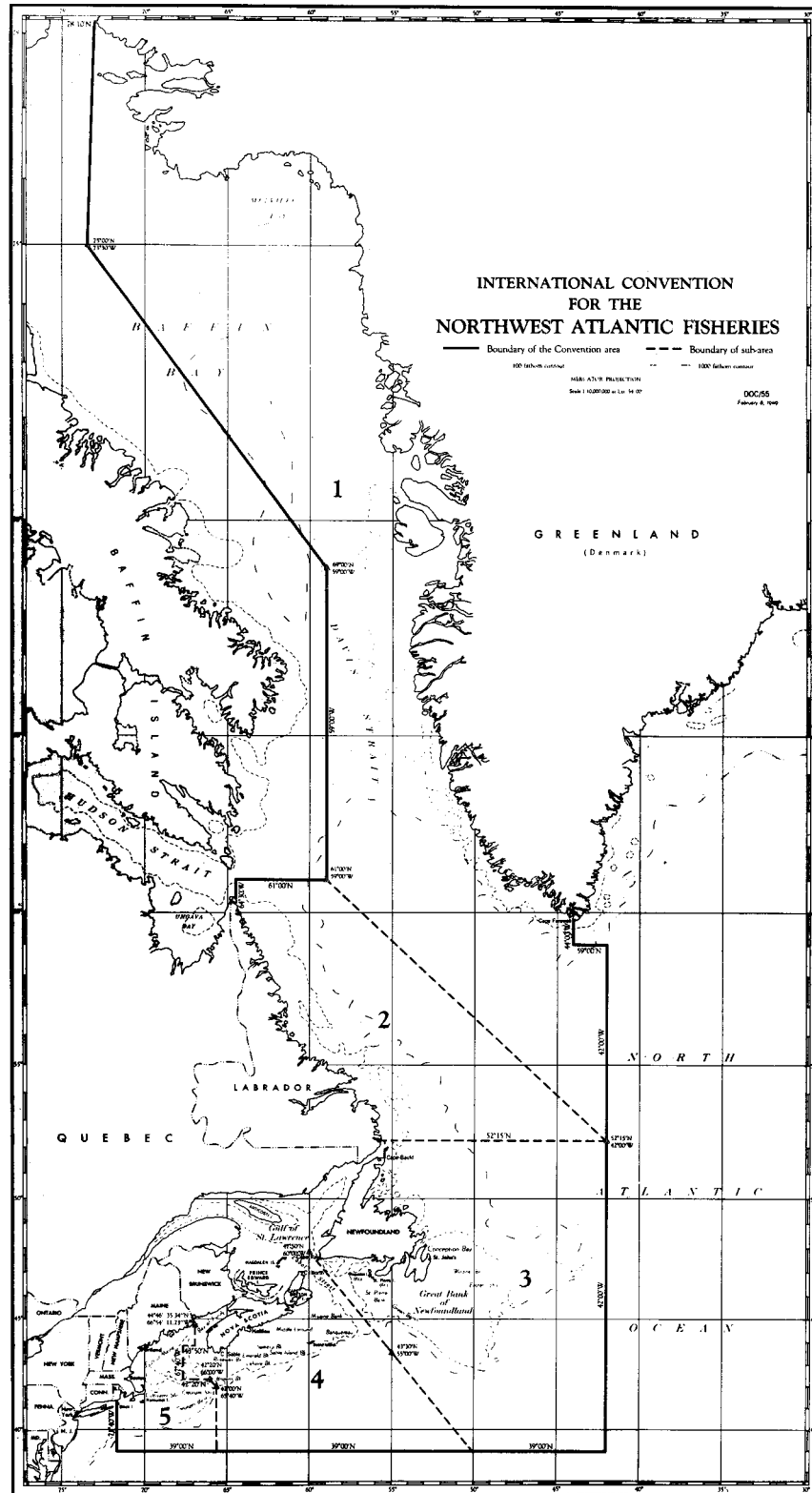


Fig. 1. Chart showing the initial ICNAF Convention Area with its five Subareas (ICNAF, 1951).

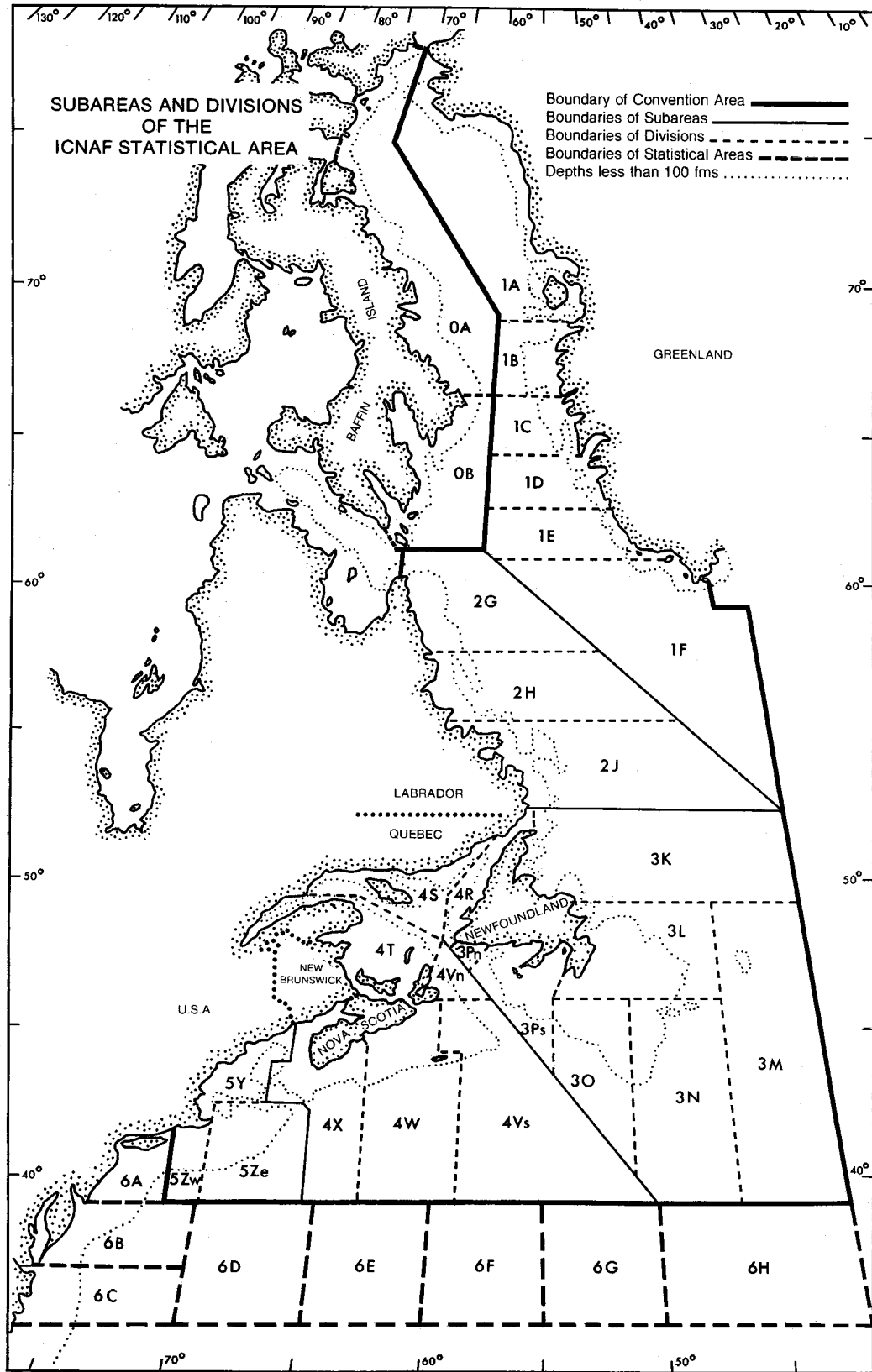


Fig. 2. Chart showing the final arrangement of Subareas, Statistical Areas, Divisions, and Subdivisions of the ICNAF Statistical Area (ICNAF, 1979).

reports, reports of committees, subcommittees and working groups, statistical tabulations, reports on status of fisheries and research carried out, and relevant reports or abstracts of activities of other international agencies. The *Statistical Bulletin* series, which began in 1952 and was issued annually, contained statistics of annual catch and effort for the fisheries in the ICNAF Area. In 1958, ICNAF began publishing the reports and proceedings of STACRES in a red-covered publication which, beginning in 1962, was entitled *Redbook*. The *Special Publication* series was also initiated in 1958 for the purpose of publishing, at irregular intervals, the results of special ICNAF projects and contributions to Symposia and Special Meetings. The *Sampling Yearbook* series was also begun in 1958 as a means of providing scientists and others involved in the work of the Commission with an annual record of the sampling carried out each year by member countries to determine length and age compositions of commercial catches of principal species required for stock assessment purposes. Beginning in 1964, ICNAF established a primary, peer-reviewed, scientific journal entitled *Research Bulletin* for publishing the results of individual research relevant to the ICNAF area. In 1976, a secondary publication entitled *Selected Papers* was established by STACRES as a means to publish certain research documents presented to ICNAF scientific meetings which were not of the standard required for publication in the *Research Bulletin*.

ICNAF also produced several other publication series of an administrative or managerial nature. As noted above, all documents produced for ICNAF meetings prior to 1965 were designated "Meeting Documents", but subsequently all documents produced for consideration by Commissioners were designated "Commission Documents". In 1953, the *Annual Proceedings* series was begun which contained the various Commission reports for the year (e.g. Administrative Report, Report of the Annual Meeting, Summaries of Research by member countries). This series continued until it was replaced in 1973 by the *Annual Report* series. In 1972, a new series of *Proceedings* of individual meetings was introduced. ICNAF also produced miscellaneous publications at irregular intervals such as *List of Fishing Vessels* and *Index and List of Titles*. Lastly, as a vehicle for routine communication of requests for data, preliminary catch reporting, meeting notices and the like to scientists, commissioners and advisers, the ICNAF Secretariat employed "Circular Letters".

The ICNAF collection and reporting system for catch statistics and biological data led to the establishment of one of the world's best fisheries data bases (ICNAF, 1951–80). Most ICNAF member countries were using fishery research vessels by the early-1950s, but fishery catch and effort (fishery-dependent) data were the basis for most if not all stock assessments until the early-1970s, when research vessel (fishery-independent) surveys were implemented in nearly all of the ICNAF subareas, and survey data began to be used more and more, particularly for stocks in US waters where standardized bottom trawl surveys, based on a stratified random sampling design, had begun in 1963 (Grosslein, 1969). The US bottom trawl survey also encompassed all of Div. 4X in Canadian waters.

The number of Contracting Parties increased from the initial five (Canada, Denmark, Iceland, UK and USA) in 1951 to a high of 18 by 1975 – Bulgaria, Canada, Cuba, Denmark, France, German Democratic Republic (GDR), Federal Republic of Germany (FRG), Iceland, Italy, Japan, Norway, Poland, Portugal, Romania, Spain, Union of Soviet Socialist Republics (USSR), United Kingdom (UK) and USA – before decreasing to only 12 (Bulgaria, Canada, Cuba, GDR, Iceland, Japan, Norway, Poland, Portugal, Romania, Spain and USSR) by the time ICNAF officially dissolved on December 31, 1979.

### **Major Challenges and Achievements**

Minimum mesh size regulations provided the basis for nearly all of the groundfish management measures during the first 15 years in ICNAF, with over 20 such measures adopted (Halliday and Pinhorn, 1985). The first such measure to be adopted by ICNAF (in 1952) was a USA–Canadian proposal for a 4-1/2 in (114 mm) minimum mesh for the Georges Bank haddock fishery (Subarea 5) which took effect in 1953. Minimum mesh size regulations (4 in or 102 mm) were implemented in 1957 for both haddock and cod in Subareas 3, 4 and 5. Other such regulations were put into effect in subsequent years, with the codend mesh size for cod, haddock and pollock throughout the Convention Area eventually increasing to 130 mm in the early-1970s. Mesh assessment work remained an important focus of STACRES through the

late-1950s and into the early-1960s. A series of trawl regulations discussed throughout the 1960s and adopted by the Commission in 1965 were finally implemented in 1968 (ICNAF, 1968).

At the 3rd Annual Meeting in 1953, a report from a Special Committee on the Commission's Research Program was adopted which outlined a comprehensive research program for the ICNAF area (ICNAF, 1953). Species on which this program would be concentrated included cod, haddock, redfish and halibut. The research program would be designed to address the following questions: 1) what principal fish stocks are there, where, how divided and how now used, 2) how do intensity and method of fishing affect the stocks and the long-term yield, and 3) how are the stocks affected by natural factors? STACRES recommended, and the Commission approved, the establishment of scientific working parties, the first of which included a Subcommittee on Cod and Haddock, a Subcommittee on Redfish and Halibut, and a Subcommittee on Hydrography. In subsequent years, additional *ad hoc* subcommittees and working groups were convened to address specific problems.

Following discussions at the 5th Annual Meeting in June 1955 by commissioners and scientific advisers which had centered around the issue of the research required to provide information essential for fisheries management, an interim technical meeting of STACRES was convened in Biarritz, France in March 1956 to 1) specify the absolutely essential information needed for predicting the effects of various fishing intensities on stocks of various sizes and various biological properties, 2) assemble American and European fishery scientists engaged in North Atlantic problems in order to compare, by working together with actual materials, their practices in field and laboratory techniques, to learn where important differences exist, and to determine how these differences can best be resolved, 3) discover gaps in research programs being carried on in the North Atlantic, and 4) suggest how these gaps might best be filled (ICNAF, 1958). The meeting format, a series of working party meetings or workshops, was found to be so successful and productive in terms of drawing forth data, ensuring participation by everyone in attendance, and producing definite conclusions and decisions that it became the pattern for future meetings (FAO, 1960) and, in essence, served as the prototype working group meeting which has since been the standard in international fisheries work. One of the most important conclusions from the Biarritz meeting was the need to correct for the lack of uniformity in scientific methods and terminology used in data collection (e.g. measuring fish and nets) among scientists from different institutions in different areas of the North Atlantic. The meeting also produced a list of recommendations made by the various working parties (ICNAF, 1958) relative to gaps in knowledge to be filled via an expanded, comprehensive and multi-national collaborative research program in the Convention Area in order to carry out the Commission's functions.

At the 6th Annual Meeting in 1956, STACRES urged Contracting Parties to begin increasing their national fisheries research programs as quickly as possible, but at the very least to immediately take steps to ensure the adequate sampling of their fishery catches. STACRES also provided a number of specific recommendations to the Commission regarding research needs under the general headings of a) statistics and sampling and b) research vessels and laboratory equipment (ICNAF, 1956).

As a result of ICNAF desiring to continue the discussions and planning begun at the 1956 Biarritz meeting relative to research on population dynamics and fishing gear selectivity, and in light of ICES and FAO sharing similar interests, a joint ICNAF/ICES/FAO meeting on fishing effort, the effect of fishing on resources, and the selectivity of fishing gear was held in Lisbon in 1957 (FAO, 1960; ICNAF, 1963). The meeting resulted in agreed lists and definitions of concepts, techniques and terms associated with fishing effort and fishing mortality, and helpful descriptions of and comments on research techniques and suggested problems to be addressed (FAO, 1963) and had a profound and positive influence on research programs in several ICNAF member countries as well as FAO.

At the 9th Annual Meeting in 1959, a Working Group on Fishery Assessment in Relation to Regulation Problems was established within STACRES to consider 1) minimum mesh sizes for Subareas 1 and 2, 2) a uniform minimum mesh size for the entire Convention Area, 3) a uniform mesh size for the entire North Atlantic, and 4) other conservation measures such as size limits of fish, closed areas and closed seasons (ICNAF, 1959).

At the 11th Annual Meeting in 1961, STACRES drew attention to the considerable growth and increase in complexity of fisheries in the ICNAF area in recent years which would necessitate more rational and practicable systems of fishery conservation which in turn would increase the demand for more comprehensive and penetrating research work. Accordingly, STACRES agreed to concentrate its work along two main lines: 1) environmental studies and 2) assessment of fish stocks and fisheries (ICNAF, 1961). The responsibility within STACRES for fisheries assessment work (particularly for groundfish), the groundwork for which had been laid in 1959–61 by the Assessment Working Group, was taken over in 1962 by the Assessments Subcommittee. Work on herring was handled by an *ad hoc* Working Group on Herring and Other Pelagic Fish, which first met in 1964.

At the 14th Annual Meeting in 1964, the Assessments Subcommittee (ICNAF, 1964) issued "*a clear warning that fishing intensity on many of the major stocks is approaching, and on some may have already exceeded, that giving the maximum sustainable yield*" and "*that the further increases in mesh size which are feasible cannot in themselves do much to offset the consequences of a continued build-up in fishing pressure*". The Commission responded by authorizing the preparation of a report reviewing the various kinds of action which might be taken to maintain the fish stocks in the ICNAF area at a level which could support MSY. This report (Templeman and Gulland, 1965) summarized the aims and methods of conservation and concluded that some direct control of the amount of fishing was necessary, with separate catch quotas for each stock preferably allocated to each segment of the industry being the least difficult method.

Heavy fishing pressure on Georges Bank haddock by distant water fleets (particularly from the USSR) in 1965 and 1966 resulted in very high catches of the very strong 1963 year-class and led to a sharp reduction in stock size. In 1969, ICNAF, on the basis of STACRES advice, adopted an overall total allowable catch (TAC) of 12 000 tons for haddock for 1970 on Georges Bank, with the understanding that this was to be reserved primarily for the two Coastal States and with only a small by-catch for other countries. In addition, two major spawning closures on Georges Bank were established which prohibited trawling for 3 months each year. A TAC was also set for haddock in Div. 4X (Browns Bank) for 1970. In addition, a regulation to prohibit fishing on winter concentrations of red and silver hake for 3 months each year was adopted in 1969 and put into force in 1970.

At the 1970 ICNAF meeting, the USA proposed TACs and minimum mesh size regulations for yellow-tail flounder on Georges Bank and in Southern New England in response to exceptionally high catches in 1969 by the USSR. These measures were adopted and put into force in 1971.

An ICNAF Protocol drafted in 1969 came into effect in late-1971 giving the Commission authority to allocate TACs among countries. At a Special Meeting in January 1972, ICNAF adopted a 150 000-ton TAC for 1972 for Georges Bank herring (Div. 5Z and Statistical Area 6), with allocations to individual countries. This action resulted in the first-ever national catch allocations formally implemented for a multinational fishery. TACs for 1972 were also set for herring in Div. 4XWb and Div. 5Y. Discussions on the basis for TAC allocations among countries for all stocks had begun in 1969 and had continued at subsequent Annual Meetings, but were stimulated by the results of a Canada-USA study (Anon., MS 1971) considered at the 21st Annual Meeting in 1971 and of an *ad hoc* Committee on Quota Agreement convened during the 22nd Annual Meeting in 1972. Agreement was reached at the 1972 Meeting for the national allocation of TACs for individual fish stocks among Contracting Parties. The quota allocation scheme was based on a formula which assigned 80% in proportion to the historical performance of member countries in fisheries for the stock in question – 40% in proportion to average catches over the most recent 10-year period (1961–70), and 40% in proportion to average catches over the most recent 3-year period (1968–70) – 10% to the Coastal States, and 10% for special needs (ICNAF, 1972a). This was commonly referred to as the "40-40-10-10" formula.

Enforcement was difficult throughout all the years of ICNAF. Discussions began quite early relative to ways and means for inspecting catches and fishing gear at sea, but a formal joint inspection scheme was not approved by ICNAF until 1970 and did not come into force until 1971.



There were intense discussions in the Assessments Subcommittee in the early-1970s questioning the scientific justification for TAC restrictions in Subarea 5 and Statistical Area 6 imposed at that time based largely on US studies which were increasingly supported by research vessel trawl survey abundance indices. US-USSR cooperative research trawl surveys in waters off the US east coast, which began in 1967 and continued until the mid-1970s, were an attempt to develop a common, comprehensive and accepted data base to be used for stock assessment purposes. These surveys, later supplemented by various surveys conducted by other member countries, demonstrated that the total fish and squid biomass in waters off the USA had been severely reduced by excessive harvesting.

Through the efforts of the STACRES Working Group on Coordinated Groundfish Surveys established in 1970 to consider the feasibility of coordinated groundfish surveys by research vessels throughout the Convention Area (ICNAF, 1970), standardized stratified random survey coverage expanded in the early-1970s to eventually include all subareas and involve numerous member countries. Canada initiated standardized surveys of Div. 4TVWX in 1969 (Halliday and Koeller, 1981) and Div. 4RS and Subareas 2 and 3 in 1971 (Pitt *et al.*, 1981). France, FRG, UK and USSR were also conducting trawl surveys in Subareas 1-4 by 1972 (ICNAF, 1973). By 1972, the Working Group was able to conclude that trawl survey data were sufficient to monitor relative changes in biomass of all components of the groundfish community (ICNAF, 1972b).

ICNAF implemented a minimum fish size regulation (9 in or 22.7 cm total length) for Atlantic herring in Subareas 4 and 5 and Statistical Area 6 beginning in 1972, with exemptions granted for the juvenile herring fisheries which supported "sardine" industries in the USA and Canada. In 1976, a minimum fish size of 25 cm total length was implemented for Atlantic mackerel.

Preemptive quotas were also introduced in ICNAF in situations, such as for Atlantic mackerel in the early-1970s, where scientific information on stock status was uncertain and/or disputed and there was a recognition of the need to constrain fishing within some limit until better information was available. Unfortunately, such quotas were almost always set higher than current catches, and hence were not effective.

Nationally-allocated TACs were set annually for eight stocks beginning in 1972; an additional 16 stocks were placed under TAC regulation for 1973, and TACs were set for 31 more stocks for 1974. By 1977, TACs with national allocations were being set annually for about 70 stocks throughout the Convention Area. However, most species were taken in trawl fisheries in which catches consisted of multiple species, making it impossible to avoid exceeding quotas on any particular species without closing down fishing for other species. Analyses demonstrated that total yield from an ecosystem was considerably less than the sum of the MSY estimates for each component stock. US scientists (Brown *et al.*, 1976) documented the relationship between total fishing effort and catch for Subarea 5 and Statistical Area 6. In January 1973, the USA proposed a total fishing effort limitation for this region which was not supported by other member countries. In June 1973, the USA proposed an overall TAC for finfish and squid in Subarea 5 and Statistical Area 6 of 825 000 tons, about 30% below current landings, and also separate TACs for each stock, with a provision that directed fishing for a particular stock would cease when its TAC was reached and that all fishing would cease when the overall TAC was reached. This too was rejected. But in October 1973, on the basis of a strong statement by STACRES that "*since the available evidence indicates the eventual requirement to stabilize and recover the biomass might be a reduction in catch to 800 000 tons, the level selected for the initial reduction must be significantly less than recent catches*" (ICNAF, 1974), agreement was finally reached for an overall TAC of 923 900 tons for 1974, 850 000 tons for 1975, and for 1976 an amount which would allow the biomass to recover to a level which would produce the MSY (eventually set at 650 000 tons).

For 1974, the sum of the individual stock TACs for Subarea 5 and Statistical Area 6 was 1 121 000 tons, compared to the overall TAC of 923 900 tons. A "two-tier" quota system was later devised and implemented under which individual stock TACs (the first tier) were adjusted downwards to account for bycatch in fisheries directed towards other stocks, and the overall TAC was the second tier. This system was effective in initially stopping the increasing trend in fishing mortality in 1974 and later in reversing

it. In addition, a proposal introduced by the USA to exclude large trawlers (i.e. >145 ft) from inshore portions of Subarea 5 and Statistical Area 6 (e.g. Great South Channel and Nantucket Shoals) was adopted. Nevertheless, in spite of reduced quotas and the exclusion of large trawlers from inshore waters, excessive numbers of distant water fishing vessels still remained on the fishing grounds.

Canada, at the 1975 Annual Meeting, pushed for and ICNAF adopted, a regulation (beginning in 1976) reducing fishing effort by non-Coastal States in Subareas 2–4 by about 40% from the 1972–73 level.

At the 7th Special Meeting in September 1975, STACRES was asked by the Commission to "*re-examine the potential effects of a range of levels of exploitation lower than that associated with MSY, with a view to promoting greater stability of stock sizes and catches*" (ICNAF, 1976a). In addressing this remit to consider possible alternative objectives for fisheries management, STACRES reviewed the past basis for the Commission's management measures (i.e. fishing mortality rate which would maximize the long-term catch) and contrasted and examined the principal features of the two measures of fishing mortality ( $F_{\max}$  and  $F_{\text{MSY}}$ ) which had been used. STACRES pointed out that because of the potentially large adverse consequences of establishing TACs based on high fishing mortality rates such as  $F_{\max}$ , a more prudent basis would be  $F_{0.1}$ , which would result in only a small loss in average catch, but would achieve a much higher average stock biomass, greater stock stability due to more age groups in the stock and a higher probability of better recruitment, higher catch per unit effort and increased economic efficiency. STACRES, at the 22nd Annual Meeting in 1972 when considering the basis for advice on catch levels (ICNAF, 1972b), had previously introduced  $F_{0.1}$  (Gulland and Boerema, 1973) as an alternative to  $F_{\max}$ .  $F_{0.1}$ , strictly an economic reference point, was defined as the fishing mortality rate at which the marginal yield per recruit (i.e. the addition to the total yield per recruit resulting from adding an additional unit of mortality) is 10% of the yield per recruit per unit mortality in a very lightly exploited stock (i.e. near the origin of the yield-per-recruit curve).

At the 26th Annual Meeting in June 1976 on the basis of its conclusions from the previous year's meeting, STACRES decided to recommend advice on TACs for 1977 based on  $F_{0.1}$  rather than  $F_{\max}$  (ICNAF, 1976b). Most TAC recommendations in subsequent years were similarly based on  $F_{0.1}$ .

The last regulatory measure introduced by the USA in ICNAF was the imposition of "windows" or specific areas where distant water fleet fishing was allowed. This was an attempt to resolve gear conflict problems between US and foreign fishermen and reduce by-catch of traditional US target species. This measure was adopted at the 9th Special Meeting in December 1976 (the last meeting attended by the USA as a member) for Subarea 5 and Statistical Area 6 (ICNAF, 1977). A similar measure (the "silver hake box") proposed by Canada for Subarea 4 was also agreed in 1976 and implemented in 1977.

At the 26th Annual Meeting in June 1976, Canada and the USA announced their respective intents to extend their EEZs to 200 miles effective January 1, 1977 and March 1, 1977, respectively (ICNAF, 1976c). The USA formally withdrew from the Commission on December 31, 1976. Also effective January 1, 1977, Denmark similarly extended to 200 miles its jurisdiction around Greenland as did France around the islands of St. Pierre et Miquelon. In October 1976, ICNAF initiated discussions regarding future multilateral cooperation in fisheries in the Northwest Atlantic, and in December 1976 adopted amendments to the Convention to allow for the continued functioning of the Commission until a final decision could be made regarding a future arrangement. Discussions continued at several conferences convened by Canada in 1977 and 1978 until agreement was reached in 1978 on a new international organization to replace ICNAF.

From 1977 until ICNAF was formally dissolved at the end of 1979, the Commission continued to manage fisheries in a somewhat abbreviated fashion. STACRES continued to provide advice for a reduced number of stocks (about 25 compared to around 70 previously) in response to Canadian requests for advice on certain stocks located within or partly within its 200-mile zone, to Danish requests for advice on several stocks in Greenland waters, to joint Canadian–Danish requests for several stocks overlapping the Canadian and Danish zones in Statistical Area 0 and Subarea 1, and to Commission requests for advice on several stocks lying totally outside any national zones.

## NAFO

### Mandate, Structure and Objectives

Declarations by the USA and Canada in 1976 of their intent to extend their fishing zones to 200 miles in 1977 led to a decision by the ICNAF Contracting Parties to create a new arrangement for multinational fisheries management in the Northwest Atlantic.

The *Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries* resulted from several conferences held in Ottawa in 1977 and 1978 and came into effect on January 1, 1979 (NAFO, 1980a). This Convention provided for the establishment of the Northwest Atlantic Fisheries Organization (NAFO). Following a 1-year transition between the two organizations, ICNAF was officially dissolved effective December 31, 1979.

The Inaugural Meeting of NAFO was held in March 1979 in Montreal (NAFO, 1980b) and the 1st Annual Meeting in June 1979 in Halifax (NAFO, 1980c). At the beginning of 1980 when ICNAF dissolved, there were 13 Contracting Parties of NAFO: Bulgaria, Canada, Cuba, Denmark (in respect of the Faroe Islands), European Economic Community (EEC), GDR, Iceland, Japan, Norway, Poland, Portugal, Romania and USSR. In subsequent years, various countries joined and withdrew. Spain joined in 1983, but, together with Portugal, acceded to the EEC in 1987 and ceased membership in NAFO (subsequently being represented by the EEC). GDR withdrew in 1990 following reunification with the Federal Republic of Germany and was subsequently represented by the EEC. Lithuania, Latvia and Estonia became members of NAFO in 1992 (having previously been represented by the USSR), and the Republic of Korea joined in 1993. In 1994, the EEC formally changed its name to the European Union (EU). The USA became a member at the end of 1995, and France (in respect of St. Pierre et Miquelon) joined in 1996.

The objective of NAFO, as stated in Article II of the Convention (NAFO, 1980a), is "*to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area.*" The Convention applies to all fishery resources in the Convention Area except salmon, tunas and marlins, cetaceans managed by the International Whaling Commission, and sedentary species (e.g. shellfish).

The NAFO Convention Area (Fig. 3) remained the same as the ICNAF Statistical Area, with the exception that ICNAF Statistical Areas 0 and 6 became NAFO Subareas 0 and 6 (NAFO, 1980a). The portion of the Convention Area outside the Coastal State EEZs is termed the Regulatory Area. In Subarea 3, important fishing grounds on the Continental Shelf in the Regulatory Area (i.e. outside the Canadian 200-mile limit) included Flemish Cap and the eastern and southern edges of the Grand Bank (commonly referred to, respectively, as the "Nose" and "Tail" of the Bank). These areas have proven to be the primary focus of NAFO's regulatory efforts. Later changes in the boundaries between some subareas, divisions and subdivisions were made by NAFO to coincide with boundaries between national EEZs. The boundary between Subareas 0 and 1 was modified in 1979. The boundary between Subareas 4 and 5 was altered (effective 1987) to reflect the 1984 decision by the International Court of Justice regarding the USA-Canada boundary in Subareas 4 and 5. As a result, catches in Subdiv. 5Ze were subsequently reported as being from Subdiv. 5Zc and Subdiv. 5Zu.

NAFO is organized into three principal bodies: the General Council, the Fisheries Commission and the Scientific Council. Although NAFO retained the same Convention Area as ICNAF, the NAFO Regulatory Area is only that part of the Convention Area which lies beyond the areas in which Coastal States exercise fisheries jurisdiction (i.e. beyond 200 miles). The General Council is responsible for overseeing all organizational, administrative, financial and internal and external affairs of NAFO. The Fisheries Commission is responsible for the management and conservation of the fishery resources in the Regulatory Area. The functions of the Scientific Council are as follows (NAFO, 1980a):

- a) *to provide a forum for consultation and cooperation among the Contracting Parties with respect to the study, appraisal and exchange of scientific information and views relating to the fisheries*

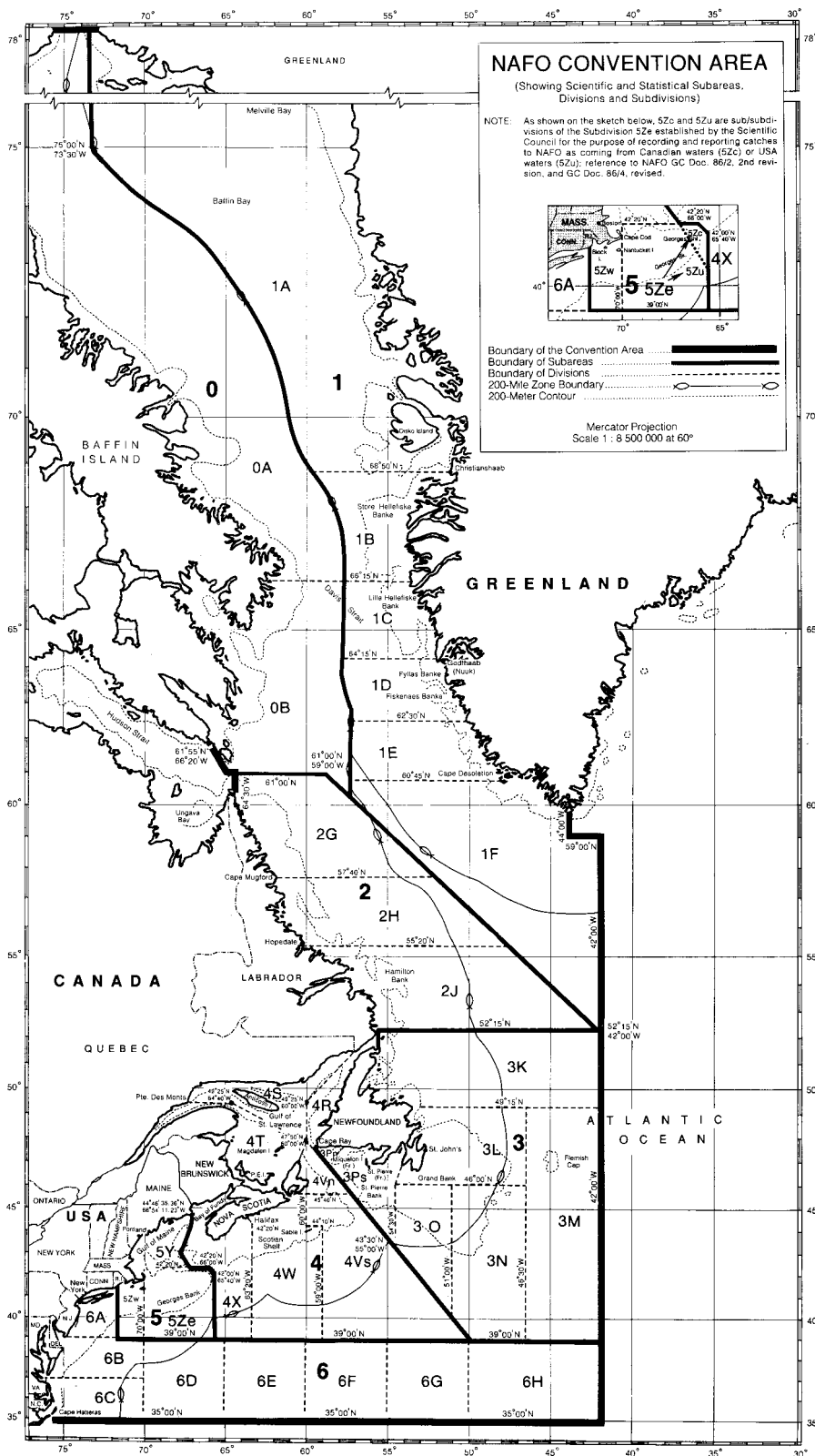


Fig. 3. Chart showing the Subareas, Divisions, and Subdivisions of the NAFO Convention Area (NAFO, 1995b).

*of the Convention Area, including environmental and ecological factors affecting these fisheries, and to encourage and promote cooperation among the Contracting Parties in scientific research designed to fill gaps in knowledge pertaining to these matters;*

- b) *to compile and maintain statistics and records and publish or disseminate reports, information and materials pertaining to the fisheries of the Convention Area, including environmental and ecological factors affecting these fisheries;*
- c) *to provide scientific advice to Coastal States, where requested to do so pursuant to Article VII; and*
- d) *to provide scientific advice to the Fisheries Commission, pursuant to Article VII or on its own initiative as required for the purposes of the Commission.*

Each Contracting Party is a member of the Scientific Council, which has three standing committees: 1) Standing Committee on Fisheries Science (STACFIS), 2) Standing Committee on Research Coordination (STACREC), and 3) Standing Committee on Publications (STAC PUB). In 1994, a new Standing Committee on Fisheries Environment (STACFEN) was established to replace the STACFIS Environmental Subcommittee (NAFO, 1995a).

During the discussions and negotiations which led to the establishment of NAFO, consideration was briefly given to utilizing ICES as the source for scientific advice. ICES, as an intergovernmental scientific organization, had the advantage of a long-standing tradition of producing and disseminating scientific advice for fisheries management, possessed a current structure for such purposes – i.e. its Advisory Committee on Fishery Management (ACFM) – the majority of countries likely to become Contracting Parties of NAFO were also Contracting Parties of ICES, and the premiere fisheries scientists in the North Atlantic fishing nations were already or could become involved in the work of ICES and hence their collective expertise could be accessed in developing the scientific advice required as a basis for managing the fish stocks in the NAFO Regulatory Area. However, according to Parsons (1993), Canadian representatives involved in the pre-NAFO negotiations rejected ICES as the source of scientific advice because the organization was perceived as being preoccupied with Northeast Atlantic matters and dominated by fisheries scientists from countries having distant water fleets in the Northwest Atlantic.

In addition to the Convention authorizing the Fisheries Commission to request scientific advice from the Scientific Council for the management of stocks within the Regulatory Area (Article VIII), it also makes provision for a Coastal State to request scientific advice from the Scientific Council for the management of stocks within its zone within the Convention Area (Article VII). Article XI of the Convention also requires that regulatory actions in the NAFO Regulatory Area be consistent with those of a Coastal State for stocks which overlap the Coastal State's EEZ and the Regulatory Area.

In 1980, NAFO established a primary scientific journal entitled *Journal of Northwest Atlantic Fishery Science* to replace the *ICNAF Research Bulletin*, and a secondary publication entitled *Scientific Council Studies* as a replacement for the *ICNAF Special Publication* and *Selected Papers* series. The *Statistical Bulletin* series initiated by ICNAF was maintained by NAFO, as well as the "Research Document (SCR Document)" and "Summary Document (SCS Document)" series for meeting papers. The *ICNAF Redbook* publication series was continued by NAFO under the title of *Scientific Council Reports*.

Other NAFO publications include "General Council Documents" and "Fisheries Commission Documents" produced for the various meetings of these two bodies, an *Annual Report* series, *Index of Meeting Documents*, *Index of Journal of Northwest Atlantic Fishery Science* and *NAFO Scientific Council Studies, 1980–93*, "Provisional Index and List of Titles Scientific Council Meeting Documents" for each year, *NAFO News* (a semi-annual newsletter of Organization activities), and "Circular Letters" which was replaced in 1996 with direct letter communications between the NAFO Secretariat and members.

As of 1997, there were 17 Contracting Parties including Bulgaria, Canada, Cuba, Denmark (in respect of the Faroe Islands and Greenland), Estonia, EU, France (in respect of St. Pierre et Miquelon), Iceland, Japan, Republic of Korea, Latvia, Lithuania, Norway, Poland, Romania, Russia and USA.

### Major Challenges and Achievements

The work of NAFO has continued in a manner similar to what it was under ICNAF, except on a greatly reduced scale. The stocks for which advice was requested from the Scientific Council (either by the Coastal States or the Fisheries Commission) initially numbered only 23 (representing 13 species in Subareas 0–4) (NAFO, 1980d) instead of about 70 under ICNAF. Far fewer scientists from member countries have participated in the work of the Scientific Council relative to that of STACRES in ICNAF. TAC advice initially continued to be based on the  $F_{0.1}$  level of fishing mortality which had been adopted as the basis within ICNAF in 1976. NAFO adopted the ICNAF trawl regulations and quota allocation scheme, but not the minimum fish size or area/season closure restrictions. Additional regulations pertaining to gear and minimum size limits for particular species were implemented in subsequent years, including a uniform minimum mesh size of 130 mm for groundfish in the Regulatory Area in 1992.

Canada has maintained control over the stocks totally within its 200-mile fishing zone within the Convention Area, although there have been allocations of catches to some countries for some of those stocks. As a consequence of the immediate sharp reduction in fishing opportunities for non-Coastal State countries in the Convention Area following the imposition of 200-mile limits, the focus of most fishing countries turned mainly to the few stocks located either totally or partially outside the 200-mile fishing zone of Canada in Subarea 3 on Flemish Cap and the eastern ("Nose") and southern ("Tail") edges of the Grand Bank where member as well as non-member vessel catches very quickly began exceeding the agreed TAC levels.

Two serious problems initially facing NAFO were 1) fishing by non-member country vessels and 2) refusal by the EEC to accept Fisheries Commission TAC and allocation decisions, and unilateral establishment by the EEC of much higher allocations for it than established by NAFO. The former situation was addressed in piece-meal fashion from about 1980 until resolution was eventually achieved in the mid-1990s as a result of diplomatic efforts by NAFO and Canada as well as threats by Canada to close its ports to fishing vessels from non-member countries such as Panama, Chile, Mexico and Venezuela in retaliation for their continued unauthorized fishing in the Convention Area. In 1990, NAFO established a Standing Committee on Fishing Activities of Non-Contracting Parties (STACFAC). Major progress towards resolution of non-member country fishing was made when 1) the Republic of Korea joined NAFO in 1993, 2) the Canadian government adopted legislation empowering Canadian authorities to unilaterally enforce NAFO regulations in international waters for stocks whose distribution overlaps the Canadian 200-mile zone and the NAFO Regulatory Area, and the subsequent arrest by Canadian enforcement authorities of several fishing vessels caught operating in the Regulatory Area using either illegal mesh or possessing illegal size fish, and 3) the UN Agreement on Straddling and Highly Migratory Fish Stocks was completed in 1995.

The latter problem, which also began in the early-1980s, was not resolved until late in 1992 following a Canadian-EEC agreement (Parsons, 1993). Difficulties arose in 1981 when Spain, prior to becoming a Contracting Party and later a member of the EEC, created concerns in NAFO because of its unauthorized fishing in the Regulatory Area. Even after adhering to the Convention in 1983, Spain opposed the reduced TACs established by the Commission for stocks in the Regulatory Area. The EEC and Portugal joined Spain in opposing these TACs. With abundance, particularly of the cod stocks, declining in the Regulatory Area, TACs were, as a result of advice from the Scientific Council, being steadily reduced. In 1985, the EEC challenged Canada's authority to exclusively manage cod in Div. 2J and 3KL, Greenland halibut in Subarea 2 and Div. 3KL, roundnose grenadier in Subareas 2 and 3, and capelin in Div. 3L, arguing that these stocks overlapped the Regulatory Area and the Canadian 200-mile zone and hence should be subject to NAFO's management authority. When requested, the Scientific Council advised that a small proportion of each of these stocks did in fact occur in the Regulatory Area (NAFO, 1986). Canada, however, felt that the proportion of the Div. 2J and 3KL cod stock available in Div. 3L was very small and that the entire stock was fully exploited in Canadian waters. Canada, therefore, proposed a moratorium on cod fishing in Div. 3L for 1986, which was adopted by NAFO (NAFO, 1993), but opposed by the EEC. This measure, as well as moratoria on fishing adopted for other stocks in the Regulatory Area, has continued to the present.

Objections by the EEC continued until resolution of the differences between Canada and the EEC were resolved late in 1992. The debate on fishing mortality strategy was not resolved, but instead focused on maximizing protection for collapsing stocks. Accordingly, there was agreement at the 15th Annual Meeting in 1993 to cease directed fishing on the transboundary stocks of cod, American plaice, yellowtail flounder and witch flounder (NAFO, 1994).

In response to pressure from the EEC, which preferred  $F_{\max}$  as the basis for TACs (to meet the requirements of EEC member vessels) instead of the  $F_{0.1}$  strategy which NAFO had inherited from ICNAF and which Canada employed, the Fisheries Commission in 1986 agreed to request scientific advice from the Scientific Council corresponding to  $F_{\text{current}}$ ,  $F_{0.1}$  and  $F_{\max}$  (NAFO, 1993). The Commission endorsed a document in 1987 entitled "Decision of the Fisheries Commission on the Establishment of an Annual Scientific Program" which should include an analysis of scientific information available on the stocks in the Regulatory Area and define the specific scientific objectives for the year and the means by which they are to be attained (NAFO, 1993). However, this was never adopted.

NAFO adopted an international Scientific Observer Program in 1979 (NAFO, 1993) for vessels fishing in the Regulatory Area to correct for deficiencies in fishery statistics and research by member countries needed for assessment purposes which had been identified by the Scientific Council. Implemented in 1980, the Program was discontinued in the late-1980s because of a persistent lack of adequate coverage.

A NAFO Scheme of Joint International Enforcement, which was virtually identical to that in place under ICNAF, was approved in 1981 (NAFO, 1993). However, participation was largely by Canada. In 1988, a revised scheme called the Scheme of Joint International Inspection was adopted (NAFO, 1993) which, in effect, differed very little from the original scheme. EU inspection vessels have been involved. In 1992, improvements were made to the Inspection Scheme (NAFO, 1993), including a hail system requiring vessels to report when entering and leaving management zones. A pilot Observer Scheme was instituted in January 1993 to monitor compliance to the Commission's regulatory measures (NAFO, 1993), but limitations in required observer coverage initially rendered the Scheme less than fully effective. However, in the last several years, enforcement and monitoring have improved considerably with observers present on every fishing vessel in the Regulatory Area.

The Scientific Council has had to address several important issues pertaining to its ability and way to provide advice to Coastal States and the Commission. In 1983, the Council adopted standard guidelines for the reporting of STACFIS assessments (NAFO, 1983). Fishing by non-member countries and a lack of statistics on such activities has had an adverse effect on the ability of the Scientific Council to provide reliable assessments and advice. In 1988, the Scientific Council for the first time provided options for  $F_{\text{current}}$ ,  $F_{0.1}$  and  $F_{\max}$  in its advice to the Fisheries Commission (NAFO, 1988). The advice had previously been limited only to the  $F_{0.1}$  option. Effective in 1989, the Scientific Council adopted a format for summary sheets to be used in presenting results of stock assessments in *Scientific Council Reports* (NAFO, 1989) comparable to that which had been adopted in November 1986 by ACFM (ICES, 1987). In 1990, the Scientific Council produced estimates of cod catches on Flemish Cap (Div. 3M) totaling 40 000 tons annually for 1988–90 at a time when a zero TAC had been in effect (NAFO, 1990). This suggested that NAFO's regulatory efforts had been largely ineffective in controlling fishing activities. The Fisheries Commission agreed in 1991 (NAFO, 1993) that an urgent priority was to obtain data on various stocks and such effort should be considered as the lack of analytical assessments was caused by absence of adequate data. In 1995, the Scientific Council implemented new working arrangements whereby STACFIS conducted stock assessments and the Council developed prognoses on those assessments and provided advice and recommendations (NAFO, 1996a).

NAFO's failure to establish firm control over harvesting levels on the stocks in its Regulatory Area and its inability to effectively enforce its regulatory measures have stemmed from 1) non-member country fishing, 2) unilateral establishment of quota allocations by Contracting Parties, and 3) quota allocations being exceeded by Contracting Parties. As a consequence, catches for most of the groundfish stocks have

exceeded the levels recommended by the Scientific Council in accordance with the  $F_{0.1}$  strategy. In the case of cod in Div. 3NO, NAFO was somewhat successful in the early-1980s in holding fishing mortality at moderate levels and achieving some stock rebuilding (Halliday and Pinhorn, 1996), but in the late-1980s, fishing mortality on this stock increased beyond even the  $F_{max}$  level, stock biomass declined, and catches exhibited an increasing dependence on small fish. Since similar trends have prevailed for other groundfish stocks totally within the Canadian zone, there is the possibility of a generalized environmental impact on all stocks, but the inadequacy of data on the amount and composition of catches in the Regulatory Area have made it difficult to estimate the true effects of fishing on these stocks (Halliday and Pinhorn, 1996). Satisfactory correction of the above three major problems will require continuation and strengthening of the Observer Scheme instituted in 1993 coupled with strong diplomatic efforts by NAFO and Canada.

The responsibilities and workload of the Scientific Council, as well as its achievements relative to the development of new assessment and management methodologies and approaches, have, for a number of reasons, been minimal in contrast to those of ICNAF's STACRES. Far fewer scientists from a smaller number of member countries have participated in the work of the Council compared to that of STACRES. The principal forum for the preparation of fish stock assessments and scientific advice for fisheries management, as well as for the discussion and development of new assessment methods and approaches for the provision of management advice in the North Atlantic since 1976 has been ICES. Furthermore, many (in Canada) or all (in the USA) of the assessment, advisory, and managerial responsibilities for stocks (except Atlantic salmon) within the EEZs of Canada and the USA previously handled by ICNAF have reverted to exclusive national authority.

For stocks within US waters of Subareas 5 and 6, the assessment and advisory functions have been handled by the Northeast Regional Stock Assessment Workshop process, and the development of fishery management plans is the responsibility of the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission, with ultimate authority delegated to the US Department of Commerce and its National Marine Fisheries Service.

In the case of stocks within Canadian waters, although some assessments and advice are provided by the Scientific Council, the remainder are handled internally, and all management is the responsibility of the Department of Fisheries and Oceans. Assessment, peer-review and advisory functions in Canada, beginning January 1977, were handled by the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) (Parsons, 1993). CAFSAC was replaced in 1993 by the Fisheries Resource Conservation Council (FRCC) to be responsible for preparing management recommendations, and in 1994 the Maritimes Regional Advisory Process (RAP) was created as a forum for peer reviewing assessments and providing scientific advice.

The NAFO Scientific Council has, however, not been a mute or ineffective body, but has made significant contributions. It has provided assessments, to the extent that reliable input data have been available, and has been forceful in recommending closure of fisheries when stock abundance has been deemed unacceptably low. It has also contributed to fisheries science through its cooperation with other organizations (e.g. ICES) and its sponsorship of annual scientific fora for the review of relevant topics. With respect to cooperation with other organizations, there are currently two joint NAFO/ICES Working Groups, one on Redfish Research in the Greenland Area established in 1980, and another on Harp and Hooded Seals established in 1990. Relative to annual scientific fora, the Scientific Council has, every year since 1981, sponsored at least one Special Session, Symposium or Workshop (Table 1), the topics for which have been applicable and relevant both to the NAFO Area as well as other geographical areas with comparable resources, environments and problems. The results of these fora have been published in the *NAFO Journal of Northwest Atlantic Fishery Science* and *NAFO Scientific Council Studies* series, which have also proven to be effective media for contributing high quality scientific papers to the international fisheries science literature base.



TABLE 1. Special Sessions, Symposia and Workshops sponsored by the NAFO Scientific Council, 1981–97.

Year	Convener(s)	Event and title
1981	R. W. Trites E. J. Sandeman	Special Session on "Remote-Sensing Methods" Symposium on "Environmental Conditions in the Northwest Atlantic during 1970–79 Decade"
1982	T. D. Iles	Special Session on "Stock Discrimination in Marine Fisheries and Invertebrates"
1983	V. A. Rikhter and G. R. Lilly	Special Session on "Trophic Relationships in Marine Fisheries"
1984	T. W. Rowell and Ch. M. Nigmatullin	Special Session on "Biology and Ecology of Squids in the Northwest Atlantic"
1985	J. Messtorff	Special Session on "Design and Evaluation of Biological Surveys in Relation to Stock Assessment"
1986	M. D. Grosslein	Special Session on "Recent Advances in Understanding Recruitment in Marine Fishes of the Northwest Atlantic, with Particular Emphasis on Georges Bank Herring and Flemish Cap Cod and Redfish Stocks"
1987	W. R. Bowering	Special Session on "Biology and Ecology of Demersal Resources of the North Atlantic Continental Slopes, with Emphasis on Greenland Halibut and Grenadiers"
1988	J. C. Rice	Special Session on "Impact of Changes in Environmental Conditions in the North Atlantic on Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Region in the Early 1980s"
1989	M. J. Fogarty	Special Session on "Changes in Biomass, Production and Species Composition in the Fish Populations in the Northwest Atlantic Over the Last 30 Years and Their Possible Causes"
1990	J. G. Shepherd	Special Session on "Management Under Uncertainties Related to Biology and Assessments, with Case Studies on Some North Atlantic Fisheries"
1991	H. Hovgård	Symposium on "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes"
1992	R. K. Mohn and R. Cook	Special Session on "State-of-the-Art in Fish Assessment: A Tutorial Workshop on Calibration Methods and Their Practical Use"
1993	S. A. Murawski and P. A. M. Stewart	Symposium on "Gear Selectivity/Technical Interactions in Mixed Species Fisheries"
1994	M. Sinclair and M. Stein	Symposium on "Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life"
1995	G. B. Stenson and J. Sigurjónsson	Joint NAFO/ICES Symposium on "The Role of Marine Mammals in the Ecosystem"
1996	H. Lassen	Workshop on "Assessment of Groundfish Stocks Based on Bottom Trawl Survey Results"
1997	H. Lassen	Symposium on "What Future for Capture Fisheries"

Work by the Scientific Council in 1994 and 1995 included advising on minimum landing sizes for all regulated species (NAFO, 1996b). Among the recent items of discussion within NAFO have been the precautionary approach to conservation and management of fish stocks in the Regulatory Area, discussed by the Fisheries Commission at the 18th Annual Meeting in 1996 and referred to the Scientific Council for possible implementation, and the need to improve the transparency of the NAFO proceedings, discussed by a Working Group at the 1996 Annual Meeting and still under study (NAFO, 1997).

## Summary and Conclusions

ICNAF came into being at a time when the exploitation of the world's marine fisheries resources was escalating as nations, faced with feeding rapidly growing populations, emerged from the ravages of World War II equipped with new and improved fishing vessels, nets and electronic fish-finding gear, by-products of war-driven technological developments, and determined to look to the sea for new sources of protein. The Northwest Atlantic, with its long tradition of fishing by European nations, its highly productive fishing grounds, and relatively untapped resources, attracted a huge influx of modern fishing vessels from many nations.

For the first 20 years of its existence, ICNAF struggled with ineffective technical measures (mainly minimum mesh sizes) for regulating its fisheries, all based on an underlying philosophy of maintaining maximum sustainable yield and bolstered with the notion that appropriate mesh sizes of fishing gear were sufficient. However, member country scientists cooperating successfully under the STACRES umbrella steadfastly designed and implemented a comprehensive research program for the ICNAF area, developed the world's foremost system for the collection and reporting of fisheries catch and biological data, and provided the scientific conscience that eventually convinced the Commission of the need for catch and effort controls. ICNAF scientists, during the first half of the 1970s, were at the cutting edge of innovative fishery analysis, providing the assessments and supporting analyses which served as the basis for TACs established for up to about 70 stocks by 1976 throughout the Convention Area, national allocations of these TACs, fishing effort regulations and the world's first attempt at multispecies management.

ICNAF perhaps failed in not persuading its member countries to agree earlier on effective conservation measures for the stocks. In the eyes of Coastal State fishermen, ICNAF failed to protect them from the impacts of the distant water fleets. However, ICNAF's management schemes developed in the early-1970s were innovative, even though their implementation had shortcomings. In many cases, these measures represented first-time multinational agreements on high-seas fishery regulations. Even though member country compliance and enforcement were less than satisfactory, regulations did lead to reduced fishing effort, and stock abundance would probably have been worse in the absence of such regulations. The willingness by member countries to adhere to Coastal State proposals and adopt increasingly restrictive measures in the 1974–76 period could be viewed as a consequence of their recognition of the impending extension of national fishing zones and a desire to gain favor with Coastal States in hopes of acquiring future fishing opportunities.

ICNAF can proudly lay claim to a number of firsts among international fisheries commissions: establishing control of the overall level of exploitation, adopting TAC regulations, adopting national allocations of TACs, and attempting multispecies management by means of "second-tier" TACs.

ICNAF enjoyed the participation of most of the world's best fisheries scientists either from member countries whose fleets fished in the Northwest Atlantic or from cooperating observer organizations such as FAO and ICES. A roll call of former STACRES members would number hundreds of names, many which are familiar and closely associated with the leading developments in fisheries science from the 1940s to the present. This critical mass of scientific expertise dissolved after 1976 following the extension to 200 miles of Coastal State fishing zones and has remained low throughout the NAFO years. The greatly reduced quota allocations for distant water fishing countries in the Northwest Atlantic eliminated the strong justification that previously existed for strong national scientific delegations to STACRES meetings. The principal forum for fisheries science in the North Atlantic shifted after 1976 to ICES. Consequently, the NAFO Scientific Council has been less fortunate in attracting the quantity and quality of scientists to its meetings and in being able to claim a leading position in major developments in fish stock assessment and management, as was the case in ICNAF.

As a multilateral fisheries conservation organization, NAFO has attempted to emulate its predecessor to some extent, but with a somewhat different structure and particularly a totally different atmosphere, legalistic and political, under which to function, this has been difficult if not impossible. The effective

area for which the NAFO Fisheries Commission has authority to establish regulatory measures is greatly reduced relative to ICNAF. There are only a handful of stocks either wholly or partially in the NAFO Regulatory Area compared to about 70 which were regulated in the mid-1970s by ICNAF. Fishing by non-Coastal State vessels is greatly diminished, and disagreement has been considerable among the NAFO Contracting Parties relative to TACs on regulated stocks.

Even though it has not been the pace-setting organization characteristic of its predecessor, although it failed until recently in establishing firm control over harvesting levels on the stocks in its Regulatory Area and effectively enforcing its regulatory measures, and regardless that its Scientific Council has been unsuccessful in extending its authority over scientific data collection and research, NAFO has nevertheless weathered several severe storms (e.g. non-member country fishing, unilateral establishment of quota allocations by Contracting Parties, and the exceeding of quota allocations by Contracting Parties). The NAFO Scientific Council has distinguished itself particularly through its sponsorship of annual Special Sessions, Symposia and Workshops which have focussed on scientific topics relevant not only to the Northwest Atlantic, but to fisheries science in general. NAFO, as an intergovernmental conservation organization, has demonstrated that in an era of extended national fishing zones and diminished international zones, multilateral scientific cooperation and management of shared fishery resources can not only be accomplished, but is a necessity.

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