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Scientific Council Reports 1989

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PREFACE

This tenth issue of *NAFO Scientific Council Reports* containing reports of Scientific Council Meetings held in 1989 is compiled in four sections: **Part A** - Report of the Meeting of 7-21 June 1989 which addressed requests for scientific advice on fisheries management, **Part B** - Report of the Annual Meeting of 11-15 September 1989 and the preceding Special Session held during 6-8 September 1989. The report of the Special Session on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes" is included in the report of the Annual Meeting, **Part C** - Brief summary of the Meeting of the Working Group on Progress in Age Determination of *Pandalus*, and **Part D** - the Agenda, List of Research and Summary Documents, List of Participants, and List of Recommendations relevant to Part A and B.

The *NAFO Scientific Council Reports* series replaced *ICNAF Redbook* series which terminated with the last issue in 1979. The first issue of this series was published in December 1980.

1 December 1989

Tissa Amaratunga
Assistant Executive Secretary

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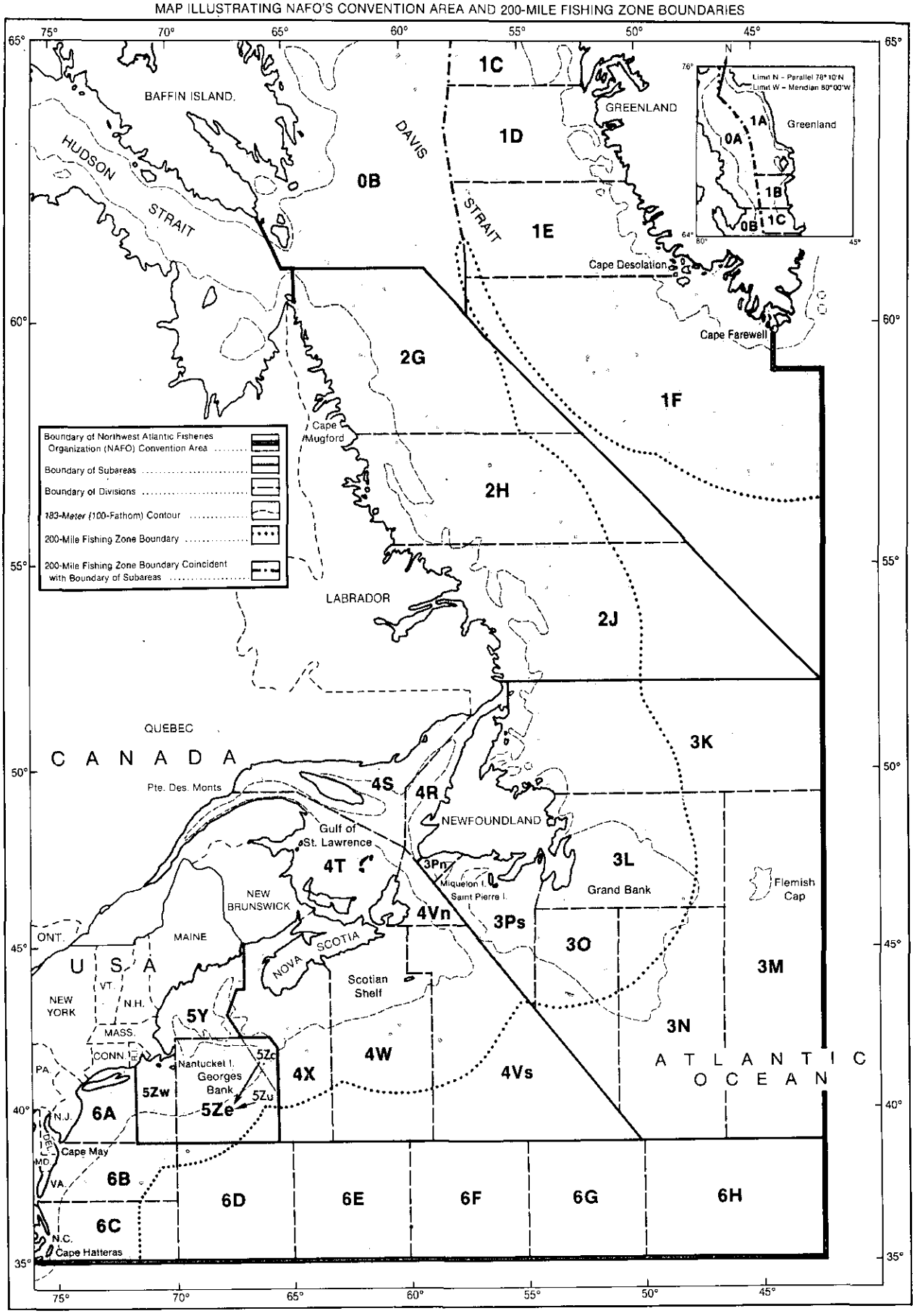

PART A

Scientific Council Meeting, June 1989

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REPORT OF SCIENTIFIC COUNCIL

June 1989 Meeting

I. PLENARY SESSIONS

Chairman: J. S. Beckett Rapporteurs: Various

The Scientific Council met at the new location of the Secretariat at 192 Wyse Road, Dartmouth, Nova Scotia, Canada, during 7-21 June 1989, to consider the various matters listed in its provisional agenda.

The Executive Committee met briefly prior to the opening session of the Council, and the provisional agenda (see PART D, this volume) and work plan were reviewed.

Representatives attended from Canada, Denmark (Greenland), European Economic Community (EEC), Iceland and Japan, and observer from USA. The NAFO Executive Secretary and Assistant Executive Secretary were in attendance.

The meeting was called to order at 1010 hr on 7 June 1989.

The Chairman welcomed everyone to Dartmouth and to the June 1989 Meeting of the Scientific Council. The Assistant Executive Secretary was appointed rapporteur, as was the usual practice, but functioned as the chief rapporteur in view of the contributions made to the report by various representatives.

The Chairman brought to the attention of the Council members that the provisional agenda contained Item II.4(e), as was requested by a Contracting Party (Part D, Agenda I, Annex 4), with the request that the Scientific Council provide advice on Cod in Div. 2J+3KL; under Article VI.1.d of the Convention, on its own initiative. There was an expressed opposition (Part D, Agenda I, Annex 5) to the inclusion of that agenda item because the Fisheries Commission had not requested the advice. A view was also expressed that any data on that stock would be of scientific interest to the Council.

The Chairman observed that a decision by vote was not possible at the present time because there was no quorum. Further discussion on that agenda item was postponed until sufficient proxy votes were obtained by the Executive Secretary and/or the late arrival of representatives to make up a quorum.

The Chairman then set out a plan of work, and drew the attention of the Council members that nominations were required for the election of Scientific Council Officers, except for the position of STACFIS Chairman, and that matter would be taken up on the final day of the meeting.

A decision was made that a first draft of the summary report be made available, if possible on the day after each Scientific Council session so that at a subsequent session the draft could be approved.

The Executive Secretary informed the Council of the results of the vote-by-mail held for the position of Chairman of STACFIS. Following a request by one Contracting Party for details of the vote, it was agreed that the information was obtainable from the Executive Secretary. The Chairman, on behalf of the Council members, welcomed the new Chairman of STACFIS for the 2-year term beginning September 1988. Meeting was adjourned at 1115 hr.

The Council met again at 0900 hr on 8 June 1989.

The Agenda Item II.4(e) was again open for an update and discussion. It was noted that the communication from Canada dated 29 May 1989 regarding the item (Part D, Agenda I, Annex 5) had been circulated by the Secretariat and made available to the Council members.

The Chairman presented the voting procedures described in Article X, paragraph 2 and explained the present shortcomings in the method by which the Executive Secretary should obtain proxy votes of abstention. It was agreed that the Chairman in consultation with the Executive Secretary would draft a resolution for consideration by the Council to rectify such inherent delays in the future.

The Agenda Item X (OTHER MATTERS) was then addressed to consider STACPUB membership.

A letter of resignation had been received from S. Kawahara (Japan). His contribution to the work of STACPUB was recognized by the Council.

Although one nomination, that of A. Fréchet (Canada) was received, the Chairman proposed that the appointment to fill the vacancy be postponed to the next session. Meeting was adjourned at 0930 hr.

The Council met briefly at 1400 hr on 9 June 1989 to consider STACPUB membership. The Chairman requested further nominations and comments from nominees.

A. Frechet informed the Council that it was not practical for him to accept his nomination at the present time.

P. Kanneworff [Denmark (Greenland)] was nominated and appointed to fill the vacancy.

The Chairman announced that the Council was likely to have a quorum by Monday (12 June) afternoon and proposed that consideration of the agenda be scheduled for Tuesday (13 June) 0900 hr. Drafts of the reports of the earlier Scientific Council sessions would also be reviewed at that time. Meeting was adjourned at 1420 hr.

The Council reconvened at 0900 hr on 14 June 1989.

Representatives attended from Canada, Cuba (12 June onward), Denmark (Greenland), EEC, Iceland, Japan and USSR (12 June onward), and an observer from the USA. The Executive Secretary had obtained a proxy vote of abstention from Norway.

Discussion was resumed on Item II.4(e) noting that all other items on the agenda had already been adopted.

The opposition to that agenda item was reiterated while special reference was made to the history of the Fisheries Commission's decision that only specific questions regarding the Div. 2J+3KL cod stocks would be addressed to the Scientific Council. According to that view, only those questions should be considered by the Scientific Council. However, it was pointed out that the purpose of Article VI.1(d) was for the Scientific Council to act as an independent body and independently consider any item for its scientific interest, and to present the information to the Fisheries Commission, irrespective of the Fisheries Commission's decision as to what they might wish to do with it.

A view was then expressed that it might be difficult to answer the Fisheries Commission's current questions with regard to the resource in the Regulatory Area without reference to the full stock, and a scientifically valuable compromise would be to consider a biological review of the stock without making a full assessment that included a forecast. It was pointed out that this was a stock complex and it was necessary to determine the basic information needs behind the Commission's questions. For that purpose, a broad interpretation of the Fisheries Commission's questions (Agenda Item II.4(b)) would be a useful option for the Scientific Council.

The Council declined by majority vote the adoption of Agenda Item II.4(e) to undertake an assessment of the cod stock in Div. 2J+3KL as requested (Part D, Agenda I, Annex 4).

The Council considered the alternative proposal that the assessment of the stock be reviewed but that no management advice be provided. It was noted by the Chairman that Article VI.1.d of the Convention and Rule 4.3 of the Rules of Procedure refer to the provision of scientific advice and that without unanimous consent, which did not exist, there was therefore no provision for adding this proposal to the Agenda. It was recognized, however, that should an existing assessment be circulated as a Scientific Council Research Document or Working Paper, it could be reviewed under Agenda Item II.8. In view of the scientific interest in that stock, that approach was encouraged but was refused on the grounds that three Canadian reports (two CAFSAC documents and an Independent Review of the State of the Northern Cod) were public documents and available to participants.

During the discussion, an opinion was expressed that reviews of the biological characteristics of different stocks of the same species might be more appropriately handled in special fora such as symposia.

The Chairman then presented draft reports of Council Sessions of the 7 and 8 June, for consideration. Those were adopted with some modifications. The meeting was adjourned at 1100 hr.

The Council reconvened at 1030 hr on 20 June 1989.

When reviewing the 4th draft of the report of the Council session of 14 June 1989, one representative, who had been at that time prevented by the Chairman to express fully his opinion, since the Chairman felt that he should not reiterate previous statements, was given a new opportunity to question the Chairman's decision about the reference to Article VI.1.d and Rule 4.3 and more specifically on the need for unanimity to consider the formulation of an agenda item. That representative stated that he was not convinced that the Article VI.1.d or Rule 4.3 could prevent such action but he thought that Article X.2 about decision pertaining to the organization of the Scientific Council's work should apply there. He further suggested that, if the wording of the Rules of Procedure were unclear, they should be amended in order to give more freedom of initiative to the Scientific Council.

Further to the discussion on 8 June, the Chairman then presented a draft resolution to change the implementation of the Rules of Procedure with respect to the method by which the Executive Secretary should obtain proxy votes of abstention.

The resolution stated below (see Section V, Rules of Procedure) was adopted by the Council. The meeting was adjourned at 1100 hr.

The concluding session of the Scientific Council was convened at 1045 hr on 21 June 1989.

The draft of the report from the Council meeting of 20 June was adopted. The Council then addressed the various agenda items that had not been considered to date and the meeting was adjourned at 1500 hr.

The reports of the Standing Committees, as reviewed and adopted on 21 June are appended as follows: Appendix I, Report of Standing Committee on Fishery Science (STACFIS), Appendix II, Report of Standing Committee on Research Coordination (STACREC), and Appendix III, Report of Standing Committee on Publications (STACPUB).

The adopted Agenda, the lists of research (SCR) and summary (SCS) documents, the list of participants and list of recommendations are given in Part D of this volume. Committee reports and other matters considered by the Council follow in Sections II and VIII.

II. FISHERY SCIENCE (see STACFIS report, App. I)

1. General Fishery Trends

The Council noted that provisional nominal catch data for 1988 were not available for EEC-France (Metropolitan), France (St. Pierre and Miquelon) and Faroe Islands at the time of the meeting. With the inclusion of 1988 STATLANT 21A data submitted from France (M) and France (SP) and chartered vessel data from Faroe Islands (at the time of preparation of this issue), the following general trends were noted. From provisional statistics for 1987 and 1988, the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) decreased (1%) to 2.95 million (metric) tons in 1988 from 2.98 million tons in 1987 (see Appendix 1, Table 1). For the same years the "groundfish" catch decreased (5%) to 1.21 million tons from 1.27 million tons, the "pelagic fish" catch decreased (1.3%) from 674,000 tons in 1987 to 665,000 tons in 1988, the "other finfish" catch increased significantly (36%) to 188,000 tons from 138,000 tons and the "invertebrates" catch decreased (1%) to 890,000 tons from 898,000 tons. With respect to the nominal catches by subarea, increases were noted for Subarea 0 (from 2,000 tons in 1987 to 6,000 tons in 1988), Subarea 1 (from 107,000 tons in 1987 to 138,000 tons in 1988), Subarea 4 (from 767,000 tons in 1987 to 806,000 tons in 1988), Subarea 5 (from 422,000 tons in 1987 to 425,000 tons in 1988) and decreases were recorded for Subarea 2 (from 112,000 tons in 1987 to 95,000 tons in 1988), Subarea 3 (from 690,000 tons in 1987 to 678,000 tons in 1988) and Subarea 6 (from 884,000 tons in 1987 to 803,000 tons in 1988).

2. Assessment of Finfish and Invertebrate Stocks

In adopting the report of STACFIS, the Council noted that tuning methods to calibrate terminal F had been discussed by STACFIS. The Council noted that the scientific debate over the numerous tuning methods remained very active, without any method being identified as necessarily better than a number of others.

The Council noted that STACFIS had reviewed the status of certain stocks in Subareas 0 to 4, as requested by Canada, Denmark (Greenland) and the Fisheries Commission, and had advised on catch levels corresponding to reference levels of various fishing mortality according to the different requests. Management advice, based on the reference levels, could not be provided for several stocks due to insufficient data. Details of the stock assessments are given in the Report of STACFIS at Appendix I.

3. Response to Questions by the Fisheries Commission

The Council agreed with the suggestion by STACFIS that the Scientific Council advise the Fisheries Commission that a more fruitful interaction would be prompted by framing inquiries in the context of the problems which the Fisheries Commission would wish to resolve. Very specific questions, as contained in item 3 of the Commission's request for advice (see Part D, Agenda I, Annex 1), would elicit very specific answers, which may well be misleading in relation to the Commission's problems unless the questions were accurately formulated. More importantly, they did not provide the Scientific Council adequate opportunity to bring forward advice relevant to the Commission's problems which might be outside the scope of these specific questions.

The Council noted that in accordance with the recommendation made by the Council in September 1988, assessments were reported in the new format. The Council adopted the Summary Sheets prepared by STACFIS for each assessment with modification as deemed appropriate and endorsed the decision to use the sheets in the Scientific Council report, particularly for the purpose of presenting the assessments to the Fisheries Commission. The Summary Sheets are given below.

The Council concurred with the information provided by STACFIS in response to the specific questions posed by the Fisheries Commission with respect to Cod in Div. 2J, 3K and 3L, Cod in Div. 3M and flounders in Div. 3L, 3N and 3O, and those responses are provided along with their respective Summary Sheets below.

SUMMARY SHEET - Cod in Subarea 1

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC	Various options (see special comments)										
Agreed TAC	62	62	68.5	28.3	12.5	12.5	53	90	90	12.5	49
Actual landings	55	58	30	15	5	19	61		61	5	35
Sp. stock biomass	60	53	30	20	26	22	49				
Recruitment (age 3)	67	11	12	4	15	500	100	20			
Mean $F_{(6-9)}$	0.62	1.16	0.93	0.55	0.27	0.40	0.64				

Catches: The increase since 1986 is caused by recruitment of the very strong 1984 year-class. Highest catch in 1962: 451,000 tons.

Data and Assessment: Stock estimate based on offshore trawl surveys (Fed. Rep. of Germany) and Greenland inshore longline surveys. Adjustment by catchability.

Fishing Mortality: Estimated by SPA. The relative low fishing mortality in 1986 and 1987 caused by depleted stocks and restrictions on the fisheries.

Recruitment: 1987-89 as estimated from trawl surveys (Fed. Rep. of Germany) and inshore young-fish survey (Greenland). Values prior to 1987 from SPA (SCR Doc. 89/69).

State of Stock: After record low level in the mid-1980s stock has increased by recruitment of the very abundant 1984 year class. This will be followed by a moderate 1985 year-class but thereafter very small year-classes of 1986-87 (probably also 1988).

Forecast for 1989: It is likely that the TAC of 90,000 tons will be fished, implying an F of 0.252.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ = 0.334	112 (000 tons)	263
F_{89} = 0.252	88	285
F_{max} = 0.679	196	187

Recommendation: Exploitation of a level of F_{max} or setting TAC significantly above 100,000 tons annually reduces the increase in SSB considerable due to initial high catches.

Special Comments: Since 1982, no specific TAC has been advised, but a number of management options have been given. Low catch levels were advised for 1987 and 1988 to let the 1984 year-class grow up before exploiting it. For the years 1982-84 low catch levels were advised in order not to reduce spawning stock further.

Response to Specific Request From the Fisheries Commission on: Cod in Divisions 2J, 3K and 3L (NAFO SCR Doc. 89/05, 34)

The Scientific Council was requested to: *continue to provide information, if available, on the stock separation in Div. 2J+3KL and the proportion of the biomass of the cod stock in Div. 3L in the Regulatory Area and a projection if possible of the proportion likely to be available in the Regulatory Area in future years. Information is also requested on the age composition of that portion of the stock occurring in the Regulatory Area.*

A comprehensive review of studies on discrimination of the various stock components of cod in Div. 2J+3KL was presented at the 1986 annual meeting (*NAFO Sci. Coun. Rep.* 1986, pages 121-124). Information on genetic variation, migrations, meristics, infestation by parasites, growth rates, ages and lengths at maturity and spawning time were discussed. It was reported at the 1986 meeting, that there was evidence from tagging, of a complex of spawning components. The adjacent groups of those overlap broadly in their distributions, particularly in coastal areas in summer. Biochemical, parasitological and meristic studies all indicated close similarities among cod in Subarea 2 and Div. 3K, but those and also the tagging studies indicated that cod in Div. 3L were a more heterogeneous group. It was also reported that, clearly, some of the cod occurring in Div. 3L, particularly those occurring in deep areas of eastern Div. 3L, were similar to those in more northern areas. However, cod on the northern slopes of the Grand Bank, especially in shallower water, showed affinities with those of Div. 3NO. From the point of view of assessing the stock in Div. 2J+3KL, in spite of some evidence for genetic subdivisions, the cod of Div. 2J, 3K and 3L were intermingled to a significant degree, especially inshore during the feeding season. It was noted that the pattern and degree of intermingling might vary, depending on environmental conditions such as ice coverage and water temperature. No new information on that topic was presently available and the conclusions remain unchanged. It was noted that while the data on stock structure of cod in Div. 2J and Subarea 3 was considerable, further analyses were continuing, for example, the results of substantial tagging programs. The ongoing analyses might provide insight as to whether smaller management units might be no more prone to mixing of fish with other management areas, than were the present management units.

To update estimates of the proportion of the biomass of cod in Div. 3L in the Regulatory Area, results from recent Canadian RV surveys in Div. 3L conducted during spring and autumn were added to previously analyzed data sets. The proportion of cod biomass in the Regulatory Area in Div. 3L relative to the biomass in the surveyed area in that Division ranged from 0.4 to 6.1% (average = 2.8%) during spring and 0.5 to 7.7% (average = 2.9%) during autumn. During winter, surveys conducted by Canada only in 1985 and 1986 suggested that about 25% of the Div. 3L cod biomass occurred in the Regulatory Area during that time of year.

Results of surveys conducted by the USSR since 1977 during spring indicated that the proportion of the Div. 3L biomass that occurred in the Regulatory Area ranged from 1% to 16% and averaged about 6.7%.

Data from autumn surveys conducted since 1981 in Div. 2J, 3K and 3L by Canada indicated the proportion of cod biomass in the Regulatory Area in Div. 3L relative to the biomass of the entire surveyed area in Div. 2J+3KL ranged from 0.1 to 1.5% (average 0.8%). The average divisional proportion of biomass derived from those surveys was about 40% for Div. 2J and 30% for each of Div. 3K and 3L. With the assumption that the relative distributions among divisions in autumn was similar to that of other times during the year, the previously reported conclusion that "the proportion of the entire Div. 2J+3KL cod biomass estimated to occur in the Regulatory Area is less than 10% in winter and less than 5%, on average, throughout the year" remained unchanged.

Results from both Canadian and Soviet surveys suggested no annual trends in the proportion of the Div. 3L cod biomass that occurred in the Regulatory Area and it might be reasonable to assume that proportions expected to occur be about the same as those observed.

Age compositions derived from Canadian surveys conducted in Div. 3L during spring and autumn for 1986-88 and during winter for 1985-86 were examined. Results from spring and autumn surveys, when only a small portion of the Div. 3L cod biomass occurred outside the Canadian 200-mile zone, indicated that a proportionately larger number of younger fish occurred in the Regulatory Area than in the entire division. During winter, when the maximum proportion of the Div. 3L biomass occurs in the Regulatory Area, age compositions for all of Div. 3L and that portion outside the Canadian zone were approximately the same.

Percent age compositions of cod in Div. 2J+3KL as a whole derived from autumn surveys conducted by Canada were similar to Div. 3L percent age compositions also derived from autumn surveys. The most abundant year-class in the 1988 surveys in Div. 3L (spring and autumn) and the whole of Div. 2J+3KL (autumn) was that of 1982 (age 6). In contrast the most abundant year-classes in 1988 estimated in the Regulatory Area in Div. 3L were that of 1985 (age 3) for spring surveys and 1986 (age 2) for autumn surveys.

SUMMARY SHEET - Cod in Division 3M

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC[a] ('000 tons)	-[c]	0	0	0	0	0	0	0	0	0	0
Agreed TAC[b]	12.4	12.4	13	13	13	13	0	0	40	0	16
Actual landings[b]	13	10	13	14	15	8	1		33	1	16
Sp. stock biomass	No estimates available										
Recruitment (age)	No estimates available										
Mean F	No estimates available										

[a] max, min and mean calculated since 1983.
[b] max, min and mean calculated since 1977.
[c] no recommended TAC for 1982.

Catches: Catches ranged from 22,000 to 33,000 tons in the late-1970s, have been stable and averaged 12,000 tons for 1980-87 with a catch of 570 tons reported for 1988.

Data and Assessment: Surveys conducted by the USSR since 1977 indicated that biomass and abundance had declined steadily since the early-1980s.

Fishing Mortality: Currently not known.

Recruitment: Some indications from research vessels that the 1986 year-class may be strong.

State of Stock: Stock size cannot be precisely determined, but research vessel survey results indicate that total stock biomass is declining and spawning stock biomass is at a low level.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation: The moratorium on fishing for cod on the Flemish Cap should continue to allow the stock to rebuild.

Special Comments: Response to specific questions posed by the Fisheries Commission follows.

Cod in Division 3M

The Scientific Council was asked to: *advise on the levels of unavoidable by-catch of cod in directed fisheries for redfish and American plaice.* The Commission asked also for comments on: *the appropriateness of establishing a minimum target level for the spawning biomass, and to provide advice on options for establishing such a level.*

During 1988 the entire reported catch of cod (570 tons) taken on the Flemish Cap, was by-catch in redfish and flatfish plaice fisheries. A total of 429 tons was taken by EEC-Portugal, the USSR and Japan as by-catch in redfish directed fisheries while an additional 141 tons was taken by EEC-Spain as by-catch in the flatfish fishery. By-catch rates of cod in the redfish fisheries were: EEC-Portugal - 5.9%, the USSR - 0.3%, and Japan - 0.2% with a total by-catch rate for cod of 2.1%. The by-catch rate by EEC-Spain in the American plaice fishery was 8.8%. It was possible that those by-catch rates would increase as the biomass of cod in Div. 3M increased mainly from the growth of the relatively strong 1986 year-class.

No information has been provided on discarding.

The rationale for establishing a target spawning biomass was to maintain a stock size that would support a viable fishery without endangering the stock. It would assume that there was some relationship between spawning stock and resultant levels of recruitment. There was presently no documentation to indicate that a stock-recruit relationship existed for Div. 3M cod. Analyses have shown, that since the late-1950s, the average total stock biomass as well as the spawning stock biomass were highest in the mid-1960s but declined thereafter and have remained at low levels. Poor recruitment has occurred when spawning stock was large (e.g. 1964 year-class) while good recruitment (e.g. 1973 year-class) was produced from low spawning stock levels. While stock-recruit relationships have not been established for most cod stocks it has been shown that the probability of poor recruitment is less when spawning stock is high.

Scientific advice, since the early-1980s for the stock had been that no directed fishery should be allowed, to protect the remaining spawning stock and to reduce the loss in yield-per-recruit resulting from fishing incoming year-classes at early ages. The average biomass (age 3+) from 1960 to 1965 was estimated at about 200,000 tons and the spawning biomass (age 6+) about 65,000 tons. Stock biomass subsequently declined to low levels by the mid-1970s and have remained low to the present. Sequential population analyses had not been possible in recent years because of insufficient data, however, biomass estimates from research surveys had indicated that the stock was low. In 1986 the age 3+ biomass was estimated at 30,000-35,000 tons with a spawning biomass at about 10,000 tons.

TACs for the stock from 1984 to 1987 were based on a management strategy of the Fisheries Commission (NAFO FC Doc. 83/IX/4, revised), namely that "the TAC will not be increased beyond 12,965 metric tons until the Scientific Council advises that the age 3+ mean biomass has reached a level approximately equal to one-half the mean age 3+ equilibrium biomass associated with fishing at F_{max} and assuming long-term average recruitment levels". The estimate for one-half the mean age 3+ equilibrium biomass was estimated at 85,000 tons.

Target spawning biomass levels had not been included in past advice and data currently available did not provide a basis for establishing a reference target level. Survey data in 1988 indicated that the current total biomass was in the range of 10,000 to 30,000 tons with the age 3+ biomass much lower than that level. It is expected that the biomass would increase in 1989 with the growth of the relatively strong 1986 year-class. The spawning stock estimated from 1988 surveys would be low because the stock was mainly comprised of cod aged 2 and 3 years.

In principle a target spawning stock biomass, as an indicator of stock status, is an appropriate management strategy. With the data currently available, the appropriate target for Div. 3M cod cannot be evaluated, but it was clear that any target should be much larger than the current spawning stock size. For this stock, spawning biomass was defined as knife-edged at age 6 years, however, STACFIS recommended that *available maturity data be analyzed for the next assessment.*

SUMMARY SHEET - Cod in Divisions 3N and 3O

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max[1]	Min[1]	Mean[1]
Recommended TAC ('000 tons)	Same as agreed								-	-	-
Agreed TAC	17[1]	17[1]	26	33	33	33	40	25	33	15	27
Actual landings	32	20	28	28	51	30	43	-	51	15	33
Sp. stock biomass	97	101	105	108	116	119	97	96[1]	119	18	79
Recruitment (age 3)	23	35	51	47	10	10	33	-	51	10	30
Mean F	0.25	0.20	0.24	0.30	0.30	0.27	0.36	-	0.62	0.16	0.29

[1] Over 1977-88 period.
[2] Excludes expected catches by Spain.

Weights in '000 tons
Recruitment in millions

Catches: Catches declined from a peak of 225,000 tons in 1967 to a low of 15,000 tons in 1978. The maximum catch since 1974 occurred during 1986 (51,000 tons) but were lower in 1988 at 43,000 tons.

Data and Assessment: Analytical assessment of catch-at-age data using Canadian and USSR survey indices in a formulation of the adaptive framework.

Fishing Mortality: Fully recruited F ranged from .17 to .36 for the 1978-88 period, with the estimate of 0.36 occurring in 1988.

Recruitment: The 1983 year-class at age 3 in 1986 estimated from ADAPT to be about 10 million fish. The Canadian RV indicated that the 1984 year-class was about the same size. These two year-classes are about one-half the next lowest year-classes observed in the 1959-88 period.

State of Stock: The mean 3+ biomass increased from 45,000 tons in 1976 to 190,000 tons in 1986 and subsequently declined to about 126,000 tons in 1988. The major reason for the decline is the size of the weak 1983 and 1984 year-classes.

Forecast for 1989: Catch 1989 is the TAC of 25,000 tons (F = 0.23).

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ = 0.15	18,600	106,600
F_{88} = 0.36	40,700	87,500
F_{max} = 0.25	29,600	97,000

Recommendation:

Special Comments:

SUMMARY SHEET - Redfish in Subarea 1

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	No TAC										
Agreed TAC											
Actual landings	8	7	6	4	5	1[1]	3[2]		8	1	5
Sp. stock biomass	No estimates										
Recruitment (age)	No estimates										
Mean F	No estimates										

[1] Low catch due to closure of the cod fishery.
[2] Provisional data.

Catches: Mainly by-catches of *S. marinus* in the cod fishery, peak catch in 1979: 9,000 tons.

Data and Assessment: Stratified-random bottom-trawl surveys since 1982.

Fishing Mortality: No estimates

Recruitment: No direct estimates but biomass and abundance estimates of juvenile redfish from surveys on nursery grounds.

State of Stock: Recent catches are only a small proportion of the redfish biomass as estimated by survey. Furthermore, the surveys are limited to the area of cod distribution which is only part of the area of distribution of redfish.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation:

Special Comments: The removal of large amounts of juvenile redfish by the shrimp fishery may adversely affect redfish recruitment.

SUMMARY SHEET - Redfish in Division 3M

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	20	20	20	20	20	20	20	20	20	20	20
Agreed TAC	20	20	20	20	20	20	20	20	20	20	20
Actual landings	15	20	20	20	29	44	23		44	15	24
Sp. stock biomass											
Recruitment (age)	No information available.										
Mean F											

Catches: Between 14,000 tons and 44,000 tons since 1977. Have averaged 20,000 tons from 1983-85. Increased landings in 1986 and 1987 mostly due to the EEC (primarily Portugal). The reduction from 1987 to 1988 was the result of a diversion of effort to other fisheries.

Data and Assessment: Catch-at-age data available, but SPA is not possible because the series is too short to enable calibration. Catch rates show no trend but may not be reflective of stock status. Research data show large fluctuation.

Fishing Mortality: No estimates available.

Recruitment: No estimates available.

State of Stock: Not possible to evaluate due to large variability around indices of abundance.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =	No information available	
F_{88} =		
F_{max} =		

Recommendation: Higher TAC may be warranted but should be set well below levels of 50,000 and 85,000 tons corresponding to reference $F_{0.1}$ and F_{max} exploitation of the 1988 USSR survey biomass estimate.

Special Comments: Due to the longevity of redfish and relatively young age of the strong early-1980s year-classes, their total potential yield will not seriously be affected by adopting too low a TAC for 1990 should the survey results be confirmed in the future.

SUMMARY SHEET - Redfish in Divisions 3LN

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	25	25	25	25	25	25	25	25	25	25	25
Agreed TAC	25	25	25	25	25	25	25	25	25	25	25
Actual landings	22	20	15	21	43	71	34		71	15	32
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Prior to 1985, averaged about 20,000 tons. The increased landings in recent years are related to increased effort in both divisions.

Data and Assessment: Catch-at-age data available, but SPA is not possible because the series is not yet long enough to enable calibration. Catch rates in both divisions show no trend with time but this may not be indicative of stock status. General production analyses are not possible because of the lack of trends in these data. Yield-per-recruit analyses done.

Fishing Mortality: No estimate available.

Recruitment: No estimate available.

State of Stock: Not possible to evaluate except in very general terms. Is sign of recruitment from the early-1980s in Div. 3N but not Div. 3L. Research survey results from the USSR suggest a decline in biomass of 50-70% from 1983 to 1988.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =	No information available	
F_{max} =		

Recommendation: TAC for 1990 be 25,000 tons.

Special Comments: General production analyses conducted in the past, yield-per-recruit analyses examined this year, and reference exploitation of the total trawling and acoustic biomass estimate from the 1988 USSR survey all indicate a yield of about 25,000 tons (with the exception of the F_{max} estimate from the 1988 survey (38,000 tons)).

SUMMARY SHEET - Silver Hake in Divisions 4VWX

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC	75	80	100	100	100	100	167	235	235	75	120
Agreed TAC	80	80	100	100	100	100	120	135	135	80	102
Actual landings	60	36	74	75	83[1]	62[1]	74[1]		83	36	58
Sp. stock biomass											
Recruitment (age)											
Mean F											

[1] Preliminary

Catches: 1988 catch of 74,000 tons was reduced slightly from a peak of 83,000 tons in 1986.

Data and Assessment: No analytical assessment was possible due to a lack of confidence in the results of calibrations using abundance indices from RV and standardized CPUE.

Fishing Mortality: Unable to determine.

Recruitment: Recruitment prospects for the 1986 (juvenile RV survey), 1987 and 1988 (July RV survey) year-classes are moderately good.

State of Stock: Unable to determine due to lack of confidence in the results of calibrations using abundance indices.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation:

Special Comments: Workshop on silver hake assessment data and analysis recommended as a prerequisite to new assessments.

SUMMARY SHEET - American Plaice in Division 3M

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	2	2	2	2	2	2	2	2	2	2	2
Agreed TAC	Same as recommended										
Actual landings	1.1	.9	1.3	1.7	3.8	5.6	2.8		5.6	1.1	2.6
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Ranged 600 and 1900 tons from 1974-85, then increased in 1986-87 as additional effort was directed on this stock. Catch declined in 1988, due to a reduction in fishing effort caused by a moratorium on cod fishing in Div. 3M.

Data and Assessment: No analytical assessment. Commercial data is scarce in most years. Information from USSR surveys (1983-88) and EEC survey (1988) used to evaluate stock status.

Fishing Mortality: No information available

Recruitment: No information available

State of Stock: Appears to be relatively stable around 10,000 tons as measured by USSR surveys, and the 1988 EEC survey.

Forecast for 1989: 2,000 ton TAC advised.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =	No information available	
F_{88} =		
F_{max} =		

Recommendation: 2,000 tons approximates the $F_{0.1}$ level.

Special Comments: Yield-per-recruit analysis used for American plaice in Div. 3LNO was assumed for this Div. 3M stock.

SUMMARY SHEET - American Plaice in Divisions 3L, 3N and 3O

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	55	55	55	49	55	48	28	30.3	55	28	46.9
Agreed TAC	55	55	55	49	55	48	40[1]	30.3	55	30.3	48.4
Actual landings	51	39	39	54	61	53	38		61	38	47.9
Sp. stock biomass(9+)	140	137	150	149	148	129	113		150	113	138
Recruitment (age)	210	199	171	185	210	213	218[2]		218	171	201
Mean F(9+wtd)	.40	.24	.28	.36	.40	.38	.31		.40	.28	.34

[1] Effective TAC was 33,585 tons.
[2] GM, 1974-87

Catches: Were highest in the late-1960s, with a peak of 94,000 tons in 1967. Were relatively stable in the 1970s around 50,000 tons. Decline in 1988 catch occurred throughout most fleets in the fishery.

Data and Assessment: Analytical assessment of catch at age using Adaptive framework with Canadian CPUE and RV survey data.

Fishing Mortality: Weighted 9+F increased from about 0.22 in 1977-80 to 0.35-0.40 in 1985-87, then declined to about .31 in 1988.

Recruitment: Relatively stable, although the year classes of the early-1980s appear slightly stronger than the preceding few.

State of Stock: Fully recruited (age 12+) population is at a low level, similar to that of the mid-1970s. 8+ population was relatively stable from 1983-86, but declined by about 12% in 1987 and 8% in 1988.

Forecast for 1989: (A) TAC of 30,300 tons, from 1988 $F_{0.1}$ (0.26) projection.
(B) Assuming 1989 catch = 40,000 tons.

(A)

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ = 0.26	24.9	152.3
F_{88} = .50	44.4	134.5
F_{max} = NA[1]	-	-

(B)

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ = 0.26	23.1	145
F_{88} = .50	41.4	128
F_{max} = NA[1]	-	-

[1] Not appropriate for this stock.

Recommendation:

Special Comments: Fishing pattern and mean weights observed in most recent years differ somewhat from long-term means, and yield-per-recruit analysis should therefore be reviewed at the June 1990 Meeting.

Response to specific request from the Fisheries Commission follows.

Flounders in Divisions 3L, 3N and 3O

With respect to flounders in Div. 3LNO, the Scientific Council was requested to: *provide advice on the impact of recent increased catches of American plaice and yellowtail flounder from areas described by the Council in its 1988 report as being nursery areas for these species.*

Advice should also be provided on management options that would reduce the extent of the impact on the potential yield if it is concluded that the changes in catch distribution are reducing the potential yield.

Catches of yellowtail flounder (ages 1-4) in the juvenile surveys continue to be greatest in the Tail of the Bank with a major portion taken in the Regulatory Area of Div. 3N.

Historically age 4 on average (1968-87) contributed 2.3% (by number) to the commercial catch. In 1988, 25.6% of the catch overall was age 4. About 45% of the catch numbers in the Regulatory Area was age 4.

Fish at age 3 have seldom occurred in the catch matrix. However, in 1988 they comprised 11.1% of the catch numbers in the Regulatory Area.

Fish at age 5 comprised 27.7% of catch numbers in the Regulatory Area. Age 5 fish comprised 2.8% in the Canadian zone.

In 1988, Canada removed 19.5 million fish for a catch of 10,544 tons. In the Regulatory Area, EEC-Spain removed 24.0 million fish or 23% more than Canada for a catch of 3,205 tons or 70% less than Canada. The average weight of yellowtail flounder in the Spanish catch was about one-fourth of the weight of a yellowtail flounder in the Canadian catch.

The 1984 and 1985 year-classes were predicted to be relatively strong. However, considering recent removals in the Regulatory Area, these have already been under heavy fishing pressure. Should this continue, the potential yield to the fishery will have been drastically reduced.

The spawning stock is now at the lowest observed level since 1970. Should fishing pressure continue at present levels on young fish, potential recruitment to the spawning stock could be seriously jeopardized.

Surveys for juvenile American plaice show that a high proportion of young American plaice were found in the Regulatory Area of Div. 3NO. Little information was available on the distribution of juvenile American plaice in the Regulatory Area of Div. 3L.

With the recent increase in American plaice catches by some fleets in the Regulatory Area in Div. 3NO there has been a shift in the age composition of the catch towards younger fish. In 1986-88, ages 8 and younger contributed 31% on average to the catch numbers from the stock compared to 13% on average from 1981-85.

The youngest age in the Spanish catch in 1988 was 3 year olds, compared with 6 year olds in the Canadian catch. The mean weight of an American plaice in the Spanish catch in 1988 was 0.56 kg compared to 0.71 kg in the Canadian catch.

The 1985 year-class appeared to be relatively strong from the Canadian juvenile surveys. However, in Div. 3N, most of that year-class was still found outside the 200-mile limit, and had already shown up in commercial catches in the Regulatory Area. Its contribution to the population (and fishery) in subsequent years would depend on the level of the fishery in the Regulatory Area on that year-class in 1989-91. The potential exists for a substantial reduction in yield-per-recruit if catches of this year-class are high in 1989-91.

The population size of the stock is currently as low as it has been in the past 15 years. This is particularly so for Div. 3N and 3O. The adult (or spawning stock) biomass is also at a relatively low level. Apart from the obvious benefits in yield-per-recruit, there should be a benefit in allowing a higher proportion of the recruiting year-classes to enter the spawning stock.

STACFIS noted that there were considerable data available from fall surveys on the distribution of juvenile American plaice and yellowtail flounder in Div. 3NO, including the Regulatory Area. In order to advise on management options such as closed areas or seasons to protect these nursery areas, STACFIS recommended that *a detailed analysis of these data be made, in conjunction with information on distribution of flounders in the commercial fishery.*

STACFIS noted that most of the reported fishing activity by Contracting Parties in the Regulatory Area was by EEC (Spain and Portugal) and that most of the juvenile American plaice and yellowtail flounder appeared to be in that area. STACFIS therefore noted that information on the location of fishing effort on flounders in the Regulatory Area, on as fine a scale as possible, should be made available to facilitate the analysis.

SUMMARY SHEET - Witch Flounder in Divisions 3N and 3O

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	5	5	5	5	5	5	5	5	5	5	5
Agreed TAC	5	5	5	5	5	5	5	5	5	5	5
Actual landings	4		3	9	9	8	6		3	9	6
Sp. stock biomass											
Recruitment (age)											
Mean F											

Catches: From 1970-84 catches ranged from 2,400 tons in 1980, 1981 to 9,200 tons in 1972. Since 1985 have exceeded the TAC by large margins.

Data and Assessment: Canadian catch rates in Div. 3O have declined since 1985 to level in 1988 near the lowest seen (1972) although based on few data. USSR survey biomass estimates were highly variable.

Fishing Mortality: Unknown

Recruitment: Unknown

State of Stock: Stock size cannot be firmly established, however, it is likely to be declining in recent years.

Forecast for 1990: Data insufficient to firmly advise any change in TAC.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation:

Special Comments:

SUMMARY SHEET - Yellowtail Flounder in Divisions 3L, 3N and 3O

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	23	19	17	15	15	15	15	5	23	5	15.5
Agreed TAC	Same as recommended										
Actual landings	12	9	17	29	31	16	15		31	9	18.4
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Peaked in 1972 at 39,000 tons, declined rapidly, and stabilized at 10-15,000 tons for most of 1970s and early-1980s. Were about double the TAC in 1985-86 as effort increased in the Regulatory Area in Div. 3N.

Data and Assessment: No analytical assessment possible. Data from Canadian catch rates, and Canadian and USSR surveys indicated a sharp decline in abundance from 1985 to 1989.

Fishing Mortality: Unknown

Recruitment: 1984 and 1985 year-classes are stronger than the three preceding, which Canadian surveys show to be the lowest from 1968-85.

State of Stock: Population of ages 6-8 in 1989 is the lowest in the 18 year series of Canadian surveys. Success of fishery in 1990-91 will likely depend on strength of 1984 and 1985 year-classes.

Forecast for 1989: 5,000 ton TAC advised for entire stock.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =	No information available	
F_{88} =		
F_{max} =		

Recommendation: 5,000 ton TAC advised for 1990

Special Comments: The Regulatory Area in Div. 3N contains a nursery area for yellowtail, with as much as 90% of some year-classes present in this area at younger ages.

Response to specific request from the Fisheries Commission is given in conjunction with the response to American plaice in Div. 3L, 3N and 3O (see pages 24 and 25).

SUMMARY SHEET - Greenland Halibut in Subareas 0 and 1

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	25	25	25	25	25	25	25	25	25	25	25
Agreed TAC											
Actual landings	5	4	7	9	9	10	12		4	12	8
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Most have been taken in the inshore fishery. The increased landings were mainly associated with the fishery expanding northward.

Data and Assessment: Results from two bottom-trawl surveys. No analytical assessment.

Fishing Mortality:

Recruitment:

State of Stock: The inshore component seems to be fully exploited while the exploitation level of the offshore component is very low.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation: See recommendation for Greenland halibut Subarea 2 and Div. 3K and 3L.

Special Comments: Stock identification study currently in progress.

SUMMARY SHEET - Greenland Halibut in Subarea 2 and Divisions 3K and 3L

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	55	55	55	75	100	100	100	100	100	55	75
Agreed TAC	55	55	55	75	100	100	100	100	100	55	75
Actual landings	26	28	25	19	16	27	18		16	28	23
Sp. stock biomass											
Recruitment (age)											
Mean F											

Catches: Peaked at 38,500 tons in 1978 and declined to an average of 20,000 tons since 1985.

Data and Assessment: No analytical assessment due to incomplete survey coverage.

Fishing Mortality: Unknown

Recruitment: The 1984-86 year-classes appeared to be relatively good with the 1985 year-class apparently strong. Only the 1984 year-class would likely contribute significantly to the 1990 fishery.

State of Stock: Stock biomass estimated in 1987 and 1988 to be about half that estimated in 1984 on which the TAC of 100,000 tons was recommended for 1986.

Forecast for 1990: A TAC of 50,000 tons would approximate fishing at $F_{0.1}$.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =	N/A	
F_{max} =		

Recommendation: STACFIS recommended that *attempts at an analytical assessment of that portion of the stock covered by the fishery and the surveys be considered for review at the June 1990 Meeting.*

STACFIS further recommended that *consideration be given to the biological and practical implications of combining Subareas 0, 1 and 2 and Divisions 3KL for stock assessment purposes when considering Greenland halibut.*

Special Comments:

SUMMARY SHEET - Roundnose Grenadier in Subareas 0 and 1

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	8	8	8	8	8	8	8	8	8	8	8
Agreed TAC	8	8	8	8	8	8	8	8	8	8	8
Actual landings	0.09	0.07	0.05	0.06	0.09	0.32	0.12		0.32	0.05	0.11
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Since about 1980, landings have been only as by-catch in the Greenland Halibut fishery.

Data and Assessment: No catch-at-age data available and no catch and effort data available for the recent period. Assessment was not possible at present.

Fishing Mortality: No estimate available.

Recruitment: No estimate available.

State of Stock: Not possible to evaluate. Research surveys by Japan and Greenland in 1987 and 1988 resulted in biomass estimates about 45,000 tons.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =	No information available	
F_{SS} =		
F_{max} =		

Recommendation: TAC for 1990 remain at 8,000 tons.

Special Comments:

SUMMARY SHEET - Roundnose Grenadier in Subareas 2 and 3

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	27	11	11	11	11	11	11	11	27	11	11
Agreed TAC	27	11	11	11	11	11	11	11	27	11	11
Actual landings	4	4	4	5	7	8	6		8	4	6
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Below 10,000 tons since 1978. Landings increased somewhat in recent years.

Data and Assessment: No catch-at-age data available. Catch and effort data did not suggest any trends in catch rates in recent years. General production analysis was not possible because of positive slopes between catch rate and effort.

Fishing Mortality: No estimates available.

Recruitment: No estimates available.

State of Stock: Not possible to evaluate. Catch rates have been stable in recent years with catches averaging about 6,000 tons.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{86} =	No information available	
F_{max} =		

Recommendation: TAC for 1990 remain at 11,000 tons.

Special Comments: Analyses presented do not indicate that the 10% Greenland halibut restriction resulted in depressed catch rates for roundnose grenadier.

SUMMARY SHEET - Wolffish in Subarea 1

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6			
Agreed TAC											
Actual landings	4	3	2	2	2	2	2		4	2	
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

Catches: Catches are composed of two species. The fishery is partly a small-scale directed fishery and partly a by-catch in the trawl fishery.

Data and Assessment: As more biological data and separate catch statistics for the two species are needed, no assessment was carried out.

Fishing Mortality:

Recruitment:

State of Stock:

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{SS} =		
F_{max} =		

Recommendation:

Special Comments:

SUMMARY SHEET - Capelin in Division 3L

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC		60	38	60	130	283	90	335	335	38	143
Agreed TAC	30	30	26	26	55	25	45	46	55	25	35
Actual landings	27	25	33	25	48	19	54		54	19	33
Sp. stock biomass[1] ('000 tons)		473	382	596	1300	2830	900	3345	3345	382	1404
Recruitment[2] (age 2) (10^9)	31.0	20.0	73.2	73.2	63.7	87.8	380.4		380.4	20.0	104.2
Mean F	Not available										

[1] Spawning stock biomass not measured. These were projected from acoustic estimates.
[2] Recruitment at age 2 in the year shown. Recruitment 1982-85 were projections from acoustic surveys. From 1986 to present, measured directly from acoustic surveys.

Catches: All catches are inshore and determined by market. The only market is Japanese roe market.

Data and Assessment: Inshore indices of abundance from catch rates and aerial survey. Projections from acoustic survey estimates of year-class abundance.

Fishing Mortality: Not estimated but very low. Recommended TACs based on exploitation rate of 10%. Catches were much lower than recommended TAC in recent years.

Recruitment: Estimated from acoustic surveys.

State of Stock: Highest biomass in 1980s due to two consecutive strong year-classes (1986 and 1987).

Forecast for 1990: High spawning biomass predicted because of strong 1986 and 1987 year-classes.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation: An exploitation rate of 10% of mature biomass would result in a TAC of 640,000 tons for 1990.

Special Comments: Actual TACs are determined by market forecast.

SUMMARY SHEET - Capelin in Divisions 3N and 3O

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	-[1]	0	0	0	0	10	10	28	28	0	6
Agreed TAC	0	0	0	0	0	10	15	28	28	0	7
Actual landings	0	0	0	+	0	1	6		6	0	1
Sp. stock biomass[2]	419	244	85	169	522	227	544		544	85	316
Recruitment (age)		No estimates									
Mean F		No estimates									

[1] No STACFIS advice.
[2] In some years these were averages of USSR and Canadian surveys and in other years, only Canadian estimates were available.

Catches: Peak catches in 1975 of 132,000 tons. Fishery was closed during 1979-86.

Data and Assessment: Acoustic surveys of the spawning stock.

Fishing Mortality: No information.

Recruitment: No direct estimates of recruitment but patterns of year-class strength appeared to be similar to Div. 3L stock.

State of Stock: Mean stock size 1981-88 was about 300,000 tons. USSR acoustic surveys during 1975-77 indicated mean biomass of 912,000 tons.

Forecast for 1990: If 1986 and 1987 year-classes are strong in this stock, as they are in Div. 3L, spawning stock should increase in 1990.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation: An exploitation rate of 10% of the mature biomass would indicate a catch of 30,000 tons in 1990.

Special Comments:

SUMMARY SHEET - Squid in Subareas 3 and 4

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC ('000 tons)	150	150	150	150	150	150	150	150	150	150	150
Agreed TAC	150	150	150	150	150	150	150	150			
Actual landings	13	+	1	1	+	2[1]	1[1]	-	13	+	3

Sp. stock biomass

Recruitment (age) No information available

Mean F

[1] Provisional data.

Catches: Peaked in 1978 at 162,000 tons and have declined to less than 2,000 tons since 1982. Currently a by-catch fishery.

Data and Assessment: Only commercial fishery data available for recent years.

Fishing Mortality: No information available.

Recruitment: No information available.

State of Stock: Dependent on one year-class only, low stock level in recent years.

Forecast for 1990:

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =		
F_{max} =		

Recommendation:

Special Comments:

SUMMARY SHEET - Shrimp in Subareas 0 and 1

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC[1] ('000 tons)	29.5	29.5	29.5	36	36	36	36	-	36	29.5	33.2
Effective TAC[1]	34.8	34.6	34.9	42.1	42.1	40.1	40.1	45.3	45.3	34.6	39.3
Actual landings[2]	44.3	46.8	43.4	54.0	63.1	67.1	65.0	-	67.1	43.4	54.8
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

[1] TACs for offshore fishery in Subareas 0 and 1 (south of 71°N). Effective TACs for Division 1A between 71°N and 72°52'5"N were 11,500 tons for 1987 and 1988 and 8,000 tons for 1989.

[2] Including inshore catches in Subarea 1 of about 7,500 tons each year and catches in Subarea 1 north of 71° of about 4,300, 11,000, 10,600 and 6,700 tons in 1985, 1986, 1987 and 1988 respectively.

Catches: Increased to about 50,000 tons in 1976, decreased to about 35,000 tons in 1978 and 1979 and increased again to about 65,000 tons in 1986 to 1988.

Data and Assessment: General biological data and fishery data. No analytical assessment.

Fishing Mortality: No information available.

Recruitment: No information available.

State of Stock: No information available

Forecast for 1990: Data insufficient to provide a forecast.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ = 0.15		
F_{88} = 0.36	No information available	
F_{max} = 0.25		

Recommendation: Catches in 1990 should not be allowed to exceed the present level (50,000 tons) in the offshore grounds in Subarea 1 south of 71°N and the adjacent parts of Subarea 0.

Special Comments:

SUMMARY SHEET - Shrimp Stock in Denmark Strait

Source of Information:

Year	1982	1983	1984	1985	1986	1987	1988	1989	Max	Min	Mean
Recommended TAC	4,200	4,200	4,200	5,000	-	-	-	10,000	10,000	4,200	5,520
Effective TAC[1]	4,500	5,725	5,245	6,090	7,225[2]	7,225[2]	8,725[2]	9,025[2]	9,025	4,500	6,720
Actual landings	4,902	4,175	6,731	8,110	10,964	12,178	12,549	-	12,549	4,175	8,515
Sp. stock biomass											
Recruitment (age)	No information available										
Mean F											

[1] On Greenland side of midline only.

[2] Not including Greenland fishery north of 66°30'N.

Catches: Increased from less than 400 tons in 1978, when the fishery began, to about 12,500 in 1988.

Data and Assessment: General biological data and fishery data. No analytical assessment.

Fishing Mortality: No information available.

Recruitment: No information available.

State of Stock: Biomass estimate of about 50,000 tons in 1988. No evident influence of fishery on mean size of dominant female component.

Forecast for 1990: No prediction.

Option Basis	Predicted catch (1990)	Predicted SSB (1.1.1991)
$F_{0.1}$ =		
F_{88} =	No information available	
F_{max} =		

Recommendation: TAC of 10,000 tons advised for a few years as precautionary measure.

Special Comments:

The Management Policy at East Greenland of Separate Quotas for the Areas Outside the Main Fishing Area.

From a biological viewpoint, there were no immediate concerns over exploratory fishing for shrimp in entirely new areas except that the effects on the redfish stocks should be monitored. However, exploratory effort should be well separated by distance or depth from the supposed area of distribution of the traditionally exploited stock. After reviewing in detail the distribution of fishing effort in the area and the results of the 1988 research survey, it was agreed that the coordinates provided at the June 1988 meeting should be revised to reflect more accurately the area of distribution. Therefore, any new exploratory effort should be avoided within the area delimited on the north by 68°N from the Greenland coast to 23°W, on the south by 65°N from the Greenland coast to 30°W, and on the east by a line between 65°N 30°W and 68°N 23°W (Fig. A), to avoid the possibility of additional fishing pressure on the stock.

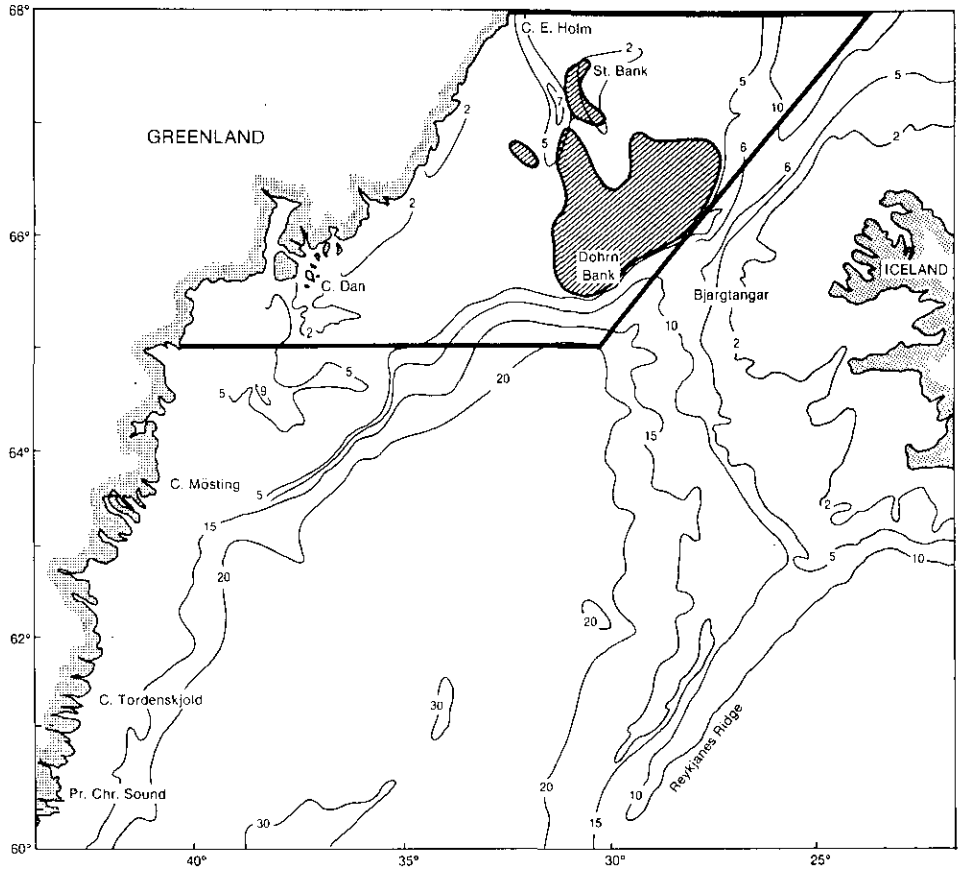

Fig. A. Shrimp fishing grounds in Denmark Strait estimated area of stock distribution.

The Possible Effect on Conservation of Shrimp as a Consequence of the Ice Coverage of the Water.

STACFIS agreed that it was difficult to determine the implications of ice coverage on conservation of shrimp. If shrimp were by some mechanism densely concentrated near the ice edge, then higher removals could be obtained at higher catch rates. On the other hand ice coverage might provide some protection for such concentrations if it restricted fishing in the area at the time. The collection of data and evaluation of those conditions would be difficult and compounded by factors such as the distribution of the stock over time, the variability in ice coverage and the possible influence of ice on shrimp distribution. However, if ice cover did not affect total removal then the stock would be unaffected.

4. Environmental Research

The Council noted that the Environmental Subcommittee had met on June 13 and that M. Stein had been elected Chairman for a 2-year term, effective September 1988. The Subcommittee had received a report on the World Ocean Climate Experiment from the Director of the International Planning Office for WOCE, and reports on a wide range of environmental activities and results. The full report of the Subcommittee is given in the STACFIS Report (Appendix 1, Annex 1).

5. Ageing Techniques

The Council noted that further ageing comparisons between national experts had been recommended by STACFIS for silver hake and American plaice and endorsed the proposals. The Council was pleased to learn that arrangements for the meeting in Iceland concerning shrimp ageing were proceeding well and also that agreement in age reading between national experts was now at a satisfactory level for Greenland halibut.

6. Gear and Selectivity

The Council received from STACFIS, reports on comparison between selectivity of square mesh and diamond mesh codends and on the escapement of groundfish beneath the footrope of otter trawls.

7. Review of Scientific Papers

The Council noted that four research papers which were not directly related to stock assessment were reviewed and summarized separately.

8. Other Matters

a) Review of Current Arrangements for Conducting Stock Assessment

The Council agreed with STACFIS, that the current arrangements for conducting stock assessments and the meeting facilities and computing arrangements at the new NAFO Headquarters were satisfactory, and noted that there was considerable usage of the Secretariat computers.

b) Special Session in September 1989

The Council noted that 15 papers had been submitted to date and that STACFIS hoped additional contributions might be forthcoming for the September, 1989 Special Session on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic over the Last 30 Years, and Their Possible Causes" with M. Forgarty (USA) as convener.

c) Special Session in September, 1990

As agreed at the September 1988 meeting of the Scientific Council, the Chairman of STACFIS had approached possible candidates to convene the Special Session in September 1990. The Council welcomed the news that J. Shepherd (Lowestoft, U.K.) had agreed to be the convener.

d) Workshop on Age Determination of Shrimp

The Council was pleased to note that 10 papers had been announced so far and that a dozen scientists had indicated their interest in participating in the workshop to be convened by U. Skúladóttir (Iceland). The sessions would be chaired by D. Parsons (Canada).

e) Special Session in September 1991

The Council deferred the selection of a topic for the September 1989 meeting.

f) Workshop on Silver hake

The Council endorsed the STACFIS recommendation for a workshop to be convened early in 1990, to consider assessment data and analyses. It was noted that the workshop might result in a request of a special meeting of the Scientific Council before the silver hake fishery began in 1990.

III. RESEARCH COORDINATION (See STACREC report, App. II)

1. Fishery Statistics

a) The Council noted with concern that the timeliness of the submission of STATLANT 21A and 21B statistical data reports was getting worse rather than better. That meant that the most recent catch and effort data were often not available for stock assessment. That also meant the severe delay of the publication of the Statistical Bulletin and the availability of confirmed data for use as required by the scientists.

b) The Council endorsed the STACREC recommendation that NAFO be represented at the 14th Session of the Coordinated Working Party on Fishery Statistics (Miami, February 1990) by the Chairman of STACREC, the Assistant Executive Secretary, and a nominee from Cuba.

c) The Council accepted the proposal by STACREC that for the purposes of statistical reporting, the parts of Subdivision 5Ze as effectively divided by the Canada/USA boundary, should be treated as separate units ('5Zc' and '5Zu'), even though they were not formally described as such in Annex III to the Convention. The data were already being requested separately in the STATLANT reports. The Council agreed that statistical publications should reflect this with footnotes to indicate that the sum of the two data sets are compatible with historical data for Subdivision 5Ze. The Council also agreed both to a refinement of the NAFO map to more accurately reflect the status of 5Zc and 5Zu, and to call attention to the need to include the changes made by the General Council in the boundary between Division 5Y and Division 4X, when any new charts were produced by domestic authorities.

The Council discussed the more general question of reporting statistics separately for waters within the Regulatory Area and for Convention waters under coastal state jurisdiction. It was considered that it would be desirable that statistics be reported separately in that manner for Divisions 3LNO.

The Council reviewed the possible options available to establish such a data reporting scheme and it was agreed to request the Executive Secretary for advice, preferably in the form of a SCS document referring to the relevant sections in the Convention, in anticipation of the Scientific Council bringing the matter to the attention of the General Council or the Fisheries Commission.

2. Biological Sampling

The Council took note that similar to the situation at the June 1988 meeting, the data from Canada (Gulf) were not available.

3. Biological Surveys

The Council noted that STACREC was presented with the compilation of biological surveys carried out in 1988 and of those planned for 1989 and early 1990 and noted the lack of information from Canada (Gulf).

4. Review of Initiatives With Respect to the Annual Scientific Program

The Council had little to report on the Fisheries Commission's request for a review of initiatives taken under the Annual Scientific Program. The information on statistical reporting and sampling coverage that was reported in 1988 remained valid. A research cruise on the Flemish Cap was carried out by the EEC in 1988, and this was expected to be repeated. The most significant element of any review of the databases was, however, the deterioration in the timeliness of submission of data and the Council reiterated its concern about this and urged Contracting Parties to give special attention to reporting procedures.

5. Other Matters

The Council took note of STACREC's discussion of the preparation of the List of Fishing Vessels for 1989 and of reports of tagging activities.

IV. PUBLICATIONS (see STACPUB report, App. III)

1. Review of Scientific Publications

The Council was informed that Volume 8 of the Journal was published in December 1988, and that Volumes 9(1) and 9(2) were expected to be issued in summer, 1989 and by December 1989 respectively.

In addition, Studies No. 13 would be issued in late summer 1989.

2. Promotion and Distribution of Scientific Publications

The Council agreed to maintain two series of scientific publications, Journal and Studies. While the Journal would be maintained as a high standard scientific journal with refereed submissions, it was felt that papers for Studies should be handled quickly with attention to editorial presentation only. Further analyses of data should not be required unless the author(s) wish to do so of their own accord. In that way, issues could be produced reasonably quickly which could highlight special papers considered during the Scientific Council's proceedings.

3. Editorial Matters

The Council was informed that the arrangements established last year for editing submissions for the Journal (see NAFO Sci. Coun. Rep., 1987, page 100 and 102) were functioning satisfactorily.

It was noted that Dr. Colebrook had resigned as Associate Editor for Biological Oceanography. Appointment of a new Associate Editor would be considered at the September 1989 Meeting of the Scientific Council.

The Council noted that Journal subscriptions have remained relatively stable over the last 5 years, and agreed with the STACPUB proposal that in the further interests of promoting the Journal, the Assistant Executive Secretary look into the possible steps of improving its appearance.

The Council endorsed STACPUB's view that invitational papers be given a special status depending on the volume and content.

The Council noted the fruitful discussions with three of the Journal's Associate Editors in attempting to develop guidelines to overcome problems of maintaining consistent criteria for judging and editing papers.

4. Papers for Possible Publication

The response of authors to invitations to upgrade Research Documents for publication so far was relatively low for 1988. However, the positive response for papers nominated in 1987 was high at 73%.

Consideration by STACPUB of research papers submitted in 1989 as well as those submitted in 1988 but were not previously evaluated, resulted in 13 papers being identified as suitable for the Journal or Studies.

5. Microfiche Projects

The Council noted that 12 sets of ICNAF Microfiche had been sold but that eight more sets would have to be sold before the ICNAF microfiche project breaks even economically.

The Executive Secretary was requested to make whatever progress was possible with microfiching NAFO documents, should opportunities arise with annual budgets. However, the decision was confirmed that a specific sum should not be requested in the publications budget for this item until the ICNAF microfiche project breaks even.

6. Other Matters

The Council expressed its appreciation to Dr. Colebrook for his work as Associate Editor.

V. RULES OF PROCEDURE

The Council noted the present shortcomings in the method by which the Executive Secretary should obtain proxy votes of abstention and considered a resolution to rectify those

shortcomings. Regarding the provisions of Subparagraph 3.c of Rule 2 of the Rules of Procedure, which specifies that the Chairman should identify the Contracting Parties from which the Executive Secretary shall seek authorization to cast a vote of abstention, should that Contracting Party not otherwise be represented at the meeting, the Council by adopting the resolution, recommended that *in this regard the Executive Secretary routinely approach Contracting Parties who do not regularly send representatives for the full period of the relevant meeting of the Scientific Council.*

VI. COLLABORATION WITH OTHER ORGANIZATIONS

1. Consideration of NAFO Participating in ICES Working Group on Seals

The Chairman informed the Council that he had written to ICES for more details on the Working Group's activities and the modalities of referrals for advice, but had not received a response. It was noted that interest in this Working Group remained strong, should the uncertainties in modalities and subject matter be resolved.

2. Fourteenth Session of CWP, February 1990

The Council noted that the *ad hoc* interagency consultation held in October 1988 reviewed developments since the last CWP meeting and drew up a provisional agenda for the 14th Session of CWP to be held in Florida, during 5-9 February 1990. The Council endorsed the STACREC proposal and recommendation for NAFO representation at that meeting.

VII. ADOPTION OF REPORTS

The Council adopted the reports of the Standing Committees as presented by the respective Chairmen on 21 June 1989 (see Plenary Sessions).

VIII. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting and Special Session in September 1989

The Council would meet in conjunction with the Annual Meeting of NAFO in Brussels, Belgium during 11-15 September, 1989. The meeting would be preceded on 6-8 September, 1989 by the Special Session on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic over the Last 30 Years, and Their Possible Causes".

The Council noted that only 3 of 15 papers so far submitted were from European countries. Since the meeting would be held in Brussels, the Council expressed hope there would be good attendance of scientists from European Communities, along with additional contributions.

2. Scientific Meeting in June 1990

The Council reviewed its earlier tentative dates of the June 1990 meeting when the Council would meet together with its Standing Committees and Subcommittee during 6-20 June 1990. The meeting would deal with requests for scientific advice on fisheries management and with other fishery related research and statistical activities.

3. Special Session and Annual Meeting in September 1990

The Council recognized that the Scientific Council Meeting in conjunction with NAFO Annual Meeting is scheduled for 10-14 September 1990, and reaffirmed its earlier tentative decision that a special session be held then. The dates for the session would be determined at the September 1989 Meeting of the Scientific Council. The Session on "Management Under Uncertainties Related to Biology and Assessments, With Case Studies on Some North Atlantic Fisheries" would be convened by J. Shepherd.

4. Workshop on Age Determination of Shrimp

The Council noted that arrangements for the meeting in Reykjavik, Iceland had progressed well. The Council hoped that a reasonable review of the state of the art of ageing and assessments would be achieved at the workshop.

5. Workshop on Silver Hake

The Council noted that a workshop on Silver hake was planned for early 1990. The meeting

would be to address the disagreements and doubts which persist about many of the input data and analyses. The Council agreed that, should the workshop recommended by STACFIS resolve the questions related to the variability in the data, the Scientific Council would be in a position to assess the stock early in 1990, if a special meeting would be called for that purpose.

IX. NOMINATION OF OFFICERS

1. Officers for 1989-91

At the opening session the Council had agreed that Sv. Aa. Horsted would solicit views of representatives of the Contracting Parties regarding potential candidates for the offices open for election. It was noted that the office of STACFIS Chairman had been filled by the election of H. Lassen (Denmark-Greenland) for the September 1988-September 1990 period. Mr. Horsted reported that although some progress was made, it would be perhaps appropriate to postpone the election of officers until the September 1989 Meeting. The view was expressed that a postponement would provide adequate time for representatives to develop firm proposals, recognizing that the usual practice of the Council was to nominate one candidate per office. The Chairman expressed his preference that the Scientific Council officers should continue the practice of holding office for only one term. It was also brought to the attention of the Council that there was no longer a quorum at this meeting, thus precluded the possibility of an election by vote.

Nevertheless, B. Jones (EEC) was nominated for the office of Chairman of Scientific Council, with a specific request that the nomination be recorded in the meeting report in order that the candidate could prepare to attend the September 1989 Meeting.

The Council agreed that further discussion on the election of officers be postponed to the September 1989 Meeting of the Scientific Council.

X. ADJOURNMENT

There being no further business, the Chairman thanked the chairpeople for their hard work, and the other participants for their contributions, and then paid special attention to the contribution of the Secretariat to the work of the Council.

APPENDIX 1. REPORT OF STANDING COMMITTEE ON FISHERY SCIENCE (STACFIS)

Chairman: H. Lassen Rapporteurs: Various

The Committee met at NAFO Headquarters, Dartmouth, Nova Scotia, Canada, 7-21 June 1989, to consider and report on matters that were referred to it by the Scientific Council, particularly with regard to provision of scientific advice on the management of certain finfish and invertebrate stocks (see Agenda). Representatives attended from Canada, Cuba, (12 June onwards), Denmark (Greenland), EEC, Iceland, Japan and USSR (12 June onwards) and an observer from the USA.

Various scientists assisted in the initial preparation of draft reports that were considered by the Committee (Sections I-III and V-VIII). The report of the Subcommittee on Environmental Research (Chairman: M. Stein) is summarized in Section IV and given in detail in Annex 1 below.

I. GENERAL REVIEW

1. Provisional Catch Data

Provisional nominal catch data for 1988, submitted to the Secretariat in STATLANT 21A reports, were insufficient for the Secretariat to compile the Summary Document to present the provisional nominal catches to the Scientific Council. Data were not available for EEC-France (Metropolitan), France (St. Pierre and Miquelon) and Faroe Islands.

The Committee agreed that a table containing provisional nominal catches for 1987 and 1988, with indications of its deficiencies, be included in its report. The tabulation of provisional data for 1988 in SCS Doc. 89/21 became possible in November 1989 when STATLANT 21A reports from EEC-France (M) and France (SP) were submitted to the Secretariat. Those data along with charter vessel data from Faroe Islands were included in the compilation of Table 1 (Table 1 and its accompanying text was prepared by the Secretariat for this issue.)

Table 1. Provisional nominal catches (000 tons) by subarea for 1987 and 1988. (+ indicates less than 500 tons.)

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
Cod	+	-	19	61	58	59	303	303	173	158	39	47	+	+	592	628
Haddock	-	-	-	-	-	-	9	11	18	16	8	9	+	+	35	36
Redfishes	-	-	1	1	3	1	133	95	57	54	2	1	-	+	196	153
Silver hake	-	-	-	-	-	-	+	+	62	74	12	11	4	5	78	91
Red hake	-	-	-	-	-	-	+	+	1	+	2	1	+	+	3	2
Pollock	-	-	-	+	-	-	6	5	44	41	24	17	+	+	74	63
American plaice	-	-	+	-	+	+	64	47	15	12	4	3	+	+	83	63
Witch flounder	-	-	-	-	1	+	13	12	6	6	3	3	+	+	23	21
Yellowtail flounder	-	-	-	-	-	-	17	15	2	1	6	4	+	+	25	21
Greenland halibut	+	+	10	10	15	6	14	13	11	8	-	-	-	-	50	36
Other flounders	-	+	+	+	+	+	4	6	8	7	14	13	10	12	36	38
Roundnose grenadier	-	+	+	+	1	1	8	6	-	-	-	-	-	-	9	7
White hake	-	-	-	-	-	-	10	4	15	9	6	6	+	+	31	19
Wolffishes	-	-	2	2	+	+	2	1	1	1	1	1	-	-	6	6
Other groundfish	-	-	3	3	+	+	2	2	6	4	16	14	6	6	33	28
Atlantic herring	-	-	-	-	+	+	20	16	221	254	40	40	+	1	281	311
Atlantic mackerel	-	-	-	-	+	-	10	4	14	20	4	5	32	38	60	67
Atlantic menhaden	-	-	-	-	-	-	-	-	-	-	15	20	302	252	317	272
Other pelagics	-	-	-	-	-	-	1	2	1	1	6	4	8	8	16	15
Capelin	-	-	+	+	29	17	32	90	1	5	-	-	-	-	62	111
Other finfish	-	-	1	2	2	1	33	27	9	17	9	9	22	21	76	76
Squids	-	-	-	-	-	-	1	+	+	1	5	11	17	11	23	22
Clams	-	+	-	-	-	-	-	-	15	7	49	47	325	311	389	365
Scallops	-	-	+	-	+	+	1	8	16	33	103	94	68	54	188	190
Other molluscs	-	-	-	-	-	+	+	+	3	2	26	35	53	44	82	81
Shrimp	2	6	71	59	3	9	+	2	12	14	5	3	+	1	93	95
Crabs	-	-	-	-	+	+	6	9	21	22	3	4	34	36	64	71
Lobsters	-	-	-	-	-	-	1	1	35	39	19	20	2	2	57	62
Other invertebrates	-	-	-	-	-	-	-	-	+	+	1	3	1	1	2	4
Total	2	6	107	138	112	95	690	678	767	806	422	425	884	803	2984	2952

2. General Trends for the Northwest Atlantic

tons. The total "groundfish" catch which represented 41% of the overall catch in 1988, was 5% less than in 1987 (1.27 and 1.21 million tons in 1987 and 1988 respectively). Significant decreases were noted for redfish (22%), pollock (15%), American plaice (24%), Greenland halibut (28%) and white hake (39%) and increases noted for cod (6%) and silver hake (17%). The total "pelagic fish" catch, which represented 23% of the overall catch in 1988 decreased only slightly (1.3%) from 674,000 tons in 1987 to 665,000 tons in 1988, although herring increased (11%), menhaden decreased (14%). The total "other finfish" catch which represented 6% of the overall catch in 1988, increased by 36% from 138,000 tons in 1987 to 187,000 tons in 1988, due entirely to an increase (79%) in the capelin catch. The total catch of "invertebrates", which represented 30% of the overall catch in 1988 decreased very slightly (1%) from 898,000 tons in 1987 to 890,000 tons in 1988. Increases were noted for crabs (11%) and lobster (9%) but these were offset by a decrease in clams (6%).

3. Fishery Trends by Subarea

a) Subarea 0

The total nominal catch (from STATLANT 21A forms) of all species in 1988 was 6,000 tons, 200% higher than the 2,000 tons reported in 1987. The catch consisted mainly of shrimp.

b) Subarea 1

The total catch of all species increased (29%) from 107,000 tons in 1987 to 138,000 tons in 1988, due mainly to an increase (221%) in cod. Cod and shrimp were the dominant species with 44% and 43% of the catch respectively and Greenland halibut (7%) the next highest.

c) Subarea 2

The total nominal catch of all species decreased significantly (15%) from 112,000 tons in 1987 to 95,000 tons in 1988. This was due to decreases in Greenland halibut (60%) and capelin (41%), although increases were reported for cod (2%) and shrimp (200%) which reported 3,000 tons in 1987 and 9,000 tons in 1988.

d) Subarea 3

The total catch declined (2%) to 678,000 tons in 1988 from 690,000 tons in 1987. This was due mainly to a decrease (11%) in groundfish which accounted for 77% of the total catch. Decreases were noted for redfishes (29%), American plaice (27%) and white hake (60%). *Pelagic species* declined (29%) due to decreases in herring (20%) and mackerel (60%). Finfish increased 80% due mainly to an increase in capelin (181%), which was partially offset by a decrease in "other finfish" (18%). Invertebrates increased significantly due to increased catches of scallops (1,000 tons to 8,000 tons) and crabs (6,000 to 9,000 tons).

e) Subarea 4

The total nominal catch of all species increased (5%) from 767,000 tons in 1987 to 806,000 tons in 1988. Decreased catches were noted for cod (9%), redfishes (5%), pollock (7%) and flounders (19%), while silver hake increased (19%). There was an increase (17%) in pelagic catches due mainly to herring (15%) and mackerel (43%). Finfish increased (120%) due mainly to increases in "other finfish" (89%) and invertebrates increased (16%) due mainly to increases in scallops (106%) and lobster (11%), although clams decreased (53%). Cod (20%) and herring (32%) continue to be the most significant components of the catch, followed by silver hake (9%), redfishes (7%), pollock (5%) and lobster (5%).

f) Subarea 5

The total nominal catch increased very slightly (1%) from 422,000 tons in 1987 to 425,000 tons in 1988. There were increases in pelagics (6%) and invertebrates (3%) due mainly to increases in menhaden (33%) and "other molluscs" (35%) but these were offset by decreases in scallops (9%). Groundfish catches decreased (5%) due to decreases in pollock (29%) but this was offset by an increase in cod (21%).

g) Subarea 6

The total catch decreased (9%) from 884,000 tons in 1987 to 803,000 tons in 1988.

Decreases were noted for pelagic species (13%) and invertebrates (8%) while groundfish species increased (15%) from 20,000 tons in 1987 to 23,000 tons in 1988. The major decreases were for menhaden (17%), clams (4%), scallops (21%) and "other molluscs" (17%). Increases were noted for mackerel (19%) and crabs (6%).

4. Review of Relevant Recommendations from the 1988 Meetings

The Chairman noted that the Secretariat in NAFO Circular Letters 89/08 and 89/20, provided a list of recommendations from 1988. Those pertinent to STACFIS were addressed under the corresponding agenda items.

5. Tuning Methods to Calibrate Terminal Fs

In response to the Scientific Council recommendation in September 1988 (*NAFO Sci. Coun. Rep.*, 1988, pages 108-114), the Committee considered two oral presentations on this subject.

a) Introduction

Estimation of stock size and fishing mortalities from catch-at-age data require additional information on stock sizes over time. Such additional information are in most cases obtained from CPUE data series from either research vessels or from commercial fleets. One way for a formal integration of those time series with catch-at-age data into a unified analysis framework has been coined "tuning".

The tuning process begins with a specification of how a particular CPUE index should be interpreted in terms of abundance. The index may account for the number of fish of a specific age group, e.g. research vessel surveys; or the CPUE index might represent the fishable biomass, e.g. CPUE data from commercial fisheries.

A sequential population analysis (SPA) on catch-at-age data provides stock sizes and fishing mortalities. These estimates depend on stock numbers in the terminal year and natural mortality. From the SPA stock sizes, it is possible to calculate what the CPUE index should have been. "Tuning" is to manipulate terminal stock numbers in the SPA until the SPA calculated CPUE index match the observed CPUE index.

b) Tuning SPA with the Adaptive Framework - ADAPT

Tuning fisheries models (SPA) to available data requires the adoption of tuning criteria. Recently, many Canadian stocks assessed by the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) have been analyzed using a least squares criterion for tuning. This criterion is chosen because it is well studied. The model formulation specifies a set of relationships between input SPA parameters, i.e. population numbers-at-age in the terminal year, and one or more observed indices of population abundance. This requires the simultaneous estimation of one or more catchability parameters for each of the given indices. While age-aggregated formulations are possible (e.g. 5+ survey numbers *vs* 5+ SPA or CPUE *vs* fishable biomass), the estimation of age-by-age calibration coefficients is more commonly done. When tuning with a single index (e.g. research vessels survey or CPUE series), the residuals can either be weighted by the reciprocal of the standard errors of the index or a log transformation can be used to reduce the variability. However, when more than one index is utilized, the respective standard errors are needed to weight the resulting residuals appropriately.

The validity of the tuning is judged on the residuals (i.e. the difference between the fitted and the observed pattern over time) if the tuning is successful.

ADAPT is largely a rationalization of several methods used in the past for tuning SPA. ADAPT represents a unified approach which is more open to vetting and performance analysis than many methods which have been used previously. A more detailed description of ADAPT can be found in CAFSAC Research Document 88/29 by Gavaris.

6. Review of New Format of Report

STACFIS noted that 'Summary Sheets' prepared by the Committee during the June 1988 Meeting had been positively received by the Fisheries Commission and the Scientific Council had agreed to utilize this format at this meeting. STACFIS agreed to supply these for all stocks for the Report of the Scientific Council.

II. ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 89/21, 22, 23, 24, 30, 32, 33, 49, 69; SCS 89/02, 14)

a) Introduction

The fishery for cod in Subarea 1 is partly an offshore fishery carried out by large trawlers, and partly a coastal and fjord fishery, in which the main part of the landings usually is taken by pound nets.

During the 1955-68 period, when the major part of the catch was taken by non-Greenland vessels, catches fluctuated between 234,000 and 451,000 tons (1962). Catches declined gradually after 1968 to a low of 33,000 tons in 1976, after a number of years of recruitment failure. Recruitment of the very abundant 1973 year-class in 1976-77 resulted in increased catches up to 1979. During 1980-83, catches fluctuated between 53,000 and 63,000 tons but decreased thereafter by about 50% each year to a low level of only 6,600 tons in 1986, the lowest catch on record since ICNAF began compiling statistics. Catches and TACs in recent years are given in Table 2.

Table 2. Cod in Subarea 1: catches and TACs for the entire area and catch-per-unit-effort for Greenland trawlers (500-999 GRT) in Div. 1D and 1E.

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Trawler	57	16	14	29	42	20	7	1	6[1]	41[1]	
Other vessels	42	38	39	27	21	13	8	6	13[1]	20[1]	
Total (000 tons)	99[2]	54[2]	53	56	58	33	15	7	19[1]	61[1]	
TAC (000 tons)	-[3]	20[4]	50	62	62	68	28.3	12.5	12.5	53	90
CPUE (tons/hr)	2.38	1.24	3.26	2.21	1.36	0.99	0.7	-	1.68[1]	2.86[1]	

[1] Provisional data.
[2] Estimates used for assessments.
[3] Catches limited to Greenland fishery and to by-catches.
[4] Quota for offshore fishery only.

After 1987 when no directed trawl fishing was allowed in the first ten months, fishing by trawlers was allowed in 1988 under quotas set by the Greenland Home Rule authorities.

The nominal catch in 1988 was about 61,000 tons, i.e. more than a trebling of that in 1987 and nearly ten times the record-low catch of 1986. The increase in 1987 and in 1988 reflects the recruitment of the very abundant 1984 year-class.

In 1987, a new statistics program was introduced for vessels below 80 GRT. This program supplied statistics of the landings by Division, gear, month, and size group for cod (above or below 55 cm). In 1988, this program covered 80% of the landings from those vessels. The remaining part was broken down by Division and month only. The ICES Working Group on Cod Stocks off East Greenland used this information to set up a table of catches in 1988 by gear and Division (SCR Doc. 89/49, table 6.1.2) when it met in February 1988.

b) Input Data

i) Commercial fishery data

Age composition. The catch statistics from the fisheries by Greenland now supply information on the gear used. The breakdown of catches by gear improved accuracy when converting catch by weight into catch by number. Further, more biological samples were taken in 1988 than in 1987.
The trawl fishery was well sampled in the first half of the year, while catches from the last two quarters were raised according to samples from December 1988 and January 1989. Pound nets and handlines were well sampled, whereas gillnets and longliners were covered by few samples only.

Trawl catches in the first quarter from Div. 1F were dominated by age-groups 4 (60%), 7, and 9, whereas in Div. 1D and 1E, catches were almost exclusively age 4 (95%). For the last two quarters, age group 4 dominated in all Divisions (80-90%), but in Div. 1C, 1D, and 1F, age group 3 was also well represented. Longline catches were dominated by the 1984 year-class, the remainder being older cod. Pound net and handline catches were heavily dominated by the 1984 year-class (more than 90% by number).

There seems to have been a high discard of fish below the Greenland minimum landing size (40 cm), mainly fish of the 1985 year-class.

The 1984 year-class accounted for about 90% (by number) of the nominal catch in 1988 (SCR Doc. 89/49, Tables 6.2.1 and 6.2.2). In terms of catch by weight, the year-class accounted for about 86% of the landings.

Among the older year-classes, only the 1979 year-class is of any importance in the total catch (4% by weight).

Weight-at-age data. In the 1979-85 period, mean weight-at-age decreased, but increased again in 1986 and 1987, only to decrease in 1988. Overall mean weight in the fisheries decreased slightly to 1.14 kg.

ii) Research data

Groundfish surveys by the Federal Republic of Germany. Stratified-random bottom trawl surveys off West Greenland have been conducted in late autumn since 1982. Cod biomass and abundance estimates for the total survey area off West Greenland on the basis of the swept-area and a catchability factor of 1 are given in Table 3. See Section d for a discussion of these estimates and SCR Doc. 89/49 for details on the surveys.

Table 3. Cod in Subarea 1: estimate of total biomass and abundance (with 95% confidence intervals) and mean weights from autumn surveys off West Greenland, 1982-88.

Year	Total biomass (tons)	Total abundance ('000 tons)	Mean Weight per fish (kg)
1982	179,934 ± 37.0%	109,039 ± 36.1%	1.65
1983	98,843 ± 28.5%	59,362 ± 26.5%	1.67
1984	24,945 ± 39.7%	16,104 ± 39.1%	1.55
1985	31,860 ± 60.1%	52,466 ± 33.3%	0.61
1986	76,220 ± 30.8%	134,716 ± 31.8%	0.57
1987	464,286 ± 47.0%	582,868 ± 42.6%	0.80
1988	547,566 ± 47.0%	563,601 ± 42.3%	0.97

From 1982 to 1984, the survey results reveal a drastic decline in cod biomass and abundance which was observed not only for the whole survey area but for all Divisions. The total survey biomass and abundance, however, increased considerably after 1984 and particularly in 1987 due to increased recruitment, mainly of the outstanding 1984 year-class which amounted to 86% of the total survey biomass and 88% of the abundance in 1987.

The survey results of 1988 showed a further increase in biomass of age 4 and younger cod by 122,000 tons, but a decrease in age 5+ cod by 39,000 tons. The resulting increase in total biomass of 83,000 tons is not as steep as in the previous year.

The survey showed, as in previous years, that the abundance was very low in Div. 1BC.

Japanese groundfish survey in waters deeper than 400 m and a Greenland shrimp survey in Div. 1ABC both confirmed that in the offshore area, negligible amounts of cod occur outside the area covered by the Federal Republic of Germany survey.

Greenland conducted a longline survey off West Greenland, in October-

November 1987 and 1988 (SCR Doc. 89/33). The survey was carried out in inshore and offshore areas of NAFO Div. 1C, 1D, and 1E.

The results of the 1988 survey showed high consistency with the 1987 survey. Based on these two years results, STACFIS considers that the offshore survey stock estimates from the trawl survey should be raised by a factor of 1.28 to account for the stock component in the non-covered coastal and inshore area.

During July 1988, Greenland carried out a gillnet survey on young cod in three inshore areas of West Greenland (SCR Doc. 89/21).

During the survey, a total of 1,979 cod were caught. Catches were dominated by 4- and 3-year-old cod, i.e. the 1984 and 1985 year-classes.

Based on this survey, the 1986 year-class was estimated to be about 5% of the 1984 year-class. One-year-old cod were virtually not found. Year-class 1987 was thus judged to be very small.

Tagging experiments. Analyses of tagging experiments at West Greenland intended to elucidate the emigration rate to East Greenland-Iceland and its variation between year-classes were presented (SCR Doc. 89/24 and 32). The results point at a fairly constant emigration rate between years and year-classes although the 1973 year-class may have had a higher-than-normal emigration rate. The West Greenland-East Greenland-Iceland migration of adult cod is best described as a one-way migration from West Greenland, through the East Greenland fishing area, with the migrants spending some time there.

c) Estimation of Parameters

Comparison of various stock abundance indices to achieve an estimate of stock size. In recent years STACFIS utilized estimates of stock size calculated from research surveys.

From the 1987 trawl survey, the 1984 year-class was estimated to be 800 million fish at age 3 (adjusted to include inshore component). However, comparing this estimate to former good year-classes lead STACFIS to judge the strength of the 1984 year-class to 500 million at age 3 (see *NAFO Sci. Coun. Rep.*, 1987, page 24).

Still using this estimate and applying the catches in 1987 and 1988 and a natural mortality of M = 0.20, leads to 283 million fish of that year-class by 1 January 1989. This value was 2.08 times less than that found by the November 1988 surveys (589 million including inshore survey).

The most recent strong year-class before 1984 was that of 1973. The size of that year-class was estimated by VPA. Comparisons of commercial CPUE figures of the 1984 and 1973 year-classes as 4-year-old fish indicate the size of the 1984 year-class about half that found by the 1988 trawl survey (SCR Doc. 89/22).

Preliminary trials with the ADAPT method on data for the period 1982-88 also suggested that the survey overestimates abundance of age 5+ fish by a factor of about 2 (SCR Doc. 89/69).

Pending further data, STACFIS therefore decided to use the 2.08 as a measure of the overestimate of survey results.

d) Assessment Results

i) Introduction

In previous years' assessments STACFIS used uncorrected survey abundance estimates in two consecutive years and catches between the times of the surveys, to arrive at estimates of fishing mortality and emigration. Due to variability in survey results this method resulted in high variation between years in the resultant estimates of emigration rate.

STACFIS this year decided not to carry out an analysis by that method. Instead, for projections, it was decided to use the survey abundance, corrected as mentioned above, for age-groups 5 and older. Recent trends in spawning stock biomass and fishing mortalities were estimated by the ADAPT

method (SCR Doc. 89/69).

ii) Recruitment prospects

1985 year-class. The abundance of the 1985 year-class in the 1988 trawl survey was 18% of the survey abundance found for the 1984 year-class in 1987. The Greenland young-cod survey gave an estimate of 22% of the 1984 year-class. Although this was slightly below last year's estimate, the survey confirmed that the year-class was above the average in recent years. A mean figure of 20%, equal to 100 million at age 3 has been used in the projections.

1986 year-class. From the inshore young cod survey as well as from the trawl survey, the size of the 1986 year-class was estimated to be low, in the range of 1-5% of the 1984 year-class. However, in both surveys, this year-class showed up in highest densities in the northernmost areas, and some proportion of this year-class was probably not covered by the surveys. Nevertheless, the 1986 year-class is expected to be small. 20 million fish at age 3 has been used in the projections.

1987 year-class. The 1987 year-class showed up in only low densities in both the young cod survey and the trawl survey, and it was, therefore, considered to be small. 20 million fish at age 3 has been used in the projections.

1988 year-class. No O-group cod were found in the Icelandic O-group survey off East Greenland in August 1988 indicating that the larval inflow from Iceland must have been negligible. In the trawl survey off West Greenland, also very few O-group cod were caught. The year-class is, therefore, expected to be small. 20 million fish at age 3 has been used in the projections. For the 1989 and 1990 year-classes, sizes of 20 million have also been used.

e) Prognoses

i) The parameters used to project catch, biomass and spawning stock biomass are as follows:

Age	Year-class	Stock size ('000) 1 Jan 1989	M	Partial Recruitment	Mean Weight (kg)	Percent Mature
3	1986	20,000	0.3	0.039	0.55	1
4	1985	73,366	0.3	0.52	1.08	3
5	1984	283,406	0.2	1	1.37	15
6	1983	2,208	0.25	1	2.00	48
7	1982	344	0.25	1	2.75	83
8	1981	713	0.25	1	3.50	96
9	1979	338	0.25	1	3.94	99
10+	<1979	829	0.25	1	4.92	100

The 1985 year-class was set at 100 million fish by 1 January 1988 and reduced by the catch in 1988, a natural mortality of M = 0.2 and an extra mortality coefficient of 0.1 to take discard into account as most fish of this year-class were below the minimum landing size in 1988.

The natural mortality of the 3- and 4-year-old fish is estimated to be 0.30 to take discards into account. Otherwise, it is considered to be 0.20 but for age-groups 6 and older an emigration coefficient of 0.05 has been added to these M-values.

The fishing pattern, i.e. the relative Fs, is that used in 1986 and in years prior to that. This pattern is different for those used in 1987 and 1988. The changes of the fishing pattern in 1987-88 was made to account for the expected fisheries in these years when most fishing was concentrated on the very abundant young year-classes. Mean weight-at-age as found for age 3 and age 4 in 1988 has been used in the projections. The number of older fish sampled in 1988, especially of the very weak year-classes of 1982 and 1983, was very limited, and mean weight-at-age data for older fish have, therefore, been taken from the 1984 fisheries (SCR Doc. 85/63) when size-at-age was similar to the present situation. As spawning potential is dependent on size of fish the percent mature fish by age is

likewise taken from that year.

These parameters were used to calculate a yield-per-recruit curve (Fig. 1) from which $F_{0.1}$ and F_{max} were estimated as 0.334 and 0.679, respectively. F_{max} is, however, not very clearly defined.

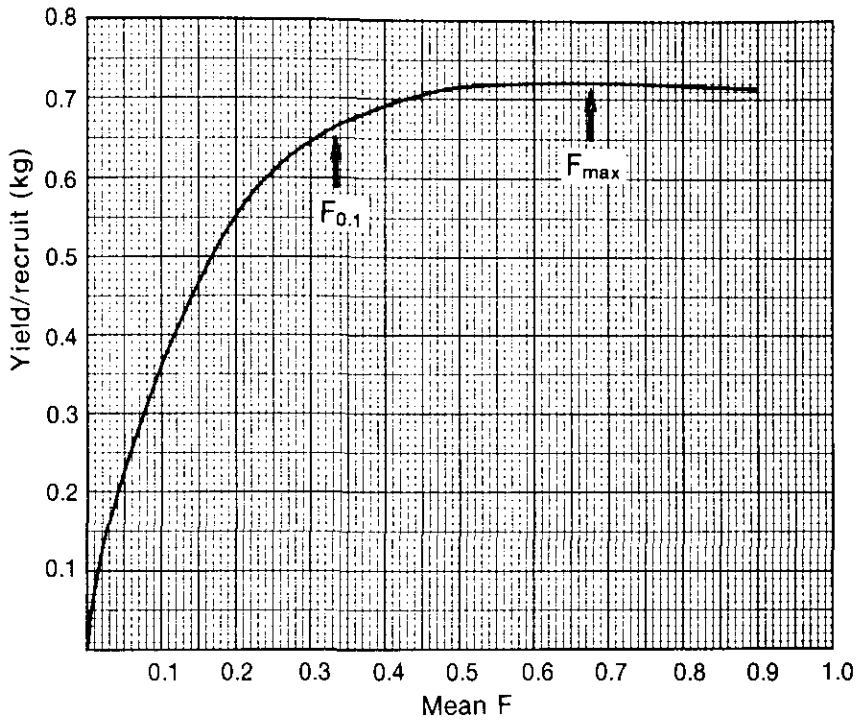

Fig. 1. Cod in Subarea 1, yield-per-recruit curve.

f) Catch Projections

All projections are carried out assuming the catch in 1989 to be 90,000 tons, the TAC set by Greenland. This catch corresponds to a fishing mortality of $F_{89} = 0.252$. Total biomass (age 3+) is given as average population biomass over the year and may, therefore, in some cases be lower than the spawning stock biomass (SSB) which is estimated as of 1 January each year.

The results of the projections of catches in 1990 and SSB at the beginning of 1991 for a range of fishing mortalities is given in Fig. 2.

Three management options were selected to cover the range of the fishing mortality between 0.252 (the F generated by the 1989 fishery by a catch of 90,000 tons) and 0.679 (F_{max}). In addition, three management options with fixed annual catches were calculated: 90,000 (TAC of 1989), 112,000 tons and 196,000 tons, the latter two corresponding to the catches which would be taken in 1990 if fishing at $F_{0.1}$ and F_{max}, respectively.

Furthermore, following the request by Denmark (Greenland), the three fixed-catch options mentioned above have also been carried out subject to the constraint that F should not be allowed to exceed 0.60 in any given year.

All projections are carried forward to include catches in 1993 and SSB at the beginning of 1994 (Table 4).

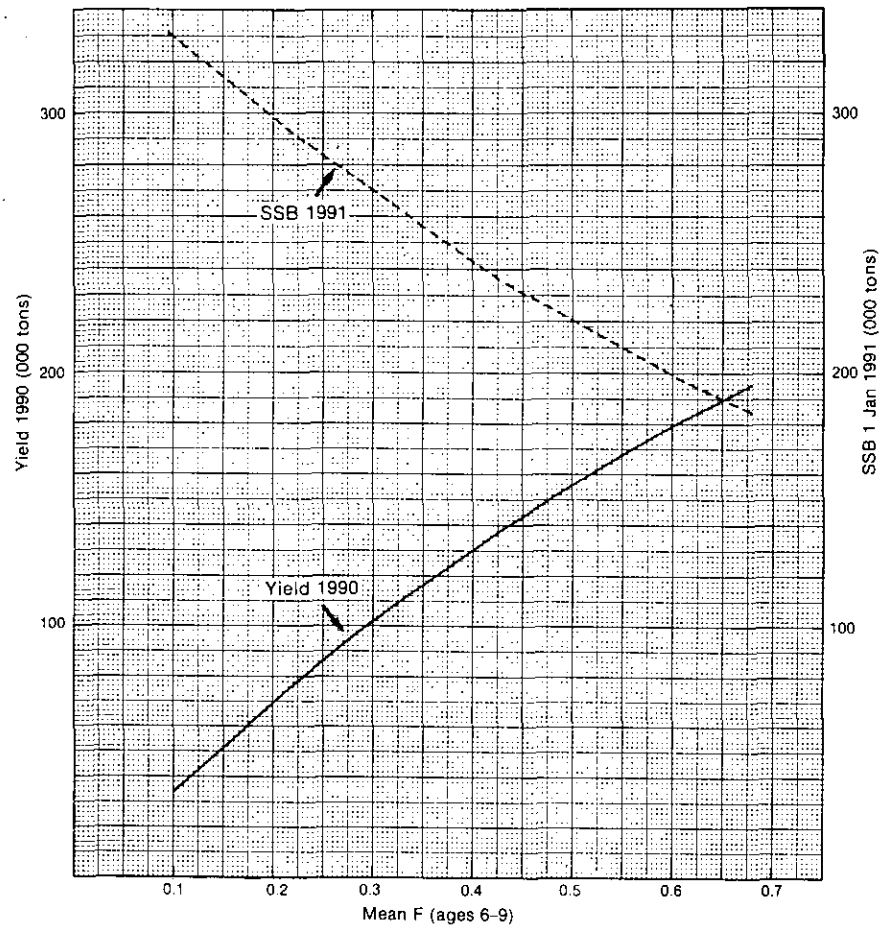

Fig. 2. Cod in Subarea 1: calculated yield in 1990 and spawning stock biomass (SSB) at beginning of 1991 for various levels of fishing mortality in 1990.

Table 4. Cod in Subarea 1. Projections of average annual age 3+ biomass (B3+), spawning stock biomass at the beginning of the year and catch and fishing mortality (F) during the year for different management strategies (weights in '000 tons).

		Stable fishing mortality			Stable catch level			Stable catch level - but F never above 0.6		
Year	Parameter	F(89)	F0.1	Fmax	TAC-90	TAC-112	TAC-196	TAC-90	TAC-112	TAC-196
1989	B(3+)	396								
	SSB	71								
	F(6-9)	0.252								
	Catch	90								
1990	B(3+)	364	351	304	363	351	305	363	351	314
	SSB	190	190	190	190	190	190	190	190	190
	F(6-9)	0.252	0.334	0.679	0.259	0.334	0.679	0.259	0.334	0.6
	Catch	88	112	196	90	112	196	90	112	179
1991	B(3+)	320	287	183	310	275	127	311	275	202
	SSB	285	263	187	283	263	187	283	263	202
	F(6-9)	0.252	0.334	0.679	0.304	0.431	B(3+)<TAC	0.304	0.431	0.6
	Catch	77	91	114	90	112		90	112	112
1992	B(3+)	266	222	111	236	117		236	183	129
	SSB	275	233	118	259	212		259	212	138
	F(6-9)	0.252	0.334	0.679	0.407	0.692		0.407	0.6	0.6
	Catch	63	69	65	90	112		90	101	68
1993	B(3+)	206	163	70	143	60		149	110	83
	SSB	212	166	62	171	106		171	117	77
	F(6-9)	0.252	0.334	0.679	0.696	B(3+)<TAC		0.6	0.6	0.6
	Catch	48	49	38	90			81	57	41
1994	SSB	170	125	36	59			98	68	47

The projections show that applying a fishing mortality coefficient of $F = F_{0.1}$ or below that or a fixed annual maximum catch (TAC) of less than 100,000 tons leads to a substantial increase in spawning stock biomass by the early-1990s to levels near 300,000 tons. Exploitation at a level of F_{max} or setting TAC significantly above 100,000 tons annually reduce the increase in SSB considerably due to the initial high catch.

g) Response to Special Requests from Denmark (Greenland)

i) Expected distribution of the 1984 and 1985 year-classes in 1989 and 1990

In the offshore area the 1984 and 1985 year-classes have been restricted largely to the southern part of West Greenland (south of 64°30') and this distribution pattern is expected also in 1989 and 1990. Some seasonal changes in the distribution should be expected with a relatively more northern distribution in summer and fall and more southernly in winter-spring.

The inshore component of these year-classes is expected to be more evenly distributed between Div. 1B and 1F than the offshore stock component.

ii) Expected size distribution of cod in 1989-91

The 1984 year-class has shown a lower growth than predicted last year (SCR Doc. 89/23) and the expected length distribution has been revised downward. The expected length distribution during 1989-91 is shown in Fig. 3.

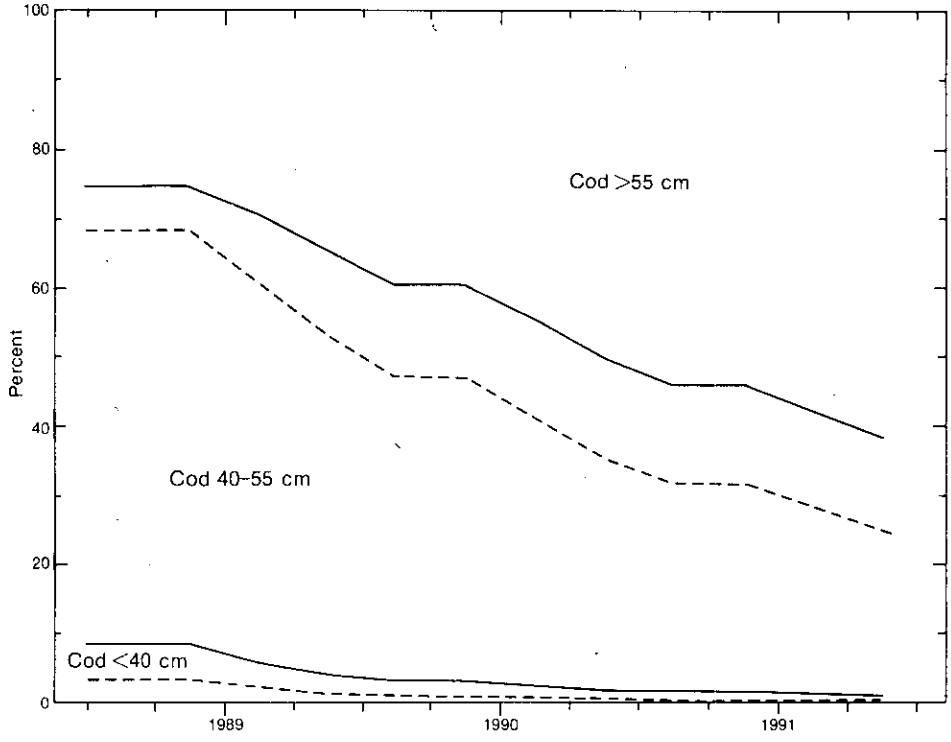

Fig. 3. Cod in Subarea 1: expected size distribution during 1989-91 of the year-classes 1984 and 1985 combined assuming relative year-class size of 100:18. Solid lines by number, broken lines by weight.

During 1989, the majority of the catch will be in the 40-55 cm size group and only a small proportion, mainly of the 1985 year-class, should be below the minimum landing size. From late-1989/early-1990 cod above 55 cm is expected to account for more than 50% of the catch by weight (SCR Doc. 89/23).

2. Cod in Division 3M (SCR Doc. 89/05, 60; SCS Doc. 89/08, 15, 16)

a) Introduction

i) Description of fishery

With a moratorium on fishing for cod on the Flemish Cap in 1988 reported catches were taken as by-catch in the redfish and flatfish fisheries. A total of 570 tons was taken by EEC-Portugal (389 tons), EEC-Spain (141 tons), the USSR (34 tons) and Japan (6 tons). The catches by EEC-Portugal, the USSR and Japan were by-catch in redfish fisheries while the catch by EEC-Spain was taken as by-catch in the flatfish fishery. There was fishing activity reported in the area during 1988 by non-member countries, but catch data is not available.

ii) Nominal catches

Catches ranged from 22,000 to 33,000 tons in the late-1970s when TACs were 25,000-40,000 tons. A decline in stock biomass after that period resulted in a reduction in the TAC to 13,000 tons in 1980. The TAC remained at that level until 1987 and during this period catches were stable and averaged about 12,000 tons. Recent catches and TACs were as follows ('000 tons):

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	40	13	12.7	12.4[1]	12.4[1]	13	13	13	13	0	0
Catch	30	10	14	13	10	13	14	15[2]	8[2]	1[2]	

[1] Excludes expected catches by Spain
[2] Provisional data.

b) Input Data

i) Commercial fishery data

Length frequencies were available only from EEC-Portugal for gillnet (June), longline (May - experimental fishing) and otter trawl (December) fisheries. Mean lengths of cod from these samples were 75.0 cm, 54.2 cm and 32.2 cm respectively. Approximately 94% of the 1988 Portuguese catch was taken by otter trawl and catches were obtained evenly over the period April to December.

ii) Research vessel data

Biomass and abundance estimates were available for research vessel trawl surveys conducted by the USSR from 1977 to 1988. Estimates for 1977 were high but survey coverage was limited (24 sets). Biomass and abundance were variable between 1978 and 1982. For the 1983-88 period abundance declined from 65.5 million to 26.7 million fish and during 1984-88 biomass declined from 31,100 to 10,500 tons. Acoustic estimates of cod biomass in the water column above the survey trawl were available for 1987 and 1988 and amounted to an additional 9,300 and 26,500 tons respectively.

A stratified-random bottom trawl survey was conducted by the EEC in August 1988 with minimum trawlable biomass estimated at 36,675 tons.

Age compositions from surveys conducted by both the EEC and the USSR during 1988 were virtually identical with cod aged 2 and 3 years comprising approximately 90% of the catch. Of these two age-groups the 1986 year-class (age 2) was most abundant.

c) Estimation of Parameters

Analytical assessments for this stock have not been conducted since 1979 because of perceived inadequacies in the commercial fishery database (*NAFO Sci. Coun. Rep.*, 1986, page 51). This situation remains unchanged for the current assessment. The average age 3+ biomass was in the range of 30,000-35,000 tons in 1978-80 (*NAFO Sci. Coun. Rep.*, 1984, page 41) in contrast to about 200,000 tons in the 1960-65 period. Research vessel surveys indicated that the age 1+ minimum-trawlable

biomass for 1988 was in the range of 10,000 to 30,000 tons.

d) Catch Projections

Catch projections at the standard reference levels cannot be provided because the status of the stock in 1988 was not precisely defined. Research vessel results indicated that biomass and abundance were at low levels and only about 5-10% of the 1988 survey population abundance was older than 3 years. This suggests that the spawning stock biomass is currently at a low level.

To protect the remaining spawning stock and to allow recent year-classes to contribute towards the most rapid rebuilding of the biomass from its present low level, STACFIS advises that the moratorium on fishing should continue. STACFIS also notes that the year-classes which dominated the survey catches in 1988 (the 1985-86 year-classes) will not contribute substantially to the spawning stock biomass until the 1991-93 period.

3. Cod in Divisions 3N and 3O (SCR Doc. 89/5, 35; SCS Doc. 89/15, 16)

a) Introduction

i) Description of fishery

Nominal catches of cod from this stock declined from a peak of about 227,000 tons in 1967 to a low of about 15,000 tons in 1978. Catches subsequently increased to 51,000 tons in 1986 and were 42,500 tons in 1988 (Fig. 4). Approximately 75% of the 1988 catch was obtained in Div. 3N and was taken mainly by Canada (19,701 tons), EEC-Spain (15,889 tons) and EEC-Portugal (3,927 tons). Canadian catches are taken mainly by otter-trawl and have been approximately 18,000 tons since 1984. Spanish catches, taken generally by pair-trawl, and Portuguese catches taken by otter-trawl and gillnet, in 1988 were approximately the same as those taken in 1987.

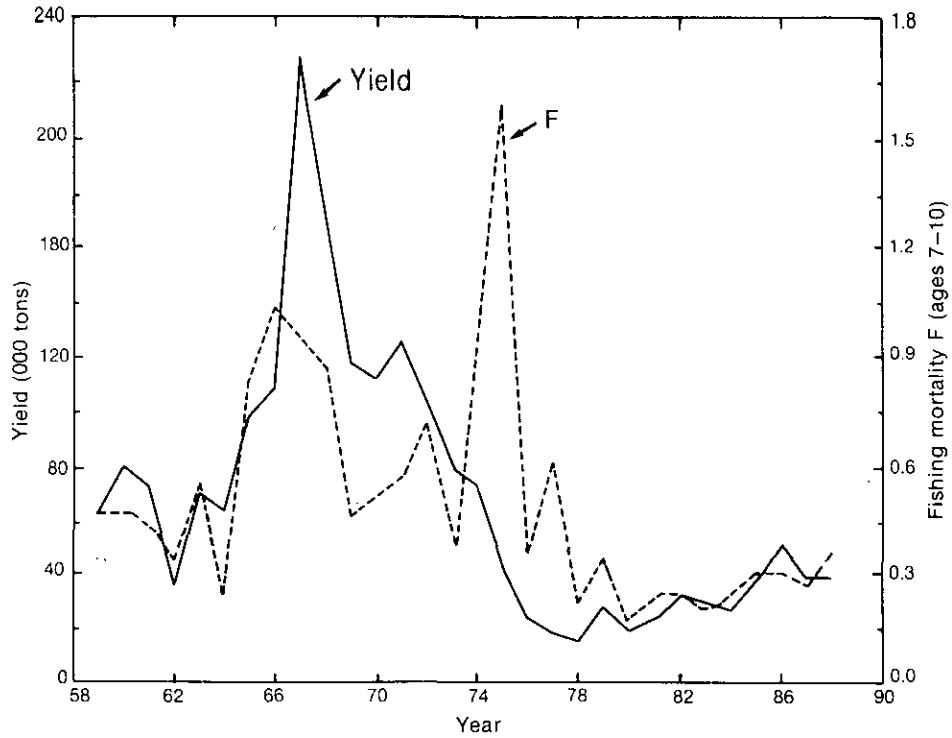

Fig. 4. Cod in Div. 3NO: trends in nominal catch and fishing mortality (ages 7-10), 1959-88.

ii) Nominal catches

Recent TACs and catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	25	26	26	17[1]	17[1]	26	33	33	33	40	25
Catch	28	20	24	32	29	27	37	51[2]	39[2]	43[2]	

[1] Excludes expected catches by Spain
[2] Provisional data

b) Input Data

i) Commercial fishery data

Catch and effort data for 1977-85 were obtained from NAFO Statistical Bulletins, while those for the Canadian otter-trawl fleet from 1986 to 1988 were provided by Canada. Spanish pair-trawl data for 1987 were those presented in the Spanish Research Report for that year (SCS Doc. 88/14). Catch-rate indices for otter trawls and pair trawls were derived separately from a multiplicative analysis using data for the 1977-88 and 1977-87 periods respectively. The Canadian otter-trawl index generally increased from 1977 to 1982, declined to 1987 with a subsequent increase.

Pair-trawl catch rates were also derived from a multiplicative analysis using official Spanish statistics for the 1982-88 period. This index agreed quite well (r^2=0.94) for overlapping years with the previously derived index using 1977-87 data. The 1988 index, taken from the Spanish statistics, was adjusted by the relationship between catch rates in both pair-trawl series for these overlapping years and appended to the 1977-87 pair-trawl catch-rate series. Spanish pair-trawl catch rates increased from 1980 to 1984, declined to 1986 and subsequently increased.

Since 1977, the fisheries conducted by Canada and EEC-Spain have generally occurred in separate areas. The Canadian otter-trawl fleet has fished mainly inside the Canadian 200 mile fishery zone, while the Spanish pair-trawl fleet has fished in the Regulatory Area. Catch-rate indices from these two fisheries were combined after weighting each to an estimate of the geographical area inside (80%) and outside (20%) the zone. The combined catch-rate index, although variable in the earlier period, showed a general increase from 1977 to 1982, stability from 1982 to 1984, a decline from 1984 to 1987 and an increase in 1988.

As in previous analyses the current method for estimating directed fishing effort for the Canadian otter-trawl fleet was to aggregate for each month all vessels' trips which have cod specified as main species. Main species was determined as the species which comprises the largest portion of the catch. At the June 1988 meeting of STACFIS it was recommended that analyses be completed using alternate methods to determine directed fishing effort for the Canadian fleet. Data was not made available to complete that analysis for the current assessment, therefore STACFIS again recommends that *the analysis for the current assessment be completed, using the percentage cod catch of the total groundfish on a more disaggregated basis than month, for the next assessment of this stock.*

ii) Research survey data

Stratified-random research vessel surveys have been conducted by Canada in Div. 3N for the 1971-89 period, with the exception of 1983, and in Div. 3O for the years 1973-89 with the exception of 1974 and 1983. To account for incomplete coverage in certain years, estimates of abundance for non-sampled strata were obtained using a multiplicative analysis.

Since 1976, with the exception of 1979, survey biomass was larger in Div. 3N than 3O until 1982 and since 1983 has been larger in Div. 3O (excluding 1986).

Survey abundance and biomass were highest in 1987 but have declined in both 1988 and 1989, with the 1989 abundance being the lowest in the time series.

Biomass in 1989 did not decrease to the same extent because the population consisted of a higher proportion of older and larger fish. The decline may be due in part to the very weak 1983 and 1984 year-classes.

Surveys by the USSR have been conducted on a stratified-random basis since 1983. Results of surveys from the 1977-82 period, which employed different survey methodology, were reanalysed to make that series comparable to the 1983-88 period. The abundance and biomass estimates generally increased from 1979-85 and have subsequently declined. The age structure estimated from the 1985 survey was not consistent with those from adjacent years and was considered anomalous. Discrepancies in the age structure estimated from the 1987 and 1988 USSR surveys were identified and consequently data for these years were not used in subsequent analyses. Acoustic estimates from the 1987 and 1988 USSR surveys indicated that 11% and 71% respectively of cod numbers were distributed pelagically.

iii) Catch-at-age data

Biological sampling data from the Canadian otter-trawl, Spanish pair-trawl and Portuguese gillnet fisheries were used to estimate the age composition of the commercial catch in 1988. The 1981 and 1982 year-classes were most abundant in the Canadian catch-at-age. Sampling for Spanish catches during November suggested that 2 and 3 year-old cod were abundant.

Average weights-at-age were available only from Canadian otter-trawl and Portuguese gillnet fisheries. Average weights in 1988 for cod aged 6 and older were lower than they had been in 1987 and for ages 6 and 7 were the lowest observed in the time series. A sum of products check indicated that the calculated catch in 1988 was about 94% of the reported catch.

c) Estimation of Parameters

i) Sequential population analysis

Commercial vessel (CV) catch-rate and research vessel (RV) survey indices of abundance including 1988 data were analyzed in separate formulations of the adaptive framework (ADAPT). The commercial catch-rate data used were the average of otter-trawl and pair-trawl indices. The fully-recruited F obtained (0.75) was about 3-4 times that for the 1977-84 period and was not considered to be a realistic estimate. As described in Section b(i) of this report the catch-rate series used may not reflect stock abundance because of problems with the definition of directed effort for the Canadian fleet. For these reasons it was decided to use only survey results for calibration.

Canadian and USSR survey data were included in a single adaptive framework. For reasons stated in Section b(ii), certain years were omitted from the analysis. These were 1984 and 1987 for Canadian surveys and 1985, 1987 and 1988 for the USSR survey. The necessity to exclude five data points because they are outliers is indicative of the inherent variability of the RV data. The ADAPT formulation used is described in Section f.

Abundance estimates for ages 3 and 4 could not be obtained precisely while those for ages 5-9 were obtained with coefficients of variation about 50%. Catchabilities at age were estimated with all CVs about 30%. The age 3+ population abundance estimated from this analysis is about 73 million fish and is the lowest in the 12 year period analyzed. The fully-recruited fishing mortality for 1988 was about 0.36 (Fig. 4).

The adaptive framework (with RV data) was used to estimate population size for 1987 for comparison with the results of last years assessment. The fully-recruited F (ages 7+) estimated from this analysis is about twice that determined during last years assessment although many of the population estimates had high coefficients of variation (50%-90%). The numbers of fish at ages 5 and 6 were estimated to be higher by 45% and 33% respectively. If the adaptive framework had been used last year, the age composition would have been different from that estimated during the 1988 assessment, however the age 3+ population abundance would have been estimated to be only about 7% higher.

ii) Yield-per-recruit

A yield-per-recruit analysis was conducted for this stock at the 1988 assessment meeting. The reference fishing mortality levels estimated and used in 1988 were $F_{0.1}$ = 0.15 and F_{max} = 0.25 (Fig. 5) with yield-per-recruits of 1.24 and 1.33 kg respectively.

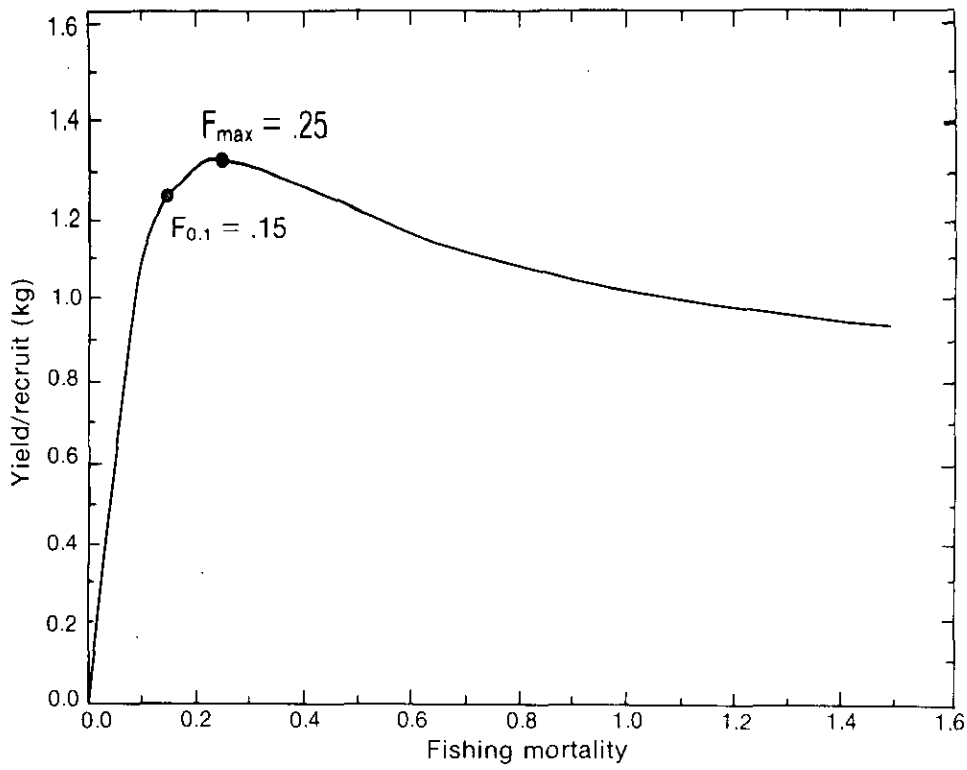

Fig. 5. Cod in Div. 3NO: yield-per-recruit for a range of fishing mortalities.

d) Assessment Results

Age 3 and 4 abundance derived from ADAPT using RV data were not precisely estimated but RV results were used to provide general indications of the size of the 1984 year-class (age 4 in 1988). That year-class was about the same size as the weak 1983 year-class (10 million fish) and STACFIS decided to set the 1984 year-class at age 3 at about this level. The 1985 year-class (age 3 in 1988) was set at the 1977-85 geometric mean at age 3 of 33 million fish. This now implies that the 1988 age 3+ population numbers about 90 million fish (Fig. 6).

Revised estimates of stock size now indicated that the mean age 3+ biomass for this stock increased from 45,000 tons in 1976 to 190,000 tons in 1986 and subsequently declined to about 126,000 tons in 1988. The major reason for this recent decline is the size of the weak 1983 and 1984 year-classes at ages 3 and 4 in 1987 and ages 4 and 5 in 1988. These year-classes have been described as weak in previous assessments, but both are now estimated to be about one-half the lowest previously observed year-class in this stock. These lower levels of recruitment as well as the estimate of fully recruited F in 1988 (0.36) now implies that the mean 3+ biomass for 1987 is about 25% lower than that estimated at the 1988 assessment of this stock.

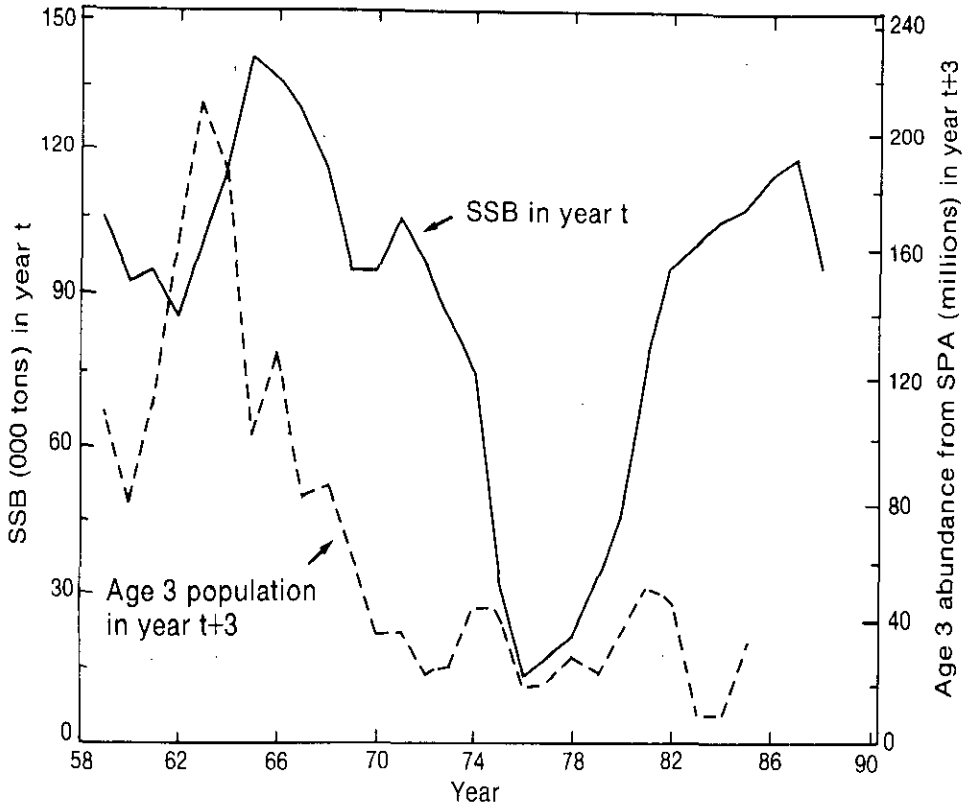

Fig. 6. Cod in Div. 3NO: trends in spawning stock biomass (SSB) and abundance of age 3 recruits from cohort analysis 1959-88.

e) Catch Projections

The parameters which were used to project stock size are given in Table 5. The partial recruitment used was the average for 1981-86 while the values used for ages 5-12 are those estimated in the calibration analysis. The 1986 and 1987 year-classes at age 3 in 1989 and 1990 were set at the 1977-85 geometric mean of 33 million fish. The 1989 catch was assumed to be the 1989 TAC of 25,000 tons.

Table 5. Cod in Div. 3NO: parameters used in projections of stock biomass and catch.

Age (yr)	Stock size 1 Jan 89 ('000)	Mean weight (kg) Mean Annual	Mean weight (kg) Start of Year	Percent Mature	Partial Recruitment
3	33,000	0.54	0.41	0	0.07
4	26,769	0.94	0.71	4	0.27
5	6,060	1.44	1.16	22	0.91
6	3,494	1.92	1.66	64	1.00
7	11,459	2.87	2.35	94	1.00
8	7,478	4.65	3.65	99	1.00
9	2,443	6.78	5.61	100	1.00
10	1,439	8.53	7.60	100	1.00
11	880	9.71	9.10	100	1.00
12	516	11.21	10.43	100	1.00

Projections of catch for 1990 and spawning stock biomass for January 1, 1991 are given in Table 6 and Figure 7. The projected 1990 catches for $F_{0.1}$ = 0.15 and F_{max} = 0.25 are 18,600 tons and 29,600 tons respectively. The TAC of 25,000 tons for 1989 now implies a fully recruited fishing mortality in that year of 0.23.

Table 6. Cod in Div. 3NO: projections of catch and spawning stock biomass (SSB) at various reference levels of fishing mortality assuming catch in 1989 = 25,000 tons.

SSB (1.1.1990) (tons)	Reference fishing mortality level	Catch (1990) (tons)	SSB (1.1.1990) (tons)
96,300	$F_{0.1}$ = 0.15	18,600	106,600
	F_{max} = 0.25	29,600	97,000
	$F_{(88)}$ = 0.36	40,700	87,500

During the last assessment of this stock, the 1983 and 1984 year-classes at age 3 were estimated to be 9.6 and 23.5 million fish respectively. The current assessment confirms the size of the 1983 year-class, but also suggests that the 1984 year-class is about the same size. The size of these year-classes is about one-half the next lowest year-class in the entire 1959-88 period and is less than one-third the 1977-85 geometric mean at age 3 of 33 million fish. During the 1977-88 period age-groups 6 and 7 contributed, on average, about 35% of the catch biomass. It is projected that the 1983 and 1984 year-classes at ages 6 and 7 in 1990 will only contribute about 10% of the catch biomass for that year. The revised estimate of the 1984 year-class (10 million compared with the previous estimate of 23.5 million fish) as well as the currently estimated population size are the major contributors to the projected catch for 1990 being lower than that for 1989.

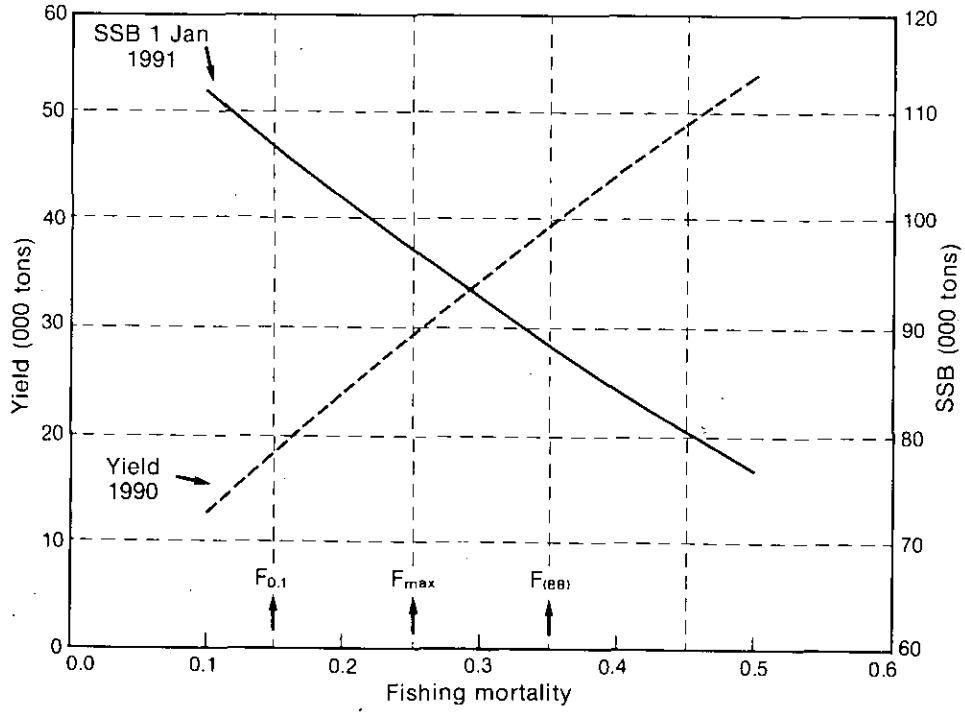

Fig. 7. Cod in Div. 3NO: projection of catch for 1990 and spawning stock biomass (SSB) at the beginning of 1991 for a range of fishing mortalities.

f) Model Formulation in Adaptive Framework

Parameters:

- Year-class estimates
  $N_{i,1988}$ i = 3-9
- Calibration coefficients for RV numbers
  $K(Can)_i$ i = 3-9
  $K(USSR)_i$ i = 3-9

Structure:

- Natural mortality was assumed = 0.20
- Error in catch-at-age assumed negligible
- F on oldest age (12) calculated as total F to ages 7-10
- F for ages 10-12 in 1988 set equal to the total
- F for ages 7-9 in 1988
- Intercepts not fitted

Input:

- $C_{i,t}$ i = 3-12, t = 1977-88
- $RV(Can)_{i,t}$ i = 3-9, t = 1977-82, 85-86, 88
- $RV(USSR)_{i,t}$ i = 3-9, t = 1977-84, 86

Objective function:

- Minimize
  $$\sum\sum_{it} [obs(lnRV(Can)_{i,t}) - pred(lnRV(Can)_{i,t})]^2 +$$
  $$\sum\sum_{it} [obs(lnRV(USSR)_{i,t}) - pred(lnRV(USSR)_{i,t})]^2$$

Summary:

- Number of observations = 126
- Number of parameters = 21

4. Redfish in Subarea 1 (SCR Doc. 89/30, 40, 41, 51; SCS Doc. 89/13, 14)

a) Introduction

Redfish landings consisted almost exclusively of golden redfish (*Sebastes marinus*). Total nominal catches were rather stable between 1978 and 1983 averaging 8,000 tons. From 1984 to 1986, catches declined to an average level of 5,000 tons. A drastic decline to only 1,200 tons in 1987 due to closure of the cod fishery was followed by an increase to 2,500 tons in 1988. The decrease of catch levels since 1984 was due to a considerable effort reduction of the mixed redfish-cod fishery by trawlers of the EEC-Federal Republic of Germany which was only partly compensated by a directed redfish fishery of Japanese trawlers in a joint-venture arrangement with Greenland. In 1988, increased effort in the cod fishery by trawlers from Greenland and the EEC-Federal Republic of Germany produced a subsequent increase of redfish by-catches. Recent catches ('000 tons) were as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Catch	8	9	8	6	8	7	6	4	5	1[1]	3[2]

[1] Low catch due to closure of the cod fishery.
[2] Provisional data.

Small juvenile redfish (*S. marinus* and *S. mentella*) were quite abundant in the northern Div. 1ABC where large numbers were taken and discarded as by-catch in the shrimp fishery.

b) Input Data

i) Commercial fishery data

Analyses of sampling data on length and age composition obtained from the commercial fishery by Greenland and the EEC-Federal Republic of Germany in recent years were not yet completed and therefore not available.

ii) Research vessel survey data

Biomass and abundance estimates for *Sebastes marinus* and *S. mentella* derived from results of stratified-random bottom-trawl surveys conducted by the EEC-Federal Republic of Germany in late autumn since 1982, indicated a continuous decline of the adult stock component of *S. marinus* inhabiting Div. 1D-1F from a level of 74,000 tons and 129 million fish to only 10,000 tons and 17 million fish respectively in 1988. Recent catch levels seem, however, not to be indicative of the decline in survey biomass. Corresponding estimates for *S. mentella* remained fairly stable over the survey period averaging about 3,000 tons and 6 million fish, however, the area of distribution of *S. mentella* in depths exceeding 400 m was insufficiently covered by the surveys primarily designed for cod.

From stratified-random bottom trawl surveys conducted jointly by Japan and Greenland in July/August 1987 and September/October 1988 in Div. 1A-D, the latter covering depths of 400-1,500 m only, biomass estimates (tons) were derived as follows:

	July/August 1987	September/October 1988
Sebastes marinus	4,000	200
Sebastes mentella	8,000	5,700

In the northern part of the survey area (Div. 1B+C, 9,877 nm^2), covered by the EEC-Federal Republic of Germany from 1982 to 1988, where predominantly small juvenile redfish below 20 cm were distributed, with highest biomass and abundance estimates obtained at 10,000 and 9,000 tons and 159 and 130 million fish in 1986 and 1987, respectively. In 1988 corresponding estimates amounted to only 3,000 tons and 74 million fish.

A stratified-random shrimp survey conducted by Greenland with the commercial shrimp trawler *Elias Kleist* in July 1988 covered a far larger area, also including part of Div. 1A, of 29,272 nm^2. Biomass and abundance estimates amounted to 23,000 tons and 750 million small juvenile redfish. The total redfish by-catch in the commercial offshore shrimp fishery in 1988 (estimated at 3,600 tons or 120 million individuals) thus would have comprised 16% of the biomass of juveniles as calculated from the survey. The northern part of Subarea 1 was confirmed by all surveys as being a nursery ground for redfish.

c) Catch Projections

Recent redfish catches in Div. 1D-F amounted to about 9% on average of the survey biomass estimates since 1982, and the observed decline in survey biomass and abundance can obviously not be attributed to the fishery. The extent to which, however, the removal of large amounts of juvenile redfish in the northern part of Subarea 1 by the shrimp fishery may adversely affect redfish recruitment is not known at present.

By-catch regulations for the shrimp fishery could, however, become advisable if considerable proportions of the biomass of juvenile redfish continue to be caught.

As long as catches of the adult component remain at recent levels comprising only small proportions of the minimum trawlable biomass as estimated from surveys, no TAC needs to be advised by STACFIS.

5. Redfish in Division 3M (SCR Doc. 87/20, 89/6, 56, 60; SCS Doc. 89/8, 13, 15, 16)

a) Introduction

i) Description of fishery

Over the past decade, USSR, EEC-Portugal, Cuba and Japan constituted the main fleets in the directed fishery on this stock. The fishery primarily occurred from January to September and midwater trawling was the predominant fishing method.

ii) Nominal catches

Nominal catches have been between 14,000 tons and 44,000 tons since 1977 and have been as high as 52,000 tons in 1959. Catches exceeded the TAC by 9,000 tons in 1986, 24,000 tons in 1987 and 3,000 tons in 1988. The increase in 1986 and 1987 was mostly due to landings by the EEC (primarily Portugal). The reduction from 1987 to 1988 was due to a reduction of fishing effort. Except for 1987, the USSR fleet has taken half of the reported landings in each year and in some years as much as 77%. Recent catches and TACs ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	20	20	20	20	20	20	20	20	20	20	20
Catch	20	16	14	15	20	20	20	29[1]	44[1]	23[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort data from ICNAF and NAFO Statistical Bulletins for 1959-85 were combined with preliminary NAFO data for 1986 and 1987 and utilized in a multiplicative model to derive a standardized catch-rate index. The derived series showed a decline from 1961 to 1967 followed by a rapid increase to the highest rate in the series in 1970. Catch rates declined sharply to 1972 but have been relatively stable to 1985. Preliminary data for 1986 and 1987 suggest a slight increase relative to 1985. STACFIS noted the variability around the catch-rate estimates in each year. While acknowledging that this series may not be reflective of stock abundance, STACFIS considers that the relatively stable catch rates since 1973 may indicate a general stability in the stock status.

Commercial length frequencies from the Portuguese fishery in December indicated two modes at 27 cm and 34 cm. Length frequencies from the Cuban fishery in August revealed a mode of 27 cm.

Commercial catch-at-age was available from 1975 to 1986 (SCR Doc. 87/20) and from 1979 to 1988 (SCR Doc. 89/06).

ii) Research data

A frequency representing percent-at-length from a USSR bottom trawl survey in 1988 indicated most individuals were in the 22-28 cm range. These corresponded primarily to the year-classes of the early-1980s. Surveys also indicated a pulse of recruitment first observed in the 1987 survey that was relatively stronger than anything seen since 1984. However, it is unknown the extent to which these young fish are recruited to the research gear. The abundance of this recruitment compared to the relatively strong year-classes of the early-1980s is unknown as there were no relative abundance estimates available.

Biomass estimates from the USSR trawl surveys showed high fluctuations from year to year since 1983. It was noted that redfish exhibit vertical migrations to the extent that a considerable proportion of total biomass was unavailable to the trawl swept area during surveys. For 1988, this proportion was estimated to be 90% compared to at least 77% in 1987. Biomass estimates ('000 tons) were as follows:

	1983	1984	1985	1986	1987	1988
Trawl	155	132	52	310	106	47
Acoustic	-	-	-	-	>350	410
Total					>456	457

Biomass from an EEC bottom trawl research survey in July was estimated by the swept-area method to be 170,000 tons. It was noted this estimate differed from the USSR trawl survey estimate by 125,000 tons. Both surveys employed a stratified-random design and were conducted in mid-summer. STACFIS noted large interannual fluctuations in the USSR survey estimate and the large difference between the EEC and USSR survey in 1988 and subsequently concluded that this information may not reflect trends in stock abundance.

c) Estimation of Parameters

i) Sequential population analysis

SPA analyses were available incorporating variable natural mortality (M) and constant M (0.1) over all ages in separate analyses. Details of partial recruitment and calibration were not provided and STACFIS was unable to evaluate the results. Illustrative SPAs were run to get an idea of population sizes from input terminal Fs of 0.1 and 0.5 with the available catch-at-age data. These data were examined in a preliminary SPA to estimate partial recruitment. Terminal F for 1988 was initially set to 0.20 and iterations carried out until the partial recruitment pattern in 1988 equalled the average for 1975-87. Weight-at-age was derived from calculated population abundance and biomass at age from SCR Doc. 89/06 but was found to give unrealistic high weights for age-groups 14 and older and were therefore not used.

ii) General production model

General production analyses were not considered appropriate for catch and effort data because there is no significant contrast in these data.

iii) Status quo methods

Effort data, calculated using the multiplicative model, and catch-at-age were utilized in two separate 'status quo TAC' models (LEAP FROG and ANOVA TAC). Retrospective analyses were carried out in order to investigate their performance in estimating TACs in the past. The LEAP FROG method indicated poor performance in forecasting retrospective catches for this stock. Predicted catches differed by 30% to 170% from actual catches when effort in year t+1 was assumed equal to effort in year t-1. When utilizing actual effort for year t+1, the divergence ranged from 40% to 275%. Linear regressions for ANOVA TAC method were not significant indicating the method is inappropriate. STACFIS considers these methods unreliable in forecasting catches of this stock.

d) Assessment Results

i) Sequential population analysis

The illustrative SPAs were not used as indicators of population size but simply to examine whether there is evidence of a converged portion in the population matrix. The results indicated divergence in age 5+ numbers from the SPA with F_T = 0.1 and F_T = 0.5. The difference in the SPAs was expressed as a percent of the SPA (F_T = 0.5) age 5+ numbers as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983-1988
Difference %	15	21	31	39	52	67	78	92	>100

It was noted that the population matrix is tending toward convergence and therefore additional catch-at-age information will prove increasingly useful in assessing the status of this stock.

Given that 5+ numbers from illustrative SPAs were within about 30% for the first three years, STACFIS considers the geometric mean of age 5 population numbers for 1975-77 from each of the SPAs (118×10^6) may indicate long term average recruitment. Applying the results of a yield-per-recruit analysis from this year's Div. 3LN redfish assessment indicates a long-term yield of about 20,500 tons at $F_{0.1}$ and 22,000 tons at F_{max} reference exploitation levels.

c) Prognoses

i) General biological information

Estimates of trawlable biomass from a series of USSR summer trawl surveys show large interannual fluctuations. STACFIS considers changes of a large magnitude between some years are too dynamic to reflect changes in the stock. Although acoustic data indicate a considerable portion of population biomass to be above the swept area of the survey trawl, estimates of this proportion were different in 1987 and 1988. Nevertheless, combined trawl and acoustic biomass estimates for 1987 and 1988 gave similar results of about 450,000 tons. Exploitation rate at reference fishing levels of $F_{0.1}$ (11%) and F_{max} (19%), applying yield-per-recruit calculations from this year's Div. 3LN redfish assessment, correspond to catches of about 49,500 tons and 85,500 tons respectively. It was noted that a biomass estimate from the 1988 EEC survey (170,000 tons) was considerably different from the USSR bottom-trawl estimate in 1988 (47,000 tons) in spite of the fact that both surveys were conducted over a similar time period. The difference observed may be related to (a) a change in the distribution of the fish in the water column; (b) the inherent variability of estimates of redfish abundance from stratified-random bottom trawl surveys; or (c) differences in the gears used in the two surveys. STACFIS welcomes additional data from these surveys if they are to be continued.

STACFIS acknowledges that assessments of redfish stocks present unique problems due to behavioural dynamics which make it difficult to interpret indices of abundance derived from available data. However, STACFIS notes that two independent analyses (general production model from the 1987 assessment and this year's Div. 3LN yield-per-recruit), aside from their shortcomings, indicate a similar long yield term at $F_{0.1}$ and F_{max} as follows:

Model	$F_{0.1}$ Yield (tons)	F_{max} Yield (tons)	Source
Non-equilibrium general production	19,000	21,000	NAFO Sci. Coun. Rep., 1987, p. 50
Thompson and Bell yield-per-recruit	20,500	22,000	From this year's Div. 3LN assessment

Applying the Div. 3LN yield-per-recruit calculations, population sizes for long-term yield at $F_{0.1}$ and F_{max} would be 186,000 tons and 116,000 tons respectively. This inherently assumes a stable age distribution and average recruitment. Redfish typically exhibit cycles of recruitment with a year or two of better than average recruitment followed by a number of years of relatively low recruitment. The USSR surveys for 1987 and 1988 estimate the population size to be about 450,000 tons. This indicates that the current population size is substantially higher than the long-term average according to yield-per-recruit calculations. The early-1980s year-classes are known to be relatively strong (*NAFO Sci. Coun. Rep.*, 1985, page 61). The USSR survey in 1988 estimated that most of the population was in the 22 cm to 28 cm range approximately corresponding to these year-classes. If this is reflective of the size distribution of the stock then a very high percentage of the 450,000 ton biomass must be associated with these year-classes. STACFIS considers that a stock size that is estimated to be

approximately double the size for long-term yield with a stable age distribution is unlikely to be completely made up of a few strong year-classes.

STACFIS noted a pulse of recruitment indicated from USSR trawl surveys in 1988 that would not recruit to the fishery until about 1992, but could not evaluate its abundance relative to the dominant early-1980s year-classes as seen in the survey catches.

STACFIS considers from the available information that a higher TAC than the present TAC of 20,000 tons may be warranted. Based on the 1988 USSR bottom trawl and acoustic survey, catches of 50,000 tons and 85,000 tons are estimated at exploitation levels corresponding to $F_{0.1}$ and F_{max} respectively. STACFIS has reservations about the survey results and considers that a TAC should be set well below either of the reference exploitation levels. STACFIS notes that due to the longevity of redfish and the relatively young age of the strong early-1980s year-classes, their total potential yield will not be seriously affected by too low a TAC for 1990 should the survey results be confirmed in the near future.

6. Redfish in Divisions 3L and 3N (SCR Doc. 89/6, 54; SCS Doc. 89/08, 13, 15, 16)

a) Introduction

From 1960 through 1985, catches averaged just over 20,000 tons, ranging between 8,000 and 33,000 tons. During that same period, about 60% were taken from Div. 3N. In 1986, the total catch increased to about 43,000 tons with 65% being taken in Div. 3L. Catches increased again in 1987 to over 70,000 tons (57% from Div. 3N) then decreased to about half that (34,000 tons) in 1988. No reports have been received from South Korea for 1988. Canadian surveillance estimated non-member catches for 1988 to be about 9,500 tons. The increases in Div. 3L were the result of increased catches by EEC-Portugal while the increased landings from Div. 3N in 1987 were the result of increased catches by USSR (18,851 tons) and South Korea (16,053 tons). For 1988, EEC-Portugal has reported catches of only 8,667 tons from Div. 3L and 1,827 tons from Div. 3N. Most of the 1988 catch was taken by the USSR and EEC. Recent catches and TACs ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	18	25	25	25	25	25	25	25	25	25	25
Catch	14	16	24	22	20	15	21	43[1]	71[1]	34[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort data from ICNAF and NAFO Statistical Bulletins for 1959-85 were combined with preliminary NAFO data for 1986-87 and preliminary Canadian statistics for 1988. These were utilized in multiplicative analyses to derive standardized catch-rate series for Div. 3L and 3N separately since it has been shown previously that there are somewhat different trends in each of the Divisions over time (*NAFO Sci. Coun. Rep.*, 1988, page 48).

The results of the analysis for Div. 3L alone indicated that there were not significant trends in catch rates over the years 1959-88.

Analysis of the Div. 3N data indicated significant differences between years, but mainly as a result of the high 1966 and 1974 catch rates. The changes observed for those years were too rapid to reflect changes in the stock status of this species. In general, catch rates have been fairly stable in this Division as well.

STACFIS has reservations as to whether catch rates for redfish are reflective of stock status given the schooling behaviour of these fish. However, the lack of trends in either Division may indicate a general stability of the stock over the 1959-88 period.

Commercial frequencies from the Canadian fishery indicated a mode of 27-30 cm in Div. 3L throughout the year except in March and April when larger fish were taken. German Democratic Republic catches, also from Div. 3L contained fish of modal length 30-35 cm throughout the year. Relatively small fish (modal length 27 cm) were caught by Cuba in Div. 3N in August. No other frequencies were available from Div. 3N.

Commercial catch-at-age data were available for the fishery from 1975-86 (SCR Doc. 87/20) and 1979-88 (SCR Doc. 89/06).

ii) Research data

Length frequencies from USSR surveys in Div. 3L for 1984-88 (SCR Doc. 89/06) indicated that most fish were larger than 22 cm in all years. In 1988 a small mode was observed at 8 cm. In Div. 3N, a mode at 21 cm in 1988 corresponds to good recruitment of the early-1980s year-class. This year-class has been present in the survey frequencies from Div. 3N beginning in 1984 but has been consistently absent in Div. 3L.

Biomass estimates were also available from the USSR surveys from 1983 to 1988 (SCS Doc. 89/08). The trawlable biomass was estimated to be about 125,000 tons in 1983 then 199,000 tons in 1984 but has been below 100,000 tons since then. The 1988 estimate, 40,000 tons, is the lowest in the series. It was noted that varying proportions of redfish have been detected up off the bottom in the different years and this may have affected the trawl survey results. It was estimated that 80% of the biomass was above the trawl in 1988.

c) Estimation of Parameters

i) Sequential population analysis

SPA of the Div. 3LN redfish was available (SCR Doc. 89/06). These analyses were carried out both with fixed M (0.10) and variable M. In addition, estimates of F_{88} were provided. No details of partial recruitment estimation or calibration were provided, and STACFIS was unable to evaluate the results.

Because of concerns regarding the representativeness of catch rates as indicators of stock status, and because the research survey database is only for a relatively short time period, STACFIS does not consider SPA to be appropriate at this time. Nonetheless, STACFIS is reasonably certain that F_{88} is not below 0.10 or above 0.50 so SPA runs were carried inputting these fully recruited Fs for 1988 for illustrative purposes. The catch-at-age data were examined using a preliminary SPA to estimate partial recruitment. The F_{88} was set to 0.20 and iterations carried out until the partial recruitment in 1988 equalled the 1975-87 average. Weight-at-age was estimated by comparison of abundance and biomass at age from SCR Doc. 87/20 and 89/06.

ii) General production model

General production analysis was not considered appropriate for Div. 3L catch and effort data because there was not significant contrast in these data. STACFIS observed that although there were significant differences in catch rates for Div. 3N, there was, in general, poor contrast in these data as well and therefore general production analysis was not performed.

iii) Yield-per-recruit

The partial recruitment determined above, along with the average weights-at-age for 1975-88 (see text table) were input into a Thompson and Bell yield-per-recruit model with ages 5-23 and M=0.10 to estimate yield at the reference fishing levels of $F_{0.1}$ and F_{max}.

Age	Partial Recruitment	Mean Weight-at-age (kg)
5	0.282	0.153
6	0.487	0.204
7	0.554	0.227
8	1	0.276
9	1	0.314
10	1	0.373
11	1	0.421
12	1	0.500
13	1	0.571
14	1	0.647
15	1	0.729
16	1	0.785
17	1	0.848
18	1	0.908
19	1	1.003
20	1	1.059
21	1	1.132
22	1	1.188
23	1	1.208

iv) Status quo methods

Although STACFIS, as already noted, has reservations concerning the catch-rate series, the calculated effort data were utilized in two separate 'status quo TAC' models. The two models examined were LEAP FROG and ANOVA TAC. Retrospective analyses were carried out in order to investigate their performance in the past.

The retrospective analyses indicated that neither status quo method was a good predictor for catches of Div. 3LN redfish. With ANOVA TAC, none of the linear regressions were significant indicating that the model was not appropriate. With LEAP FROG, the predicted catches ranged from 10% to 230% of the actual catches when effort in year t+1 was assumed equal to effort in year t-1 and from 13% to 120% when inputting actual effort for year t+1. STACFIS does not consider these models useful in forecasting catches of this stock.

d) Assessment Results

i) Sequential population analysis

The illustrative SPAs were not used as indicators of stock status but only to examine if a portion of the matrix could be considered as converged. The results indicated divergence in the age 5+ biomass as follows (expressed: difference as percent of F_t = 0.50 age 5+ biomass):

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986-88
Diff.(%)	12	15	18	23	30	37	44	49	60	71	92	>100

STACFIS considers that the matrix is beginning to converge, and therefore these catch-at-age data will prove increasingly more useful in assessing the stock as time progresses. At present however, there are insufficient fixed points to allow calibration.

ii) Yield-per-recruit

The results of the yield-per-recruit analysis (Fig. 8) are as follows:

	F	Yield (kg)
$F_{0.1}$	0.120	0.173
F_{max}	0.222	0.186

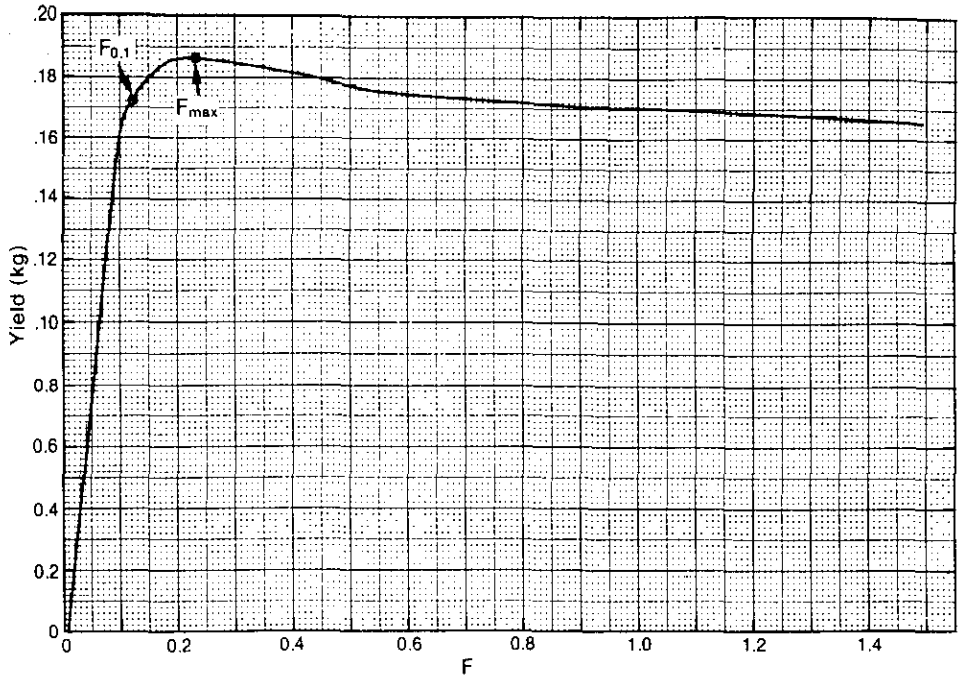

Fig. 8. Redfish in Div. 3LN: yield-per-recruit curve.

Noting that the illustrative SPA 5+ biomass estimates were within about 25% for the first four years, STACFIS used the derived age 5 population numbers for 1975-78 to estimate long-term yield. The geometric mean of the 8 values is about 120 × 10^6 age 5 fish. Applying the yield-per-recruit values derived above indicates a long-term yield of about 21,000 tons at $F_{0.1}$ and 22,300 tons at F_{max}. STACFIS notes that these are very close to the current TAC of 25,000 tons.

e) Prognoses

i) General biological information

Catch rates in neither Div. 3L nor 3N show any trends with time from 1959 to 1987/88. STACFIS acknowledges that this may indicate that exploitation may be below potential but has serious reservations as to whether the catch rates are reflective of stock status given the schooling behaviour of the species. Density of concentrations may not change with changing abundance, only the number of concentrations. With this scenario, the population may drop to a critically low level before catch rates change. Information concerning search time would be useful in this context, but these are not currently available. STACFIS does consider that in general terms, the stable catch rates may indicate an overall stability of the stock.

The results of research surveys by the USSR indicate a drop in trawlable biomass of 50-70% between 1983 and 1988. Although acoustic data indicate a considerable portion of the stock to be above the trawl swept area in 1988, the variability of this is not currently known. Redfish are known to distribute in the water column, and assuming that behaviour does not change from one year to the next (at the time of the survey), then a fairly constant proportion may be pelagic from one year to the next. If this is so, then accounting for pelagic distribution will only scale the survey data without changing the trend over time. The total biomass (bottom and pelagic) estimated from the 1988 survey is about 200,000 tons. Applying $F_{0.1}$ and F_{max} exploitation (11 and 19% respectively) gives yields of about 22,000 and 38,000 tons respectively.

STACFIS acknowledges that assessment of redfish stocks presents unique difficulties because of the nature of the species. The distribution patterns make it difficult to evaluate catch-rate data as noted above. Their pelagic distribution and schooling mean that interpretation of stratified-random survey results is difficult. Because they are long lived and slow growing, many years of data are necessary before SPA is useful.

However, STACFIS notes that three independent analyses (general production analyses run in the past, yield-per-recruit analysis, and reference exploitation of a 1988 biomass estimate) all with the exception of the F_{max} catch based on the 1988 survey biomass (38,000 tons), give very similar results, and indicate a yield of about 25,000 tons. Two of these three are long-term estimates.

STACFIS notes that there will be increased recruitment to the fishery over the next few years in Div. 3N, but not in Div. 3L.

Based on all of the above, STACFIS advises that the TAC for 1990 be 25,000 tons. Catches of this magnitude approximate long-term yield at both $F_{0.1}$ and F_{max}. STACFIS is unable to evaluate the effects, on the stock, of catches in excess of this. With reference to Section 2, paragraph c of the Fisheries Commission Request for Scientific Advice (Part D, Agenda I, Annex 1), STACFIS cannot evaluate the current stock biomass in relation to the virgin stock.

7. Silver Hake in Divisions 4V, 4W and 4X (SCR Doc. 88/98, 89/02, 12, 14, 15, 16, 17, 48; SCS Doc. 89/08)

a) Introduction

The silver hake fishery is conducted by large otter trawlers using small-meshed bottom trawls. Prior to 1977 the fishery was not restricted by season or area, however since 1977 the fishery has been restricted to the months of April through November and to the area seaward of the small mesh gear line. Nominal catches of silver hake since 1970 ranged from a maximum of 300,000 tons in 1973 to a minimum of 36,000 tons in 1983. Since 1977 catches have generally increased from 37,000 tons in 1977 to 83,000 tons in 1986. Recent catches and TACs ('000 tons) are as follows:

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	80	70	90	80	80	80	100	100	100	100	120	135
Catch	48	52	45	45	60	36	74	75	83[1]	62[1]	74[1]	

[1] Preliminary

The 1988 fishery commenced on April 1 and was completed late in June with most of the allocations taken. The catches fell short of the TAC in recent years because of Canadian allocations to countries which did not fish for silver hake. However, since 1986 both the USSR and Cuba have taken more than 90% of their respective allocations.

b) Input Data

i) Commercial fishery data

As advised by STACFIS in 1988, discrepancies in the 1985 reported effort for the USSR required that those data be substituted by data from the Canadian International Observer Program (IOP). Following the recommendation made by STACFIS in 1988, the 1977-84 catch and effort data from ICNAF and NAFO were combined with the 1985-88 IOP data using a multiplicative model.

The catch rates have increased irregularly from 1980 to 1987. The catch rate in 1982 is much higher than adjacent years and is the third highest in the series. It was considered unlikely that the drastic change in catch rate seen in 1982 was representative solely of a change in biomass. The 1986 and 1987 catch rates were similar and were slightly higher than in 1982.

The catch rate in 1988 was near the level of 1984 but 2/3 of that in 1986 and 1987.

For this assessment, the age composition of the catches in 1977-88 were reconstructed from Canadian data. While reviewing the input data used to construct the previous catch-at-age matrix, certain errors in data coding, improper identification of sample and gear types was found. The new catch-at-age matrix is based on separate male and female age/length keys. Segregation of sexed samples is supported by three papers (SCR Doc. 89/02, 89/17 and 89/48) which describe the difference in growth between the sexes as significant after age 3.

For the 1984-87 period, the new matrix estimated fewer fish at age 1, because several samples taken from the fish reduction process formerly, were added to samples taken from the commercial catch without the proper weighting.

The total number of fish estimated by this and the previous assessment was similar. In absolute terms the changes were highest in the earlier years and the most recent. The sum of products, using the revised catch-at-age and average weights-at-age showed good agreement with the nominal catch, varying by 1 to 2%.

The age composition in 1988 was calculated from IOP samples. Of the 74,500 tons reported, the IOP observed 70,700 tons (95%). More than 370,000 length measurements and 1700 otoliths were taken. In addition, extensive sampling and ageing were conducted by USSR and Cuba. However, as was the case in previous assessments, these data have not been used due to discrepancies between the data sources. STACFIS recommends that *the marked differences found between Canadian and USSR length frequencies of silver hake samples be investigated.* STACFIS emphasized its recommendation to continue the otolith ageing exchange as outlined under "Ageing Techniques and Validation Studies" in this report.

The 1988 age composition in the catch was dominated by the 1985 year-class at age 3 (66% by number) which is the largest in the age 3 series. The 1986 year-class at age 2 (16%) and the 1987 year-class at age 1 were below average.

A study (SCR Doc. 89/12) on the appropriate level of sampling of the catch for ageing, presented that a 20% coefficient of variation was considered acceptable for each age. The study indicated that the number of samples should be increased for the older age-groups over that of the present level to meet the objective. However, certain year-classes may require sampling intensity which was impractical.

ii) Research vessel indices

The Canadian research vessel survey in July was used to estimate numbers of silver hake from 1977-88. For consistent comparisons with the catch data only the 1977-88 research vessel survey estimates were used in this assessment although survey data were available from 1971 onwards. The research vessel indices for 1982-88 have been higher on average than in the period prior to 1982. The change in research vessel which occurred in 1982 was adjusted for by the use of a conversion factor, however, an effect due to research vessel may still be present. It should also be noted that the conversion factor was a general one which did not take into account age-specific differences in catchability and thus abundance estimates of age 1, for example, may not be directly comparable between 1977-81 and 1982-88. The abundance in numbers for the 1986 survey was the highest in the series, while the abundance in 1988 is 50% of the average estimated from 1985-87.

However, the abundance of the 1985 year-class at age 3 in the 1988 survey was found to be much below what had been seen in earlier surveys.

The joint USSR-Canada juvenile silver hake survey has been conducted in a consistent manner since 1981. A standardized method of calculating the index was agreed upon in 1986 (*NAFO Scientific Council Rep.*, 1986 page 121) and was used to calculate the following series.

Year-class	1981	1982	1983	1984	1985	1986	1987	1988
Number/tow	579	9	232	43	285	198	102	205

This juvenile survey indicates that the 1988 year-class is similar in size to the 1983 and 1986 year-classes and is below the strong 1985 year-class.

iii) Commercial fishery observations

In 1988, as in the previous year, extremely dense and stable aggregations of silver hake were observed on the Scotian Shelf slope (NAFO SCR Doc. 89/16). The by-catches of pollock, cod, haddock, hakes (*Urophycis* spp.) and mackerel were low relative to earlier years and were within the Canadian allowable rate.

In 1988, silver hake moved out of the fishing area in late June consistent with the usual pattern. SCR Doc. 89/16 suggested that the hydrographic conditions rather than fish reaching spawning conditions, was the main reason for the migration.

c) Estimation of Parameters

i) Introduction

Two stock assessment documents were reviewed. SCR Doc. 89/14 described a standard SPA calibrated by fitting a regression of population biomass and standardized catch rates. As the assessment used the previous catch-at-age and assumed M = 0.5, it was considered inappropriate. SCR Doc. 89/48 was based on comprehensive sampling data for 1988 catches and used the previously accepted value of M = 0.4. The latter document was taken as the basis for this assessment.

ii) Partial recruitment

The partial recruitment used in the previous assessment was considered appropriate for the current assessment and is presented below.

Age	1	2	3-9
Partial recruitment	0.045	0.301	1.0

iii) Natural mortality

Consistent with previous assessments, STACFIS used a natural mortality estimate of 0.4 for this assessment.

iv) Total mortality

Research vessel catch and the previous catch-at-age were used to calculate total mortalities (SCR Doc. 89/15). The research vessel estimates suggested minimal changes in Z between the 1972-78 period compared to the 1979-86 period.

d) Assessment Results

i) Fishery mortality in 1988

Several formulations of the ADAPT framework using research vessel and commercial catch indices were explored. The research vessel survey index was highly variable and in particular the estimates of population size in 1988 were considerably lower than would be expected from those of the previous year. Calibration using the research vessel survey was considered to be less reliable than using the catch-rate index. Thus, for illustrative purposes an ADAPTIVE framework run based on CPUE, weighted by standard errors, was used to calculate population size for 1988.

ii) Influence of change in catch-at-age matrix

To determine the impact of revision of the catch-at-age matrix on the calculations, estimates of terminal F and population size using the revised catch-at-age and the catch-at-age used in the last assessment were examined by comparing the results from two ADAPT runs. Inputs were the two catch-at-age matrices for the 1977-87 period, the partial recruitment used in the previous assessment, the current CPUE series weighted by standard errors. The results are summarized below.

Run	F_t	Numbers (10^9)	1987 population biomass (10^6 tons)	Numbers	Slope	Estimates of Age 1 numbers (10^9) 1986	1985	1984
Old catch	0.200	8.2	0.92	Sig.	Sig.	7.1	1.6	1.9
New catch	0.204	6.7	0.82	Sig.	Sig.	7.0	1.7	2.1

The similarities in terminal fishing mortalities and numbers at age 1 indicate that the changes in the catch-at-age are having a marginal influence on estimates of terminal fishing mortality.

iii) Reliability of population size estimates for 1988

Comparison of the results of the calculations based on 1977-87 data with those when 1988 data are included illustrates that the 1988 data results in a radically different view of stock status. The population estimates for 1988 implied a fully recruited fishing mortality in 1987 of F = 0.41 while the estimated population from the retrospective analysis corresponds to a fully recruited F in 1987 of 0.20. This discrepancy as well as similar discrepancies in population abundance and biomass and the size of the 1985 year class at age 1 caused STACFIS to lack confidence in the calibration of the SPA. It was decided, therefore, not to depend on specific calculations, but to formulate advice on the basis of general considerations.

e) Catch Projections

An analytical assessment could not be made because of the high variability in the data. However the stock is well documented, CPUE data were presented for the period 1977-78, a survey provides an estimate for the 1+ age-groups by numbers and a juvenile survey provides an estimate of 0 group silver hake.

The 1990 fishery will be dominated by the year-classes 1986-88 with the 1985 year-class giving a minor contribution. The three year-classes 1986, 1987 and 1988 are judged from Fig. 9 more or less average in as much that none of these shows very marked deviations, for example the 1985 year-class. The 1+ survey in 1988 is dominated by the 1985 year-class which will be fished out by 1990-91 (Fig. 10).

The catch rates (Fig. 11) are highly variable and although they show a marked drop between 1987 and 1988 this drop is not statistically significant and is hence difficult to interpret. Changes of this magnitude have been noticed several times in each direction, (Fig. 11), and is not uncommon in this stock. The different analyses of the catch-at-age data give a consistent picture of a higher level of fishing mortality in 1984-86 than in 1987-88. The different analyses however give highly variable results in absolute level of abundance which would imply catches at the $F_{0.1}$ level varying over the complete range of TACs advised in the past.

STACFIS is therefore not able to make a meaningful catch projection for 1990 for this stock.

Should the workshop recommended under Section f - Future Studies, resolve the questions related to the variability in the data, the Scientific Council would be in a position to assess the stock early in 1990, if a special meeting would be called for that purpose.

Given the irregular pattern of strong and weak year-classes seen in this stock, there seems to be little concern that a temperate fishing mortality above $F_{0.1}$, would have any lasting impact on the spawning stock biomass. The possible impact on spawning stock biomass is also reduced because of the limited number of age groups in the fishery.

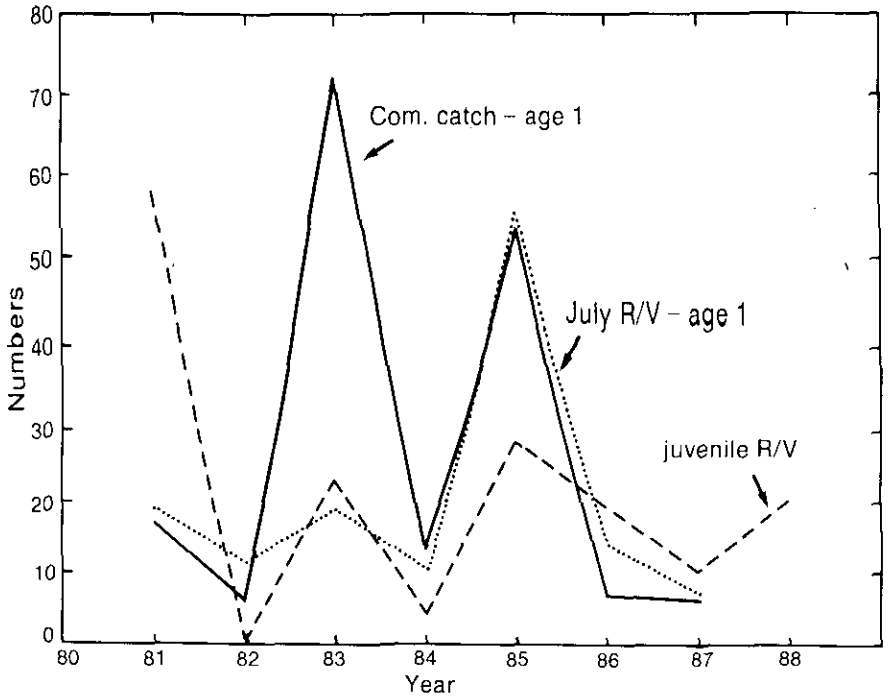

Fig. 9. Silver hake in Div. 4VWX: juveniles stratified mean catch/tow (x 0.1) plotted with R/V (x 10^{-6}) and commercial catch age 1 numbers for the following year.

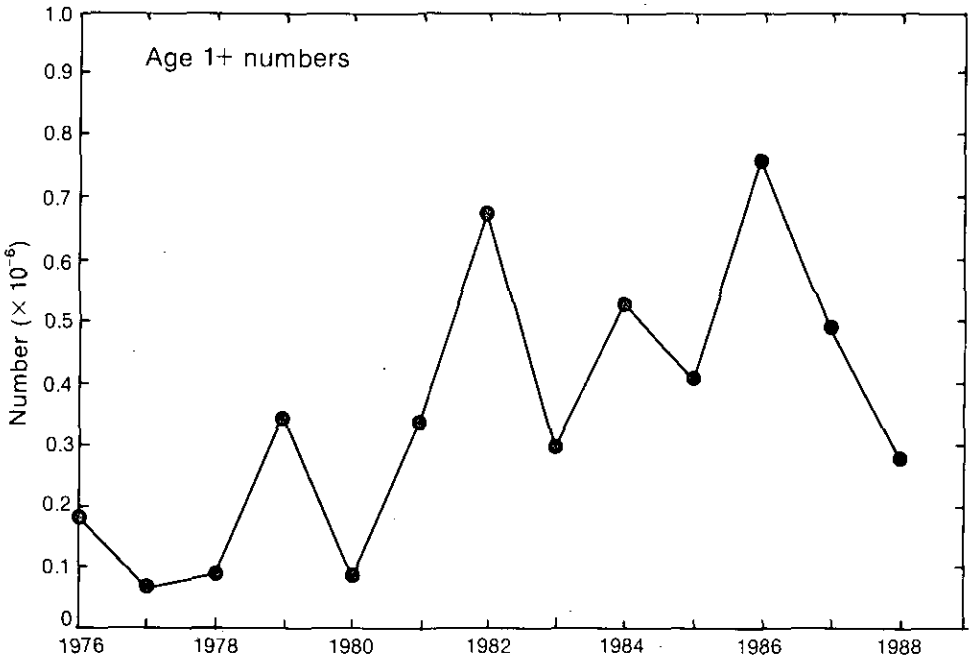

Fig. 10. Silver hake in Div. 4VWX: July R/V survey estimates of silver hake numbers.

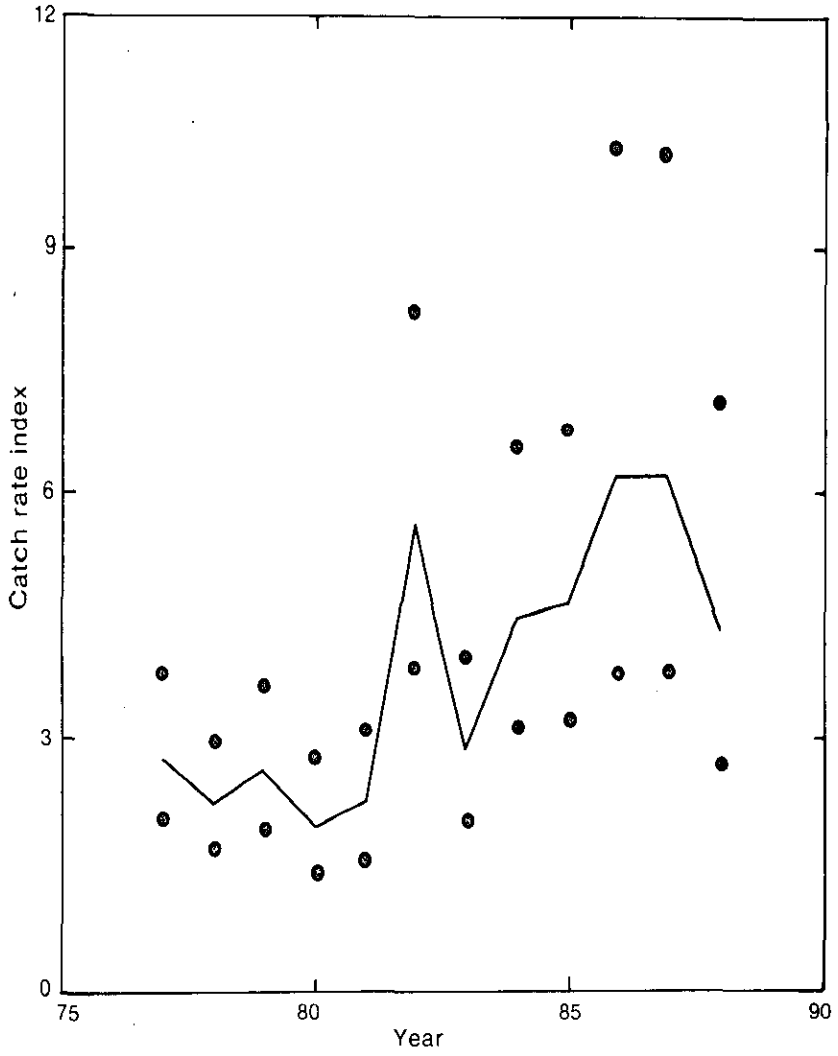

Fig. 11. Silver hake in Div. 4VWX: standardized mean-catch-rate series from 1977-87.

f) Future Studies

The continuation of the joint Canada-USSR juvenile research vessel surveys is encouraged. STACFIS notes that disagreements and doubts persist about many of the input data and derived indices and parameters and recommends that *a workshop be held on silver hake stock assessment data and analysis. This workshop should be convened early in 1990.*

8. American Plaice in Division 3M (SCR Doc. 89/60, SCS Doc. 89/8, 15, 16)

a) Introduction

From 1974, when TAC regulation was introduced, to 1985, reported catches from this stock ranged from about 600 to 1,900 tons. The catch increased from about 1,700 tons in 1985 to 3,800 tons in 1986 and 5,600 tons in 1987. With the moratorium on fishing for cod in Div. 3M in 1988, fishing effort and therefore catches of A. plaice were reduced. Consequently, the catch in 1988 decreased to about 2,800 tons, 1,600 tons of which was taken by EEC-Spain. STACFIS again noted that because estimates of the catch by non-member countries do not exist for some years, doubts exist about the accuracy of catch levels for this stock. Recent TACs and nominal catches ('000 tons) are as follows:

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	2	2	2	2	2	2	2	2	2	2	2
Catch	0.8	1.2	0.6	1.1	1.9	1.3	1.7	3.8	5.6[1]	2.8[1]	

[1] Provisional data

b) Input Data

i) Commercial fishery

Length frequency samples were available for 4 months from the Spanish fishery in 1988. However, data for 1986 and 1987 were too scarce to allow for a comparison.

ii) Research vessel surveys

Surveys by the USSR showed the biomass to be relatively stable between 6,500 and 9,300 tons from 1983-88, with the exception of an anomalously high value in 1986. An EEC survey in 1988 showed the biomass to be about 12,000 tons, but it was noted that this was thought to be an underestimate because of the type of trawl gear used in the survey. STACFIS noted that the EEC survey in 1988 was the first in a time series, and its comparability with the USSR surveys was not known at this time.

The USSR survey in 1988 showed that American plaice from 32 to 38 cm were predominant in catches. This was also found in the EEC survey, which identified the major age-groups to be 5-8 years old.

c) Catch Projections/Prognosis

STACFIS noted that the biomass from USSR surveys had been relatively stable, and that the average biomass from the 2 surveys (EEC, USSR) in 1988 was about 10,000 tons. It was also noted that no yield-per-recruit analysis was available for this stock from which exploitation rates could be calculated. Therefore, STACFIS decided to use the Y/R analysis available for the adjacent Grand Bank stock, which shows $F_{0.1}$ to be 0.26 and F_{max} to be about 3.1. The $F_{0.1}$ level of 0.26 and a natural mortality rate of 0.2 implies an exploitation rate of about 20%.

This indicates that a catch of 2,000 tons would approximate $F_{0.1}$. STACFIS noted that fishing at F_{max} would require an increase in effort of over 10 times to realize an increase in yield of only 20%. STACFIS does not consider F_{max} to be a realistic reference point for this stock, and reiterates its advice for a TAC of 2,000 tons in 1990.

9. American Plaice in Divisions 3L, 3N and 3O (SCR Doc. 89/37, 71; SCS Doc. 89/08, 15, 16)

a) Introduction

The stock has been exploited consistently since the early-1950s, with the largest nominal catch (94,000 tons) occurring in 1967. USSR vessels took significant catches during 1965-76, while Canada took over 90% of the catch during 1976-82. Starting in 1982, other nations, notably South Korea, Panama, Cayman Islands, USA, and EEC (Spain, and Portugal) have increased their involvement in the fishery. This resulted in a catch by non-Canadian vessels of about 27,500 tons in 1986, about double the 1985 level. In 1987, the non-Canadian catch was about 17,500 tons. Decreases in catch by EEC-Portugal (-6,700 tons) and non-member countries (-4,500 tons) accounted for this decline. Catches by EEC-Spain increased from about 12,000 tons in 1986 to 14,500 tons in 1987, while the Canadian catch remained stable around 34,000 tons. Overall, the 1987 catch was about 53,000 tons (5,000 tons over the TAC), down slightly from the 1985 and 1986 catches of 54,000 and 61,000 tons respectively. The catch in Div. 3L increased by about 6,500 tons in 1987 to approximately 32,300 tons, while the catch in Div. 3N declined by almost 50% to 16,000 tons and the catch in Div. 3O remained constant at about 5,000 tons. The decline in Div. 3N resulted from a redeployment of fishing effort into deeper water by some nations which had fished for American plaice in 1986. In 1988, the overall catch was about 38,000 tons which was the lowest catch from this stock since 1963. The catch by Canada was 26,800 tons which was also the lowest Canadian catch since 1963. This decline between 1987 and 1988 was primarily the result of a reduced catch in Div. 3L with catches in Div. 3N and 3O remaining relatively stable.

STACFIS noted that catch statistics for this stock are not adequate and that for some non-member nations, substantial catches in some recent years have been included in the assessments, based on estimates of catch and effort from Canadian surveillance authorities. For example, in 1986 about 4,600 tons of the total catch came from the surveillance estimates. This was not a major concern for 1987 and 1988 statistics since there was very little effort directed towards flatfish stocks by non-reporting countries. STACFIS also noted that there was very little information on discarding for this stock and that reported catches continue to reflect landings, rather than actual removals. The limited information available, which is from several years ago, suggests that discarding may be substantial in some years. Recent TACs and nominal catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	47	47	55	55	55	55	49	55	48	40[1]	30.3
Catch	49	49	50	51[2]	39[2]	39[2]	54[2]	61[3]	53[3]	38[3]	

[1] Although the TAC was set at 40,000 tons, Canada reduced its domestic quota to 33,000 tons, therefore the effective TAC was 33,585 tons.
[2] Includes approximately 40% of the "flounder non-specified" catch reported to NAFO by South Korea.
[3] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort. Catch and effort data from the commercial fishery in Div. 3LNO during 1956-88 were analyzed using a multiplicative model to obtain a catch-rate series. It was noted that an error in the data from 1984-87 had been corrected in 1989, and that the catch rates calculated for 1984-87 in last year's assessment were overestimated by up to 15%. The error was largest for 1984.

As was done in the 1988 assessment of this stock, data from Canada (N) trawlers (tonnage classes 4 and 5) were used in the model, and the same procedure was followed in the analysis. The results showed a decline in CPUE from about 1.3 t/hr in the late-1950s, to about 1.0 t/hr in 1961-67, and a further decline to about 0.45 t/hr in 1974-78. Catch rates subsequently increased to over 0.6 t/hr in 1980-85, then declined almost 30% to about 0.45 t/hr from 1986-88. The CPUE in the last 3 years were very similar to the lowest level observed for this stock, which was in the 1974-78 period.

STACFIS noted that the addition of Div. 3O to the dataset in 1989 did not produce any changes in the CPUE trends from those in the analysis which used Div. 3LN only.

Catch-at-age and mean weights-at-age. Catch-at-age was available from the Canadian, Spanish, and USA fisheries in 1988. The major age groups in these 3 fisheries were 9-11, 6-8, and 8-10 respectively. Approximately 77% (by number) of the Spanish catch was at ages 8 and younger, compared to about 10% in the Canadian catch and about 20% in the USA catch. Overall, about 26% of the 1988 catch numbers were ages 5-8, compared to about 37% in 1986 and 30% in 1987. Both in absolute numbers and percentage, the catch of older fish (12+) remained very low in 1988.

At the recommendation of STACFIS in 1988, the catch-at-age for the portion of the stock in Div. 3O was calculated and added to the catch-at-age in Div. 3LN used in previous assessments. These calculations resulted in a catch-at-age matrix for the years 1974-88 for Div. 3LNO, compared to the years 1965-87 for Div. 3LN used previously. STACFIS noted that the overall pattern of catch-at-age for 1974-88 was not changed substantially by the addition of the data for Div. 3O.

The mean weights-at-age in 1988 were similar to those in recent years. Again, the incorporation of Div. 3O in the weights-at-age for previous years did not result in substantial changes.

ii) Research vessel surveys

Canadian stratified-random groundfish surveys. Data from spring surveys in Div. 3L, 3N and 3O were available from 1971-89, excluding 1983. In Div. 3L, the biomass had remained relatively stable from 1985-88, ranging from 174,000 tons to 193,000 tons. However, the estimate for 1989 is somewhat lower at 153,000 tons. In Div. 3N, the estimate of biomass declined from about 60,000 tons in 1984-85 to 43,000 tons in 1989. In Div. 3O, the biomass has fluctuated between 44,000 tons and 77,000 tons in the 1984-89 surveys, with the 1989 estimate being the lowest.

In addition to the annual spring surveys in Div. 3LNO, a number of seasonal surveys have been conducted by Canadian vessels in Div. 3L from 1983 to 1988. Coverage in all these surveys was virtually complete to depths of 200 fathoms (366 m) in all years, and in some years was extended to 400 fathoms (732 m). In 1983-84, the average biomass was about 290,000 tons. In 1985, the average from the four surveys was 209,000 tons; and three of the four estimates were between 212,000 and 227,000 tons. 1986 produced three widely-different estimates with the winter value clearly being an anomaly at about 49,000 tons. In 1987, three surveys indicated a biomass between 168,000 and 202,000 tons, with the average (184,000 tons) being very close to the 2 estimates (spring and fall) for 1988 of about 190,000 tons.

To examine the biomass in the NAFO Regulatory Area in Div. 3N, all the strata <201 fathoms (368 m) which have all or almost all their area in that zone were selected. These strata showed a steady decline from 1984 to 1988, totalling 79%. However, in 1989, the biomass increased to slightly above the 1987 level. In 1984-86 these strata in the regulatory area contained about 26% of the total biomass in Div. 3N. This figure declined to about 13% in 1987 and about 11% in 1988 and rose to about 19% in 1989. Preliminary reports of increased effort on flounders on the Tail of the Bank in 1989 compared to 1988, are consistent with the increase in abundance in this area as indicated by the 1989 survey.

Age-by-age abundance estimates for Div. 3L, 3N and 3O for the 1971-88 period were derived using multiplicative models to fill in values for strata not fished in a given year. This procedure was initiated in Div. 3LN in the 1988 assessment and upon the recommendation of STACFIS in 1988 Div. 3O was included in the 1989 assessment.

In Div. 3L, the abundance in recent years was considerably lower than that observed from 1976 to 1982, when a number of strong year-classes were present in the population. Although the recent surveys indicated that the early-1980s year-classes may be somewhat higher than those of the late-1970s, the estimates of these year-classes in the 1987 and 1988 surveys were still well below the estimates observed for strong year-classes at the same ages in earlier surveys. It should be noted that the biomass estimate in Div. 3L from the 1989 survey was about 20% lower than the 1988 survey.

In Div. 3N, the abundance estimates have shown more fluctuation over the series, but it was again clear that the abundance in 1986-88 was substantially lower than average and was probably at the lowest level in the 17-year series. Unlike Div. 3L, there was no evidence of better than average recruitment in the 1987 and 1988 surveys. The 1989 biomass estimate approximated the average value from the 1986-88 surveys in Div. 3N.

In Div. 3O, the estimates of abundance show even more variability than Div. 3N; however, 1986 and 1988 are the lowest two estimates in the 14-year series.

From fall surveys in Div. 3L, population estimates in 1985-88 were much lower than those from 1981 to 1984. Although ages 7 and 8 were dominant in the fall and spring surveys in 1988, these year-classes did not appear as strong in fall surveys as seen in the spring time series. The numbers of age 8+ and 12+ were similar in the 1987 and 1988 fall surveys.

Canadian juvenile flatfish surveys. Stratified random surveys of the Div. 3LNO have been conducted inside the 50-fathom depth contour, and were directed primarily for juvenile yellowtail flounder. In 1988 largest catches of American plaice (in numbers) were made in stratum 353 (see Fig. 16 in yellowtail flounder in Div. 3LNO) in Div. 3O and strata 360 and 376 in Div. 3N, similar to surveys in the previous years. Similarly, largest catches of juvenile American plaice ages 1 to 4 years were found in these strata, which occupy most of the Regulatory Area.

The distribution of 1-year-old American plaice on the southern Grand Bank is overlapped by the distribution of 2-, 3-, and 4-year-old American plaice. There have been smaller concentrations of 1-year-old American plaice distributed in other areas of the Bank in Div. 3N and in Div. 3L. Catches of 3- and 4-year-old American plaice increased in Strata 353, 360 and 376 from 1987 to 1988 while ages 1 and 2 were lower. Stratum 360, where most of the abundance of juveniles was usually found, was examined for changes in population numbers at age for 1986, 1987 and 1988. Total abundance decreased in 1987 by 40%, from 1986, but increased by 18% in 1988. This increase in estimates for the last year is reflected in the abundance of 1- to 4-year-old American plaice being dominated by 3-year-olds from the 1985 year-class. The abundance of American plaice aged 7+, decreased 84% from 1986 to 1987 but increased by 78% in 1988, with the increase consisting mainly of 7- and 8-year-olds from the 1979-80 year-classes. Length frequency for catches showed the highest catches of plaice less than 26 cm were made in the Regulatory Area, in comparison with the rest of Div. 3LNO.

These conclusions support the hypothesis that the area of the Grand Bank known as the "Tail of the Bank" supports a nursery area, which is dominated by 1- to 4-year old American plaice in large quantities and includes adults, for the southern Grand Bank American plaice population. Evidence from exploratory sets outside the survey area in 1988 indicated that Div. 3L has large concentrations of juveniles in northern strata occupying depths of 51-100 fathoms.

USSR Stratified-random groundfish surveys. USSR surveys of Div. 3LNO have shown a steady decline in biomass of American plaice from 1984 to 1988 while the abundance declined for the period 1983-88. Biomass in 1988 declined by 29% from 1987 while abundance decreased by 24%. Both the 1988 abundance and biomass estimates were the lowest in the time series 1983-88.

c) Estimation of Parameters

i) Sequential population analysis

Several formulations of the adaptive framework were attempted to determine the stock size in 1988. For the CPUE fits with fishable biomass (using both annual and average partial recruitment for the years 1975-88), there were trends in the residuals which were not acceptable. These trends were also present in the formulations using 8+ and 10+ population biomass, but were not present in the 12+ formulation. Consequently, this formulation was felt to represent the best fit with the CPUE data and showed that the fully recruited fishing mortality in 1988 was 0.5. However, STACFIS noted that the population sizes at ages 5-9 were in conflict with the survey information, and attributed this to the fact that the partial recruitment values on these ages were not well estimated.

Using the Canadian survey data for Div. 3LNO for 1975-88 (excluding 1983, when no survey was conducted), and estimating ages 6-15, the adaptive framework showed fully recruited fishing mortality in 1988 to be about 0.9. However, STACFIS noted that fishing mortality values for ages 10+ were very high compared to most years and expressed doubt that these values were realistic. It was noted that the estimates at all ages were significant and that the formulation did not require estimates of partial recruitment to determine the population sizes.

STACFIS noted that the calibrations for this stock using the ADAPT method showed the same divergence in the indices that was shown in recent assessments. In 1988, the CPUE index showed F to be about 0.5, while the RV survey index showed F to be about 0.7 or higher. Noting that the divergence was somewhat wider in this assessment (0.5 to 0.9) STACFIS concluded that it would not be appropriate to average the fishing

mortalities, as was done in 1988. Therefore it was decided to use the population estimates at ages 6-9 from the survey formulation, and the population at ages 10+ from the CPUE run. STACFIS noted that these were the more optimistic parts of each formulation, but that the combined population estimates were more reasonable than those in total from one formulation or the other. STACFIS felt that the previously noted characteristics associated with the commercial fishery and research vessel survey data made this choice appropriate. That is, that the CPUE index was a better indicator of population size at older ages, and that the research vessel surveys were a better index of the population of younger fish.

ii) Yield-per-recruit (Fig. 12)

A Y/R curve was presented which used the mean weights-at-age and partial recruitment from the commercial fishery in 1986-88. This indicated that $F_{0.1}$ was 0.21 and that F_{max} was 0.40. STACFIS noted that these results were similar to an analysis done in 1988 (*NAFO Sci. Coun. Rep.*, 1988, page 57). The parameters used in the new Y/R analysis are thought to reflect the situation in the current fishery, in which the mean weights-at-age are somewhat higher than in the long-term average. Although STACFIS felt that the short-term averages were likely to be representative of the fishery in the near future, it was reluctant to accept the new Y/R analysis without a more detailed analysis of changes in partial recruitment, mean weights, and age structure of the population. Therefore STACFIS recommends that *the currently-used Y/R analysis for American plaice in Div. 3L, 3N and 3O, which indicates $F_{0.1}$ to be 0.26 and F_{max} to be 3.1, be maintained and that the necessary work be carried out so that an analysis of changes in Y/R can be evaluated in 1990.*

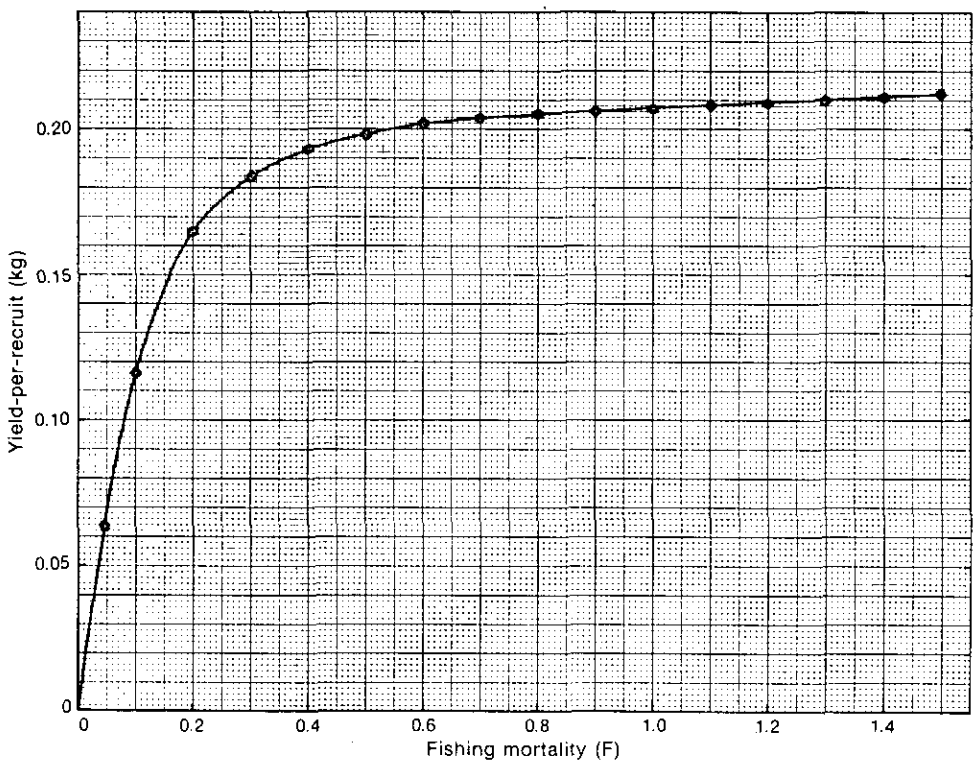

Fig. 12. American plaice in Div. 3LNO: yield-per-recruit curve.

d) Assessment Results

This assessment indicated that F increased over the 1983-86 period then declined somewhat in 1987 and 1988 (Fig. 13). Fully recruited F in 1988 was 0.5 and was calculated to be 0.6 in 1987, agreeing with the estimate for 1987 in last year's assessment. The population size at ages 8+ was relatively stable from 1983-86, but declined about 12% in 1987 and a further 8% in 1988. The fully recruited population (ages 12+) sizes in 1987 and 1988 were virtually unchanged, and remained at close to the lowest levels in the 15-year series of the SPA. The assessment indicated that the 1978-80 year-classes were lower than average (Fig. 14), but that the 1981 and 1982 year-classes were slightly larger, although they were still lower than those of the late-1960s and early-1970s.

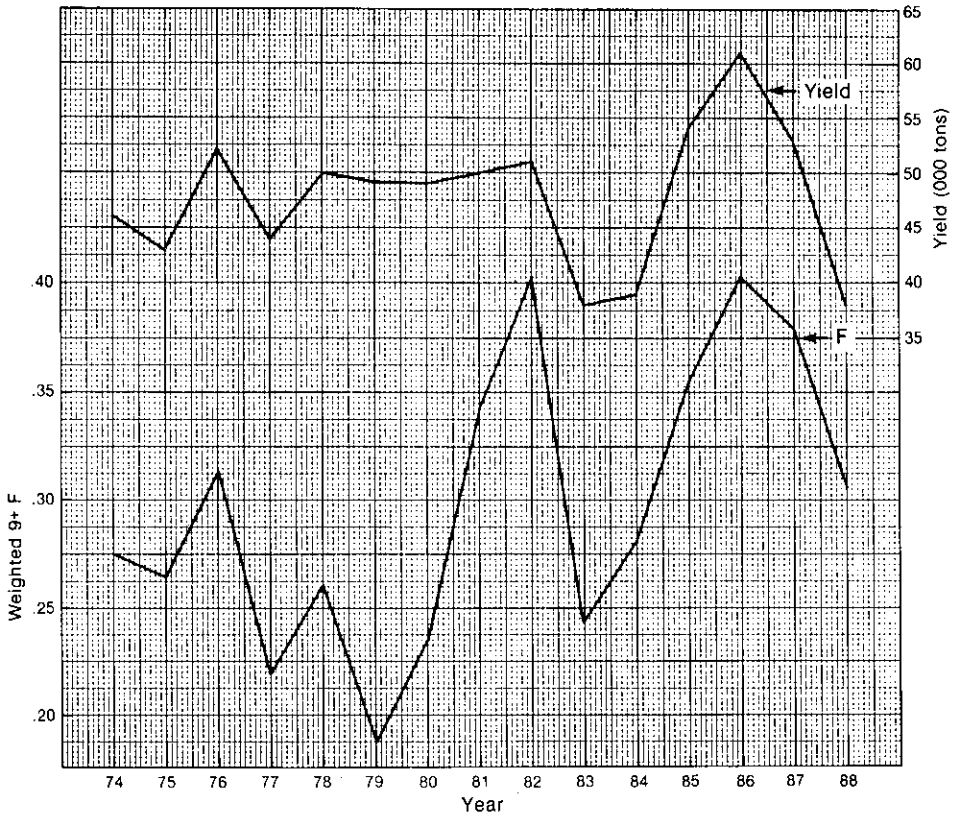

Fig. 13. American plaice in Div. 3LNO: trends in yield and 9+ F(weighted by populations numbers).

e) Prognoses

i) General information

STACFIS once again pointed out, that at present there is no control over the catch by non-member countries. TACs have been exceeded in recent years and if this continues, the stock will be difficult if not impossible to manage. This is of particular concern, given that a very high proportion of young American plaice is found in the Regulatory Area and therefore are particularly susceptible to such uncontrolled fisheries.

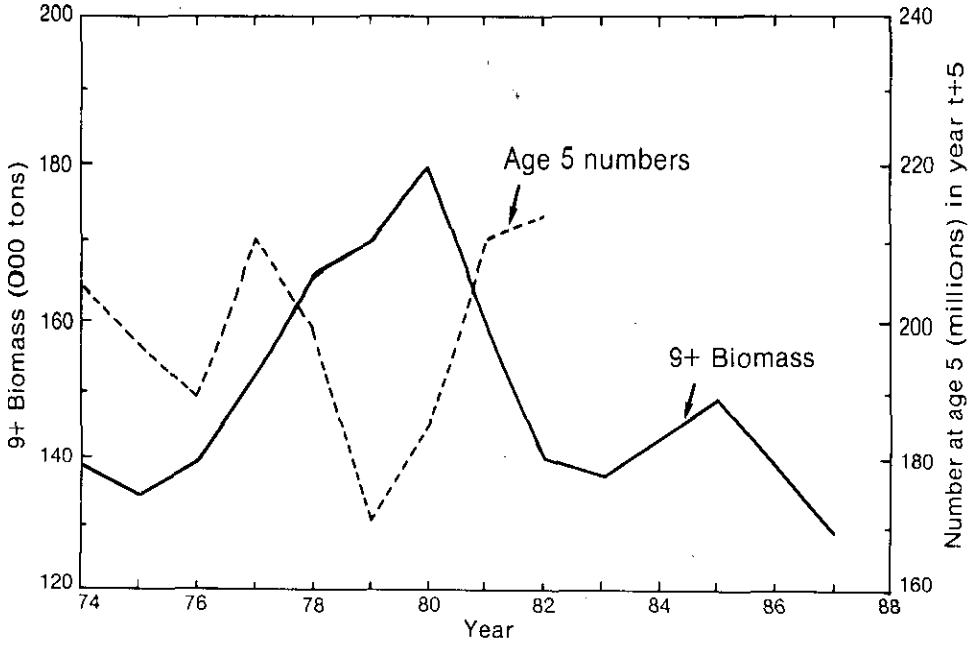

Fig. 14. American plaice in Div. 3LNO: trends in 9+ population biomass in year t and recruits-at-age (year t+5).

ii) Catch projections

The population sizes from the ADAPT formulations described previously were used to project catches for 1990. The population at age 5 in 1989 and 1990 was taken as the geometric mean from 1974-87. The average weight-at-age and the partial recruitment were averages from 1986-88 (Table 7).

Table 7. American plaice in Div. 3LNO: parameters used in projections of biomass and yield.

Age	Jan 1, 1989 Stock Size	Avg. wt.	PR
5	218,000	.173	.020
6	176,592	.247	.058
7	138,866	.338	.113
8	106,246	.426	.189
9	66,849	.504	.331
10	39,108	.632	.504
11	30,643	.789	.733
12	19,024	1.032	1.000
13	8,531	1.342	1.000
14	3,804	1.710	1.000
15	1,634	2.165	1.000
16	905	2.765	1.000
17	356	3.356	1.000
18	55	4.322	1.000
19	1	4.365	1.000

Table 8 contains the results of the catch projections at a) $F_{0.1}$ in 1990, b) catch in 1990 = catch in 1988, and c) $F_{90} = F_{88} = 0.5$, assuming a catch of 30,300 tons in 1989 (Fig. 15).

Table 8. American plaice in Div. 3LNO: projected catch in 1990 and biomass on Jan 1, 1991 at various F levels, assuming 1989 catch = 30,300 tons.

F in 1990	Catch in 1990 ('000 tons)	9+ Biomass on 1 Jan 1991 ('000 tons)
0.26	24.9	152
0.42	38.1	140
0.50	44.4	134

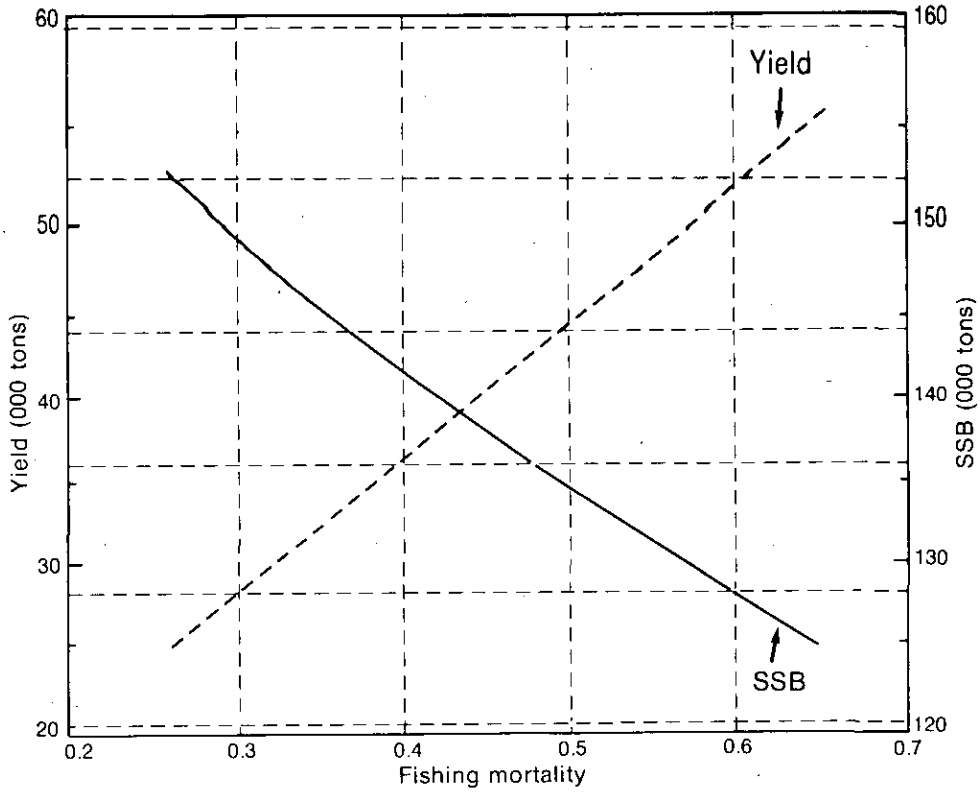

Fig. 15. American plaice in Div. 3LNO: projected yield in 1990 and 9+ biomass at 1.1.1991.

Table 9 shows the results for the same data, assuming a catch in 1989 of 40,000 tons. These latter options represent the situation if an overrun of the 1989 TAC of about 30% occurs.

Table 9. American plaice in Div. 3LNO: projected catch in 1990 and biomass on Jan 1, 1991, at various F levels, assuming 1989 catch = 40,000 tons.

F in 1990	Catch in 1990 ('000 tons)	9+ Biomass on 1 Jan 1991 ('000 tons)
0.26	23.1	145
0.42	35.6	133
0.50	41.4	128

STACFIS noted that these projections were for the entire stock (Div. 3LNO) and that no figure for Div. 3O was to be added as has been the case in previous assessments. STACFIS again pointed out that no projections were done at F_{max} as that was not a meaningful reference point for this stock when the current Y/R analysis was used. Using the new Y/R analysis presented at this meeting, the values for the $F_{0.1}$ catch in Tables 8 and 9 would be 20,400 tons and 18,900 tons respectively. The options at 0.42 in these tables would correspond closely to the F_{max} (0.40) option calculated in the new Y/R analysis. STACFIS also noted that the decline in the projected $F_{0.1}$ catch for 1990 was due in part to the overrun of the 1988 TAC, and in part to the fact that the 1989 TAC would generate a fishing mortality above $F_{0.1}$, as based on the current assessment.

f) Formulations of Adaptive Framework Used

i) Survey

Parameters:

- Year-class estimates
  N_i, 1988 i = 6,15
- Calibration coefficients for RV numbers
  K_i i = 6,15

Structure:

- Natural mortality = 0.2
- Error in catch-at-age assumed negligible
- F on oldest age (19) calculated as weighted F for ages 12-16
- F on ages 16-19 in 1988 was set equal to the F for ages 12-15 in 1988
- Intercepts not fitted

Input:

- $C_{i,t}$ i = 6,15 t = 1975-88
- $RV_{i,t}$ i = 6,15 t = 1975-82, 1984-89

Objective function:

- Minimize
  $$\sum_{it} [obs(\ln RV_{it}) - pred(\ln RV_{it})]^2$$

Summary:

- Number of observations = 126
- Number of parameters = 20

ii) CPUE

Parameters:

- Year-class estimates (N_i, 1988, i = 12)
- Calibration constant for CPUE (q)

Structure:

- For oldest age (19) set equal to weighted F on ages 12-16
- intercept not fitted
- Error in catch-at-age assumed negligible
- Natural mortality = 0.2
- The following PR was assumed for 1988

Age	5	6	7	8	9	10	11	12-19
PR	.01	.04	.12	.23	.37	.54	.75	1.00

Input:

- $C_{i,t}$ i = 5-19, t = 1975-88
- C/E_t related to 12+ population biomass

Objective function:

- Minimize

$$\sum [\text{obs}(\ln C/E_t) - \text{pred}(\ln C/E_t)]^2$$

Summary:

- Number of observations = 14
- Number of parameters = 2

10. Witch Flounder in Divisions 3N and 3O (SCR Doc. 89/07)

a) Introduction

Reported catches of witch flounder from 1970-84, ranged from about 2,400 tons in 1980 and 1981 to 9,200 tons in 1972. With increased effort mainly by EEC countries in 1985 and 1986, particularly Spain and Portugal, catches rose rapidly to 8,800 and 8,500 tons respectively. This increased effort was concentrated mainly in the Regulatory Area of Div. 3N. Other non-member countries such as the USA, Korea, the Cayman Islands, and Panama also contributed to increased catches. In 1987 and 1988, the catch was 7,600 and 6,100 tons respectively and was taken mainly by Canada, EEC (Spain and Portugal) and the USSR. With reduced catch rates for flatfish generally outside the Canadian 200-mile limit, some countries have diverted effort towards other species such as redfish, and this may explain some of the reduction in catch in 1987 and 1988 compared to 1985 and 1986. Recent catches and TACs ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	7	7	5	5	5	5	5	5	5	5	5
Catch	3	2	2	4	4	3	9	9[1]	8[1]	6[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort statistics for Canada (N) from 1972-88 were available from the fishery conducted in Div. 3O. Canadian catch rates declined from 0.72 tons/hr in 1972 to a low of 0.19 tons/hr in 1979. Between 1979 and 1984 catch rates fluctuated from 0.19 tons/hr and 0.67 tons/hr. The catch rates declined somewhat over the 1985-87 period, however, were still considerably above those levels experienced during the late-1970s. For 1988, on the other hand, the catch rate fell to 0.27 tons/hr near the lowest level for the period. It is recognized, of course, that for some years the proportion of main species catch on which the figures are based is very low and the precision of such data as indices of stock size is questionable.

ii) Research vessel surveys

Biomass estimates were available from USSR surveys during 1983-88. Estimates, highly variable over the period, were relatively stable at a level near 18,000 tons for 1987 and 1988. The length compositions were also similar for the 1983-88 period suggesting a relatively stable age composition in the stock.

c) Catch Projections

Considering the commercial fishery data, STACFIS concluded that the stock component in Div. 3O may have declined since 1985, however, the information is based upon small proportions of the total removals. With the high variability in estimates of biomass from surveys STACFIS was unable to draw firm conclusions regarding stock size. With the information available STACFIS could not advise a change in TAC for 1990 from the 5,000 ton level presently in effect.

STACFIS reiterated its concern about the increasing catch levels in recent years, particularly in Div. 3N, and considered that the stock would unlikely sustain such catch levels without a decline in stock abundance.

d) Future Research

STACFIS reiterates its recommendation that *countries fishing the witch flounder stock in Div. 3NO should collect catch and effort information as well as length and age data and present them to NAFO to allow for a better evaluation of the status of this resource.*

11. Yellowtail Flounder in Divisions 3L, 3N and 3O (SCR Doc. 89/68; SCS Doc. 89/08, 15, 16)

a) Introduction

Nominal catches increased rapidly from a few hundred tons in 1963-64 to a high of about 39,000 tons in 1972. Vessels from Canada and the USSR took almost all of the catch, up to and including 1975, with only Canada taking significant catches in 1976-81. After 1981 several other countries entered the fishery, notably South Korea, EEC (Spain and Portugal), Panama, USA and the Cayman Islands. In 1986 an estimated 16,581 tons were caught by non-Canadian vessels (54% of total catch of 30,736 tons). In 1987 catches by Canada dropped by 741 tons (5%) to 13,414 tons while catches by other countries fishing outside the Canadian 200-mile limit dropped by 13,614 tons (82%) to 2,967 tons from 1986. In 1987, no catch was reported by or estimated for EEC-Portugal, Panama, and Cayman Islands, countries which took over 11,000 tons in 1986. That change was attributed to a switch in fishing effort to species in deeper water, such as redfish. Overall the preliminary estimate for 1987 of 16,381 tons was 9% over the TAC and represented a reduction of 47% from the 1986 catch. In 1988, catches by non-Canadian countries increased to 4,137 tons compared to 2,717 tons observed in 1987. The Canadian catch, however, declined in 1988 to about 10,500 tons, down about 3,000 tons from the relatively stable catch level in 1985-87.

STACFIS noted that catch statistics for this stock are not adequate and that for some non-member nations, substantial catches in some recent years have been included in the assessments, based on estimates of catch and effort from Canadian surveillance authorities. For example, in 1986 about 8,000 tons of the total of 29,000 tons came from the surveillance estimates. This was not a concern for 1987 and 1988 statistics since there was very little effort towards flatfish stocks by non-reporting countries. STACFIS also noted that there was very little information on discarding for this stock and that reported catches continue to reflect landings, rather than actual removals, for which there are no complete estimates. Recent TACs and catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	18	18	21	23	19	17	15	15	15	15	5
Catch	18	12	15	12	9	17[1]	29[1]	31[2]	16[2]	15[2]	

[1] Includes approximately 60% of the "flounder non-specified" catch reported to NAFO by South Korea.
[2] Provisional data.

b) Input Data

i) Commercial fishery data

CPUE data. A multiplicative model was used to analyze the catch and effort data for this stock for the first time. Data were available from the NAFO Statistical Bulletins only from 1974 onward in a format identifying main species as yellowtail flounder. Thus it was decided to use Canadian (N) trawler data from 1965 to 1988, from files maintained at the Northwest Atlantic Fisheries Center in St. John's. It should be noted that for some years, particularly the late-1970s, the Canadian fleet provided the only source of CPUE data for this stock. The data used in the model were the same as those used to calculate the CPUE series used previously. However, in 1989, an error was discovered in the data which led to underestimates of effort in 1984-87 of up to 12-15%. These errors were most severe in 1984 and were corrected before the data were used in the multiplicative model.

A comparison of the multiplicative model series with the CPUE values calculated previously for this stock revealed that the two indices were very similar. However, with the correction of the erroneous data for 1984-87 and the application of the multiplicative model, a change in the catch rate trend is apparent in the early-1980s, with 1981 and 1982 no longer showing up as high points. The large decline in catch rate from 1985 to 1986, however, is still obvious. It was also noted that the model shows the 1986-88 CPUE values to be about as low as the previously observed lows for this stock in 1975-76.

As STACFIS noted in 1988, it is likely that the Canadian catch rate index does not reflect the true magnitude of recent declines in stock abundance. This fleet rarely entered the area outside the 200 mile limit in recent years, an area where catches and estimated catch rates have been declining after the large catches in 1985 and 1986.

Catch-at-age and mean weights-at-age. Age compositions were available from the Canadian, Spanish, and USA fisheries in 1988. For the USA data, age-length keys from the Canadian commercial fishery in Div. 3N were used. For the Spanish catch, keys from the Canadian surveys in 1988 were required, because the Spanish length frequencies contained fish of sizes smaller than those seen in the Canadian commercial age-length keys. The age compositions from these 3 fisheries were combined and adjusted to represent the entire catch in 1988.

In 1988, the catch-at-age in the Canadian and USA fisheries were similar with age 7 being dominant in both catches, although the USA catches contained a slightly higher percentage of yellowtail flounder at ages 4-6. However, there were major differences in the Spanish catch-at-age in 1988. About 84% of the Spanish catch numbers were taken at ages 3-5, compared to about 3% for these ages in the Canadian catch. This was consistent with data from research vessel surveys which indicated that juvenile yellowtail flounder were found mainly outside the Canadian 200-mile limit in Div. 3N. The Spanish catch of 3,205 tons was estimated to contain about 24 million fish, while the Canadian landings of 10,544 tons contained approximately 19.5 million fish.

A comparison of the Canadian catch-at-age and mean weights-at-age over the 1986-88 period showed little difference between years.

STACFIS noted that the catch sampling had improved in recent years and that most of the fishery was sampled in 1988. However, there were still substantial portions of catch in recent years, mostly from non-member countries, for which no sampling was available (e.g. 13,600 tons or 44% of the 1986 catch). It was unlikely that the information would ever be available (if it exists) and the deficiency in the database could severely hamper attempts to produce an accurate analytical assessment in the near future.

ii) Research vessel surveys

Canadian stratified-random groundfish surveys. Surveys have been carried out by Canadian research vessels in Div. 3LNO each year from 1971-82 and 1984-89. The surveys from 1984-1989 are comparable in terms of coverage and vessel/gear used. Estimates of biomass of yellowtail flounder from these surveys have decreased in recent years, from about 94,000 tons in

1985-86 to 82,000 tons in 1987 and 53,000 tons in 1988. The 1989 estimate was about 47,000 tons. Most of this decline occurred in Div. 3N, where the biomass estimate in 1985-86 was about 60,000 tons, compared to 50,000 tons in 1987 and 34,000 tons in 1988-89.

In strata 360 and 376 (Fig. 16) which encompass virtually all the yellowtail flounder habitats in the Regulatory Area, the biomass declined from 32,000 tons in 1984 to 1000 tons in 1988 (97% decrease) but increased to 15,000 tons in the 1989 survey. The 1989 estimate comprised 40% of the total biomass in Div. 3N. This increase measured by the recent survey is consistent with reports of increased commercial effort on flounders in the area around the 200-mile limit in 1989.

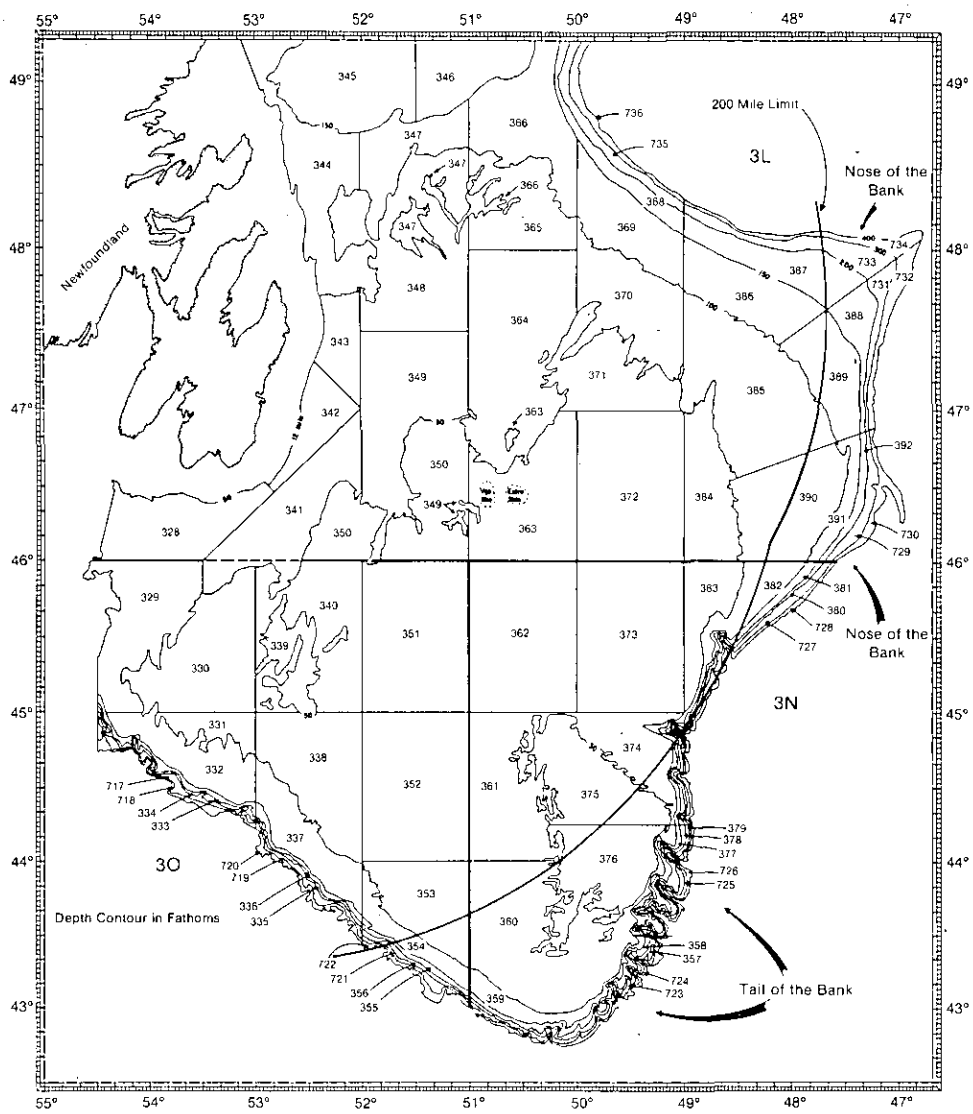

Fig. 16. Yellowtail flounder in Div. 3LNO: strata in the Regulatory Area.

As was done in the 1988 assessment, a multiplicative model was employed to obtain estimates of abundance which accounted for strata not surveyed in some years. The total abundance has decreased substantially in recent years after a period of relative stability from 1975-84, with the values from 1985-89 being the lowest in the series. The overall trends in this new series are essentially the same as those found in the survey abundance index (from selected strata) used previously for this stock. After a decline from very high levels in the early-1970s, the abundance remained relatively stable between 240 and 340 million from 1975 to 1984, after which time it declined to about 100 million in 1988. The 1989 estimate is about 33% higher, but is still the second lowest value in the 18 year series.

On an age-by-age basis, the 1981 and 1982 year-classes continue to show up as very poor, consistently ranking as the worst 2 year-classes in the time series. The 1983 year-class, was shown by both 1988 and 1989 surveys to be very poor. These 3 consecutive poor year-classes (1981-83) produced a population estimate at ages 6-8 in 1989 of about 78 million, which is the lowest value at these ages in the series. This is important because it is these 3 ages which contribute almost exclusively to the commercial catch at age in many years.

The population sizes at ages 4 and 5 were higher in 1989 than in all surveys since 1982. The 1984 year-class, which did not show well in the 1988 survey, appeared to be larger than the 1980-83 year-classes, but was still about 20% lower than the average size at age 5 for the 1968-83 year-classes. The 1985 year-class, which had also shown strongly in the juvenile surveys, was the highest value at age 4 (in 1989) since the 1968 year-class. The biomass in strata 360 and 376, known areas of juvenile yellowtail flounder abundance, was much higher in 1989 than 1988, as the 1984 and 1985 year-classes recruited to the survey. In fact, of the total population abundance at ages 4 and 5 in the stock in 1989, over 90% was estimated to be in these 2 strata, which are largely outside the 200-mile limit.

The following table, which shows the ranks of the estimates of the 1981-83 year-classes at age 5-8 (1986-89 surveys), indicates that the recent estimates for all three year-classes are the worst in the 18 year series:

Year-class	Age 5	Age 6	Age 7	Age 8
1981	15	17	18	17
1982	17	18	17	-
1983	18	16	-	-

The estimate of age 7+ abundance in 1988 was about 62% of the average from 1985-87, and is higher than only the value calculated for 1974. In 1989 the abundance of age 7+ decreased 40% from the 1988 and constituted only 40% of the entire 1989 estimate of abundance at age.

Canadian juvenile yellowtail flounder surveys. From 1985-88 annual fall stratified-random surveys of NAFO Div. 3LNO have been conducted using a Yankee 41 (80/104) shrimp trawl to determine indices of abundance of yellowtail flounder, particularly those aged 1-4 years. All depth strata inside the 50-fathom contour were sampled in 1988. Largest catches (numbers) of yellowtail flounder were made in Stratum 352 in Div. 3O and strata 360, 361, 362, 375 and 376 in Div. 3N (Fig. 16). Catches in Div. 3L were much lower in comparison. Biomass estimates of yellowtail flounder, in selected strata, showed a steady decline since 1986.

In 1988, average numbers-per-tow, after showing an increase from 1985 to 1987, were less than half of the 1987 estimate. Estimates of commercial size yellowtail flounder, age 4+ and fully-recruited yellowtail flounder, age 7+, both showed a steady decline in abundance since 1986. In 1988, abundance estimates of 1 to 4 year juvenile yellowtail flounder were less than half of the 1987 estimate. The 1982 and 1983 year-classes (ages 5 and 6) were only moderate in size while the 1985 and 1984 year-classes appeared to be much stronger in the 1988 survey. The 1981 year-class made up the bulk of commercial size yellowtail flounder (age 7) in the 1988 survey.

In the 1985-88 surveys highest catches of ages 1, 2, 3, and 4 years were found consistently in strata 360, 375, and 376 of Div. 3N. Larger yellowtail flounder were found distributed mainly in stratum 352 of Div. 3O and stratum 361 of Div. 3N. The distribution of 1-year-olds found in the surveys since 1985-88 were concentrated mainly in and around the Southeast Shoal. The 1988 survey showed that the majority of yellowtail flounder under 30 cm were distributed in stratum 376, of which 93% of the area is in the Regulatory Area, and stratum 360, of which 89% of the area is in the Regulatory Area.

USSR stratified-random groundfish surveys (1983-88). Results from these surveys conducted in Div. 3NO generally agreed with results of the Canadian surveys. Abundance and biomass indices were highest in 1983 and 1984. In 1988 the biomass declined by 21%, while abundance declined by 30% from the 1987 estimate. Both the biomass and abundance estimates for 1988 were the lowest in the series. As was the case in the Canadian groundfish survey, the catches were comprised mainly of larger fish in the size range 35-42 cm as was the case in the 1987 USSR survey.

c) Estimation of Parameters

STACFIS again noted that the very high levels of mortality observed at the older ages in SPA has still not been resolved for this stock. In addition, it was noted that the catch-at-age pattern in 1988 was substantially different than any other observed previously, making the calculation of fishing mortalities at age in 1988 very difficult. STACFIS discussed the possibility of using a population estimate from the 1988 surveys as the basis for catch projections, but decided that this analysis contained too many assumptions which could not be justified. Consequently, STACFIS decided that SPA could not be used as the basis for catch projections for this stock.

d) Assessment Results

STACFIS noted that the recent surveys in 1988 and 1989 have confirmed that the 1981-83 year-classes are likely the poorest three in the 18 year time series. The combined population size of these year-classes at ages 6-8 in the 1989 survey is the lowest in the survey series. This value is about one half the average from 1985-87, and is about one-third of the long term average. This is noteworthy in that these are the ages which usually contribute most to the fishery as well as to the spawning stock biomass.

The 1984 and 1985 year-classes appear to be larger than the 3 preceding ones. Although the 1984 year-class did not show strongly in the 1988 Canadian groundfish survey, the estimate of this year-class in the 1989 survey showed it to be larger (at age 5) than the 4 preceding year-classes, but still about 20% lower than the long-term average. The 1985 year-class, has shown consistently in the juvenile surveys to be strong, and the estimate of this year-class, at age 4 in the 1989 groundfish survey, is the highest since the 1968 year-class.

STACFIS noted that most of the fish of the 1984 and 1985 year-classes were located outside the 200 mile limit and were being taken in large numbers by some fisheries in the Regulatory Area. On a yield-per-recruit basis STACFIS also noted the considerable loss involved in catching yellowtail flounder of these year-classes in 1988-90.

STACFIS expressed concern about the decline in the population at ages 6-8 in recent years, taking this as an indication that the spawning stock biomass is now at the lowest level (as measured by surveys) in the 1971-89 period. Although no stock-recruitment relationship was discussed, it was noted that the 1984 and 1985 year-classes were spawned when the large 1978 and 1979 year-classes formed the bulk of the spawning biomass. Since that time, there have been a succession of weak year-classes contributing to the spawning stock size, although the 1984 and 1985 year-classes should contribute to the spawning stock biomass in 1990-91.

e) Catch Projections

STACFIS once again reiterates its concern that it may be possible to continue to reduce this stock to even lower levels, perhaps even to the level of the early-1960s when catches from this stock were negligible. Noting the very low estimate for fish aged 6-8 in 1989, and the prospect of better recruitment, STACFIS advises that the total catch in 1990 should not exceed 5,000 tons. At this level, the spawning stock biomass should not decline further, as the 1984 and 1985 year-classes recruit to the spawning stock.

STACFIS also reemphasized that the advised total catch of 5,000 tons applies to the entire stock. In some recent years, documented catches inside the Canadian 200-mile limit and catches in the Regulatory Area have each approached the recommended TAC. With no control over the catch by non-member countries, this fishery will continue to be virtually impossible to manage. This is of particular concern, given the observation that a high proportion of young yellowtail flounder is found in the Regulatory Area. These younger fish are thus particularly susceptible to such uncontrolled fisheries. Should these fisheries concentrate on the recruiting 1984 and 1985 year-classes, reducing them to the levels of the early-1980s year-classes, the spawning stock biomass will be seriously depleted.

12. Greenland Halibut in Subareas 0 and 1 (SCR Doc. 89/25, 26, 27, 30, 31; SCS Doc. 89/14)

a) Introduction

Description of fishery and nominal catches. Catches have been rather stable in the 1980-88 period with an average catch of 9,000 tons. Most of the catch has been taken by Greenland (86%) in 1988. The Greenland fishery has been carried out mainly as an inshore gillnet and long-line fishery, with 89% of the total catch in 1988 taken in Div. 1A. The fishery in Div. 1A has expanded northward in the last two years and these new exploited areas amounted to about one third (3,000 tons) of the total catch in that division in 1988. A joint-venture offshore fishery between Greenland and Japan carried out by a Japanese vessel amounted to 1,568 tons. Recent TACs and catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	25	25	25	25	25	25	25	25	25	25	25
Catch	19	8	10	9	9	7	10	9	10[1]	12[1]	

[1] Provisional data.

b) Input Data

i) Biological information

Greenland halibut is considered a unit stock throughout the Northwest Atlantic with the Gulf of St. Lawrence and Fortune Bay, Newfoundland constituting separate stocks. Spawning supposedly takes place in the deeper waters of the Davis Strait south of 67°N. The larvae are dispersed by the north going currents both to the west coast of Greenland and then turning to the eastern Canadian coast.

The recruitment to the stock therefore have 2 major components: a Canadian and a Greenland component. However, the Greenland component is further divided into a component migrating southwest to the Davis Strait area and a component migrating east to the deeper fjords at West Greenland especially in Div. 1A. This split into recruitment to the spawning stock in the Davis Strait and recruitment to the Greenland fjords gradually takes place during the immature phase (age 1-10). Tagging experiments by Greenland in different fjords have shown that Greenland halibut may remain in the tagging area for several years. The Canadian components cover the continental slopes in Subareas 0, 2 and 3 as well as the deep water channels running between fishing banks of Labrador and Eastern Newfoundland.

ii) Commercial fishery data

The commercial inshore catches consist of larger fish (average length about 70 cm) than those in the offshore catches (average length about 50 cm). The age composition of the inshore catches is comprised mainly of age-groups 8-15 inclusive, while in the offshore catches, age-groups 6-12 dominate.

iii) Research data

Offshore trawl surveys. A bottom-trawl survey was carried out jointly by Japan and Greenland in Subarea 1 during September and October 1988, covering the depth range between 400 m (200 m, north of 70°N) and 1,500 m. The biomass was estimated to be 62,900 tons for Div. 1A (south of 73°N) to Div. 1D. A comparison between survey biomass estimates for 1987 and 1988

for strata which were covered in both surveys, showed that the 1988 survey estimates were less than those from the 1987 survey. This decline could reflect seasonal migration (the 1987 survey was carried out in July/August on one side only of the Davis Strait). Biological samples from the survey showed that for a given length, the average gonad index increased from north to south.

A bottom-trawl survey was conducted by USSR in Div. 0B and Div. 1BCD in autumn of 1988, covering the range 200-1,250 m. In Div. 0B, the biomass was estimated to 54,600 tons which was higher than estimated from the 1987 survey but generally low compared to the entire series of trawl surveys. In Div. 1BCD, the biomass was estimated to be 47,200 tons showing a decline from the 1987 survey estimate (55,644 tons).

Compared to the estimates from the 1986 Canadian survey in Subareas 0+1, the USSR and Japanese survey estimates were considerably lower. It is unlikely that the decline of the biomass estimates reflects a stock decline caused by the fishery. It is suggested that changes in hydrographic conditions over the period may have caused changes in the distribution of Greenland halibut to deeper offshore waters.

iv) Other research results

A stock identification study of meristic characters and biochemical genetics from 6 areas in the western North Atlantic (offshore: Div. 3K, 1C and ICES Subarea XIVb, inshore Div. 1A, 1D, 1F) showed significant differences in mean numbers of vertebrae between catches of the inshore areas at West Greenland which might indicate separation of these fjord stocks from each other. According to the biochemical genetics studies, small differences in allele frequencies were found which indicated only small genetic differences among the areas studied. However, there was evidence to suggest that there were separate breeding populations among the areas investigated.

c) Catch Projections

The USSR and Japanese offshore surveys do not cover the whole area of distribution of Greenland halibut in Subareas 0+1. For the area surveyed, the USSR survey results indicate a biomass level of about 100,000 tons in Div. 0B+1BCD and the Japanese survey a level of about 63,000 tons in Div. 1ABCD. The biomass in Div. 0A is not known.

The stock in the inshore areas of Subarea 1 seems to be isolated from the offshore component at least from the age of recruitment to the fishery (about 9-years old). The biomass in these inshore areas is also unknown, however, a large part of the catch in the inshore areas is from newly exploited areas and may be higher than at equilibrium.

STACFIS could not advise on a precise level of catch for 1990. However, based upon the available information, STACFIS advises that the present TAC level of 25,000 tons would not have a negative effect on this stock. STACFIS further advises that any expansion of the present fishery should be directed towards the offshore components.

13. Greenland Halibut in Subarea 2 and Divisions 3KL (SCR Doc. 89/61; SCS Doc. 89/08)

a) Introduction

Greenland halibut catches in the Labrador-eastern Newfoundland area had averaged between 25,000-30,000 tons annually from 1970 to 1976 with the 1978 catch being the highest since the beginning of the fishery in the early-1960s. Catches declined rather steadily since 1978 to reach an all time low of about 16,000 tons in 1986. In 1987, the fishery improved to the extent that the 1987 preliminary catch of 27,000 tons was approaching double the 1986 catch and slightly above the average over the last 18 years. The 1988 catch, however, was again one of the lowest in the time series at 18,000 tons. Most of the catch in 1988 was accounted for by Canada with 8,300 tons; followed by EEC with 4,118 tons; the GDR with 2,200 tons; and Poland, Japan, and Faroe Islands accounting for most of the remainder. The Canadian catch is taken primarily by gillnet fishermen operating particularly in Div. 2J+3KL. Recent TACs and catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC[1]	30	35	55	55	55	55	75	100	100	100	100
Catch	34	33	31	26	28	25	19	16[2]	27[2]	18[2]	

[1] TAC for Div. 2J+3KL only for 1977-84.
[2] Provisional data.

b) Input Data

i) Commercial fishery data

Considering the nature of this fishery, the migratory behaviour of this species as well as the low levels of directed catch, it was difficult to obtain catch and effort statistics which were accurately representative of total stock size. Data that are available [mainly Canada (N)], however, could be helpful as indicators of distribution and abundance in localized areas. The only directed catch-effort data available for recent years was from Div. 2J during the summer. The catch rate declined steadily from 1.51 tons/hr in 1984 to 0.56 tons/hr in 1986 then increased to 0.82 tons/hr in 1987. This level was higher than that observed for 1982 (0.61 tons/hr) but still below the levels of 1983-84. It subsequently declined in 1988 (0.38 tons/hr) to the lowest observed during the period examined.

The age composition of the commercial fishery is usually comprised mainly of age-groups 6-8 inclusive. However, age compositions from only the Canadian fishery were available for 1988. These indicated that more than 55% of the Canadian catch was comprised of age 7 with 94% of the catch in the age range of 6-8 with very few caught beyond age 12. Considering that the highest proportion of the commercial catch is taken by gillnet fishermen in the southern range of the stock, the exploitation of these few relatively young age-groups would likely be maintained. Furthermore, it can be expected that this fishery, which exploits such few age-groups, would be highly sensitive to fluctuations in individual year-class strengths.

ii) Research survey data

Groundfish surveys. Biomass from Canadian surveys in Div. 2J, 3K and 3L was estimated for most missing strata using a multiplicative analysis model. For Div. 2J in 1988 the biomass estimate was 35,450 tons, which was the lowest in the time series. The previous low was in 1987 at 50,771 tons. The 1986 estimate of 77,555 tons was near the average over the period. The low 1985 estimate was possibly attributed to the effect on availability due to extremely low temperature conditions. Such conditions were not adverse in 1987 and 1988 and would unlikely explain the drop in those years.

In Div. 3K, the 1988 biomass estimate was 73,852 tons which was near the lowest in the time series and considerably below the 1986 estimate of 114,000 tons. The average biomass over the time period is 85,000 tons. In Div. 3L, the 1988 biomass estimate was 13,795 tons and was virtually the same as the 1986 and 1987 estimates. These estimates were about 20% lower than the average of 16,000 tons since 1981.

Groundfish surveys were conducted in Div. 2G and 2H in 1978, 1979, and 1981 using fixed stations which were post-stratified to provide biomass estimates; however, in 1987 and 1988, surveys were conducted using stratified random design. For Div. 2G, the 1987 and 1988 estimates of 16,076 tons and 15,307 tons respectively, were less than half the post-stratified estimates for the earlier period despite the fact that coverage was much more intensive in the 1987-88 surveys. However, from examination of strata commonly fished, there had been a considerable decline in biomass between the two periods examined. For Div. 2H, the 1987 and 1988 estimates were also virtually the same at 23,300 tons and 22,003 tons respectively. As with Div. 2G, the more recent estimates were well below the earlier estimates despite better coverage. Again, it was clear for most strata commonly fished between the periods that there had been an obvious decline in catch per set. For all divisions combined, the estimated biomass for 1988 was 160,137 tons.

Estimates of biomass from USSR surveys in Div. 2GH indicated that the 1988 estimate was the lowest in the time series from 1983-88. From USSR surveys conducted in Div. 3K from 1981-88 no trend in biomass estimates could be established. The 1988 estimate was near the average over the time period.

Year-class strengths from groundfish and shrimp surveys. From age compositions of the Canadian surveys in Div. 2J+3KL, it was apparent that Greenland halibut do not fully recruit to the groundfish survey gear until age 5, but were probably fully recruited to the shrimp survey gear at age 1.

1982 year-class. This year-class appeared to be weak in both the Canadian groundfish surveys and shrimp surveys in Div. 2GH and 2HJ respectively. The Canadian groundfish surveys in Div. 2J+3KL have shown it to be about average at both ages 5 and 6.

1983 year-class. This year-class was estimated to be about average from shrimp surveys and Canadian groundfish surveys in Div. 2GH during 1987 and 1988. It was estimated to be about 93% of the strength of the strong 1979 year-class at age 5 in the Div. 2J+3KL Canadian groundfish surveys and slightly better than average at age 6.

1984 year-class. This year-class dominated the catch in the Canadian groundfish surveys in Div. 2J+3KL during 1987 at age 3 and was more abundant than any other year-class in the series at both age 3 and age 4. It also appeared relatively strong in the Canadian groundfish surveys in Div. 2GH during 1987 and 1988. In the shrimp surveys it dominated the catch in Div. 2H at age 1 and was still very abundant at age 2. While it did not dominate the catches in the shrimp surveys in Div. 2J it still appeared in large numbers.

1985 year-class. In the Div. 2GH Canadian groundfish surveys it dominated the catch at both ages 2 and 3 particularly in Div. 2H, however, it did not appear in particularly high numbers in the Div. 2J+3KL Canadian groundfish surveys. In the shrimp surveys it dominated the catch at ages 1 and 2 and was the most abundant year-class at age 3 in the shrimp survey time series. From results of USSR surveys during 1983-88 in Div. 3K, this year-class was predicted to be the strongest observed during that period.

1986 year-class. This year-class was relatively abundant at age 1 in 1987 during the Canadian groundfish surveys in Div. 2G. In 1988 it also appeared in relatively large numbers in Div. 2H suggesting a possible southward migration of young fish as observed in the past. While it was not the dominant year-class at age 1 in the shrimp surveys it was, in 1988, the most abundant at age 2 in Div. 2G observed over the time period.

1987 year-class. The only estimate of this year-class was at age 1 from the shrimp survey in 1988. For both Div. 2H and Div. 2J it was estimated to be the weakest year-class in the 10 years observed for shrimp surveys.

c) Estimation of Parameters

Due to the lack of appropriate research vessel survey coverage and adequate catch and effort data, suitable calibration information for SPA was unavailable and therefore SPA was not performed.

STACFIS recommends that *attempts at an analytical assessment of that portion of the Greenland halibut stock covered by the fishery and the surveys in Subarea 2 and Div. 3K and 3L be considered for review at the June 1990 meeting.*

d) Prognoses

The TAC of 100,000 tons, set in 1985, was put in place for 1986 largely based upon high survey biomass estimates, potentially good recruitment, and what was considered to be low fishing mortality. The biomass was estimated in excess of 400,000 tons of which 200,000 tons was estimated for Div. 2GH alone. The 1987-88 results for Div. 2GH based upon more appropriate survey design and data analysis would suggest that these two Divisions contain now only about 38,000 tons.

In Div. 2J+3KL, the estimated biomass had declined from about 225,000 tons in 1984 to nearly half that level in 1988. Such declining trends in biomass were also reported in the 1988 assessment (SCR Doc. 88/41) from USSR surveys. It was also clear that the fishery was unlikely to have contributed solely to such declines. Nevertheless, as the declining trends continue STACFIS cannot advise a TAC level

of 100,000 tons which is no longer supported by the data. However, there is some potentially good recruitment for the future. Since the existing fishery prosecutes such few and relatively young age-groups, the success of the fishery will remain contingent upon the strength of the recruiting year-classes mainly in age groups 6-8. These age groups in 1990 represent the 1982, 1983 and 1984 year-classes which may range in strength from average to above average.

e) Catch Projections

In the face of continued declining trends in biomass STACFIS concluded that the complete Canadian survey coverage of the stock area in 1987 and 1988 may provide a more realistic estimate of biomass at the present time: The data suggest that the biomass of Greenland halibut in Subarea 2 and Div. 3KL is now in the order of 200,000 tons compared to a level of about 400,000 tons estimated in the 1983-84 period. An $F_{0.1}$ reference level of 0.29 (NAFO SCR Doc. 87/45) and a natural mortality rate of 0.20 implies an exploitation rate of about 25%. Therefore, STACFIS advises that a catch in *1990 of 50,000 tons* would approximate fishing at the $F_{0.1}$ = 0.29 level.

STACFIS recommends that *consideration be given to the biological and practical implications of combining Subareas 0, 1 and 2 and Divisions 3KL for stock assessment purposes when considering Greenland halibut.*

14. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 89/08, 30, 55; SCS Doc. 89/08, 13)

a) Introduction

A total catch of 120 tons has been reported to date for 1988, compared with 319 tons reported for 1987. All of the 1988 catch was taken in November-December. Catches since 1978 continued to be restricted to by-catches in the Greenland halibut fishery. Recent catches and TACs ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	8	8	8	8	8	8	8	8	8	8	8
Catch	7	2	+	+	+	+	+	+	+	+	

b) Input Data

i) Commercial fishery data

There has been no directed fishery for roundnose grenadier in these Subareas since 1978. Again, no update of the catch/effort analysis which was presented previously (*NAFO Sci. Coun. Rep.*, 1985, page 72) was possible.

ii) Research data

The results of a research survey in Subarea 1 by Japan and Greenland in 1988 were presented (SCR Doc. 89/08, SCR Doc. 89/30). The total estimated trawlable biomass was determined to be about 45,700 tons. This compares with an estimated 44,000 tons from the 1987 survey.

USSR research data (SCR Doc. 89/08, SCS Doc. 89/08) indicated that roundnose grenadier were caught mainly as by-catch with Greenland halibut in depths <1,000 m, but generally constituted >50% of the catch-by-weight in deeper water. Fish length also increased with depth similar to observations made previously, but there were no differences in mean lengths between Div. 0B and Subarea 1.

c) Prognoses

STACFIS noted the continuing lack of commercial data for this stock due to continued low catches. While it was observed previously (*NAFO Sci. Coun. Rep.*, 1987, page 71) that the present TAC of 8,000 tons represented an exploitation level of <10% of the biomass estimated from a 1986 Canadian survey, it is almost 20% based on the biomass estimates from the 1987 and 1988 Japanese surveys. Given these considerations, STACFIS advises that the 1990 TAC remain at the 1989 level of 8,000 tons.

15. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 89/08, 55; SCS Doc. 89/08, 09)

a) Introduction

The 1988 catch of 6,337 tons was down by about 2,000 tons from the reported catch in 1987 and was only about 58% of the TAC. Catch by EEC-Portugal totalled about 900 tons, similar to 1987, but landings by the USSR and GDR both declined by about 1,000 tons compared to 1987. Nominal catches remaind low compared to those prior to 1979 (1967-78 average was about 26,000 tons). Catches and TACs ('000 tons) for the recent period are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	35	30	27	27	11	11	11	11	11	11	11
Catch	8	2	7	4	4	4	5	7[1]	8[1]	6[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort data were available from ICNAF and NAFO for the period 1967-87, and from the Canadian Observer Program for 1978-87. The two data sets were analyzed separately using a multiplicative model to derive two estimates of standardized catch rate and effort (SCR Doc. 89/55). Catch rates of roundnose grenadier are less variable when this species comprises relatively larger proportions of the catch, therefore a new category type, percent catch composition of roundnose grenadier by weight, was included in both data sets. In addition, the category type depth (<800 m, ≥800 m) was added for the Observer Program data analyses. The addition of these new category types did not alter the trends in catch rates from previous analyses. Both series indicated relative stability in catch rates in the 1980s. The series derived using ICNAF and NAFO statistics suggested two periods of stability; 1967-76 and 1979-86 with a slight decline in the period between these two.

It has been noted previously that the level of by-catch of Greenland halibut allowed in the roundnose grenadier fishery (10%) may have been restrictive and catch rates in recent years may reflect this restriction rather than stock status. In 1986, 1987 and 1988 the GDR fleet has been allowed to fish with a 30% by-catch limitation in depths >800 m, and the USSR has been under similar regulation beginning in 1988. As was recommended by STACFIS in 1988 (*NAFO Sci. Coun. Rep.*, 1988, page 70) the Canadian Observer data were examined in more detail comparing catch rates of the GDR fleet and those of the Soviet fleet, particularly over the period of regulation change in depths >800 m, and comparing catch rates at different percent by-catch levels. GDR catch rates did not increase compared to those of the USSR when only they fished under the new regulation. Neither was there an increase in catch rate for the USSR when they were allowed an increased by-catch. The multiplicative analyses predicted that lower catch rates would be experienced with a higher percentage by-catch. Based on these analyses, STACFIS concludes that the 10% by-catch restriction for Greenland halibut did not depress the catch rates of roundnose grenadier.

Length frequency data for 1979-88 were available from the Canadian Observer Program. Mean lengths were variable from year to year, but generally showed a decrease over time. Generally, smaller fish were caught in Div. 3K than Subarea 2.

ii) Research data

The results of research surveys to Subarea 2 and Div. 3K by the USSR were presented (SCR Doc. 89/08, SCS Doc. 89/08). The largest catches were taken in depths >1,000 m. As was the case in 1987, smaller fish were found in Div. 3K (mean total length 42.7 cm) than in Subarea 2 (mean total length 47.2 cm). As noted above, this pattern was also similar to that of commercial catches.

c) Estimation of Parameters

There are insufficient data available at present to carry out any analytical assessment of this stock. Examination of the relationships between standardized CPUE and standardized effort was not carried out again this year because previously these indicated that the relationships were not satisfactory. Thus general production analysis is not possible (*NAFO Sci. Coun. Rep.*, 1988, page 70).

d) Prognoses

Catches have increased slightly from 1984 to 1987, but catch rates have not increased during this period, instead they remained relatively stable.

Analyses presented suggest that the low and stable catch rates in recent years are not a result of by-catch limitations. The precautionary TAC level of 11,000 tons was imposed because of concern expressed by STACFIS regarding the status of the stock. Catches averaging about 50% of this in the 1980s seem to have stopped the decline in catch rates, but no increase has yet been observed. Given this, STACFIS advises that the precautionary level of 11,000 tons should remain in effect for 1990.

16. Wolffish in Subarea 1 (SCR Doc. 89/30; SCS Doc. 89/14)

a) Introduction

The nominal catch of wolffish reported for West Greenland waters includes two species: Atlantic wolffish (*Anarhichas lupus*) and spotted wolffish (*A. minor*). Since 1957, the combined nominal catch of both species has been in the range of 1,000-6,000 tons.

The fishery is partly a small-scale directed fishery and partly a by-catch in the trawl fishery for cod. Recent catches ('000 tons) are as follows:

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Catch	5	4	4	3	2	2	2	2[1]	2[1]

[1] Provisional data.

b) Input Data

A Japanese survey in Div. 1ABCD covering depth range 400-1,500 m, where wolffish were not usually abundant, confirmed the known distribution. This survey estimated the biomass of spotted wolffish in that depth range to only 100 tons.

c) Catch Projections

Until more biological data and separate catch statistics for the two species become available, it would not be possible to carry out any assessment. The previous advice of 5,000-6,000 tons corresponded to the average catch in the seventies while the catches in more recent years were well below this level. There are however no indications that this decline in the yield reflects a corresponding drop in the biomass and hence the level of 5,000-6,000 tons could be a sustained yield. Therefore, STACFIS finds no reason to change the previous advice of 5,000-6,000 tons.

17. Capelin in Division 3L (SCR Doc. 89/04, 43, 44, 52)

a) Introduction

Nominal catches of capelin in this Division were less than 4000 tons between 1970 and 1973, then increased to 58,000 tons in 1974 and declined to 12,000 tons in 1979. No offshore fishing has occurred since 1978. Provisional statistics for 1988 indicated a total catch of 54,000 tons in the inshore fishery by purse seines, traps and beach seines during June and July. In recent years, the final TAC has been based on the market forecast for roe capelin. Recent TACs and catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Advised TAC	16	16	30	-[1]	60	38	60	130	283	90	335
TAC	10	16	30	30	30	26	26	55	25	45	46
Catch	12	14	24	27	25	33	25	48	19[2]	54[2]	

[1] No STACFIS advice
[2] Provisional data

b) Input Data

i) Commercial fishery

A logbook survey of the inshore capelin fishery in Div. 3L, designed to provide estimates of catch-per-unit effort, was initiated in 1981. The catch rates of trapnets and purse seines in the following table (where catches were derived from the addition of the quantities actually landed and the quantities of discards from logbooks) show similar patterns over the first six years. Catch rates of traps showed an increase in 1987 and a decline in 1988 while purse seine catch rates showed the opposite pattern between 1986 and 1988. However, catch rates for both gear types were high in 1988; for traps, the 1988 catch rate was the second highest in the series and for purse seines, the 1988 catch rate was the highest in the series.

	1981	1982	1983	1984	1985	1986	1987	1988
Trapnets (tons/day)	2.9	3.1	3.4	2.9	4.6	4.6	8.8	6.2
Purse seines (tons/day)	9.4	16.4	18.8	14.3	16.4	19.0	18.1	20.7

The discarding rates (which included dumping of dead capelin as well as releasing fish alive) for 1988 were 14% and 17% for purse seines and traps respectively. These rates were lower than the 35% for purse seines and 74% for traps observed in 1987.

Low percentage of females was the dominant reason for discarding from traps, and for purse seines, it was the presence of "redfeed" in the fish. The reported by-catch of cod in traps in 1988 was 0.5% of reported logbook landings of capelin, approximately the same as reported for 1986 and 1987.

The 1985, 1984, 1983 and 1986 year-classes accounted for 59%, 15%, 14% and 11% respectively of the commercial catch (by numbers) in the 1988 inshore fishery.

ii) Research data

Aerial surveys of capelin in Trinity and Conception Bays have been conducted in June and July since 1982. Total surface area of schools, estimated from aerial photographs, provided an index of abundance. The 1988 survey provided repeat coverage of at least four times for three out of four transects. The estimate of total school surface area was the second highest in the series and approximately 60% of the 1987 estimate. The aerial survey index, the two inshore catch rates and the projected biomass from acoustic surveys have shown the same trends except for 1988. In this year, the inshore indices were higher than would be expected from the projected biomass, suggesting that the projected biomass for 1988 was conservative.

The USSR conducted a preliminary survey in Div. 3KLNO during 17 March to 30 April 1988 and an acoustic survey during 13 May to 3 June in Div. 3LNO. A biomass of 3,950,000 tons of capelin was estimated from the latter survey. The 1986 year-class was dominant in Div. 3L, an observation in agreement with the results of a 1988 Canadian acoustic survey.

An acoustic survey was conducted by Canada in Div. 3L during 12-28 May 1989. The total biomass was estimated to be 3,829,000 tons compared to an estimate of 4,551,000 tons in 1988 and 2,576,000 tons in 1987. In the 1989 survey, the 1987 year-class accounted for 74% of the estimate by number and 47% by weight. The estimate for the 1986 year-class was biased down by an unknown magnitude because of technical problems during the survey in an area where this year-class was dominant. The 1987 year-class was estimated to be about 80% of the size* of the 1983 and 1986 year-classes which had been the strongest in the series to date.

Replicated calibrations during May 1989 of the Canadian acoustic system resulted in a 0.83dB difference* from a calibration performed on the same system in October 1988. The May 1989 calibration was used to derive the estimates of abundance reported above. STACFIS noted that calibrations using calibration hydrophones, as was being done by Canada, had been examined by scientists in ICES and inconsistencies between calibrations had been observed. As a result, standard targets, with stable and known acoustical properties, were now being used to calibrate hydroacoustic systems by acousticians in ICES member countries. Therefore, STACFIS encourages the use of standard targets in future calibrations of acoustic systems.

c) Estimation of Parameters

The major contributors to the mature population in Div. 3L during 1990 will be the 1986 and 1987 year-classes. While the 1986 year-class will be reduced in abundance due to natural mortality, spawning mortality and fishing mortality, it is expected to be abundant in 1990 because of its relative strength. The bulk of the 1987 year-class has not spawned nor has it been fished extensively and because this year-class is the strongest in the series, the spawning biomass in 1990 is expected to increase.

Spawning mortality and weight-at-age vectors and proportion mature were the same as used in previous assessments (Table 10). No estimates of spawning mortality at age 2 are available, and for catch projections, the estimate of spawning mortality at age 2 is assumed to be the same as age 3. STACFIS noted that the trends in spawning biomass projected from acoustic surveys have generally agreed with the trends in inshore indices of abundance. Thus, as in previous assessments, estimates of year-class strengths for immature and mature capelin were derived from the 1989 Canadian acoustic survey.

Table 10. Capelin in Div. 3L: parameters used in the projections of stock size.

Age (yr)	Spawning mortality	Proportion mature[1]	Mean wt (g)
3	1.39	0.47	21.2
4	1.69	0.87	28.4
5	2.23	0.93	31.1
6	2.23	1.00	32.4

[1] Used to calculate mature biomass in 1990.

d) Catch Projections

The results of the projections, using the estimates of year-class strength and parameters as outlined above, together with M = 0.30 and a spawning date of 1 June are given in Table 11.

* An error in calibration of the hydroacoustic equipment, detected after the June 1989 Meeting, resulted in changes to the assessment. A change to this value was incorporated in this report at the September 1989 Meeting.

Table 11. Capelin in Div. 3L: projections of stock size for 1990.*

Age (yr)	Number of fish (millions) June 1989 Mature	Immature	June 1990
2	1,900	312,900	
3	47,600	48,600	232,300
4	10,900	100	44,800
5	1,400	-	1,600
6	-	-	100
	Biomass (tons) of mature fish		3,500,000

STACFIS continues to consider an exploitation rate of 10% of the mature biomass to be appropriate for capelin, and accordingly advises* a TAC of 350,000 tons for Div. 3L for 1990, which corresponds to a 10% exploitation rate.

STACFIS reiterates its previous caution that the estimates of abundance of the year-classes used in the projections were derived from acoustic surveys and therefore exhibit large variances.

18. Capelin in Divisions 3N and 30 (SCR Doc. 89/04, 52; SCS Doc. 89/08, 13)

a) Introduction

Nominal catches in these divisions increased from about 750 tons in 1971 to 132,000 tons in 1975 and declined to 5000 tons in 1978. During this period, most of the catch was taken by USSR midwater trawlers and Norwegian purse seiners. The fishery was closed during 1979-86. The provisional catch in 1988 was 4,736 tons reported by USSR and 1,395 tons reported by Japan. Most of the USSR fishery occurred in Div. 30 in May. Recent TACs and catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Advised TAC	0	0	0	-[1]	0	0	0	0	10	10	28
TAC	0	0	0	0	0	0	0	0	10	15	28
Catch	0	0	0	0	0	0	+	0[2]	1[2]	6[2]	

[1] No STACFIS advice
[2] Provisional data

b) Input Data

Research data. An acoustic survey by Canada in Div. 3N during 22 June-3 July 1988 provided a biomass estimate of 561,000 tons of which 544,000 tons were estimated to be mature capelin. This was the highest estimate since 1981 and more than double the 1987 estimate of 230,000 tons. Of the total estimate, the 1986 year-class accounted for 166,000 tons and 40% by numbers. This was the highest contribution by two-year-olds to the biomass estimate since 1985 when the 1983 year-class accounted for 28% of the biomass and 45% of the numbers. In the 1988 estimate the 1985 and 1983 year-classes contributed 38% and 8% by numbers respectively.

The USSR surveyed a portion of Div. 3NO as part of the Div. 3LNO survey during 13 May - 3 June 1988. An estimate for the Div. 3NO stock could not be extracted from the total biomass estimate for Div. 3LNO of 3,951,000 tons. In Div. 3NO, capelin of the 1985 year-class dominated, followed by the 1986 and 1984 year-classes.

* An error in calibration of the hydroacoustic equipment, detected after the June 1989 Meeting, resulted in changes to the assessment. Changes to this table and TAC were incorporated at the September 1989 Meeting.

c) Catch Projections

No stock projections were made for capelin in Div. 3NO because estimates of the 1986 and 1987 year-classes were not available. Although the 1986 year-class occurred in significant numbers in the 1988 spawning stock, these were mature fish and STACFIS considered that this was not an accurate estimate of the entire year-class. STACFIS considers that an exploitation rate of 10% of the mature biomass to be appropriate for the Div. 3NO capelin stock. Since 1981, there have been 12 acoustic estimates of this spawning stock, with average spawning biomass being 303,000 tons. The 1986 year-class made a significant contribution to the spawning stock in 1988 similar to the strong 1983 year-class; this suggests that the 1986 year class is strong in the Div. 3NO stock. If the 1987 year-class is also strong in this stock, then the biomass in 1990 will be higher than average but STACFIS cannot estimate by how much. Based on these considerations, STACFIS advises that the 10% target removals be based on the average spawning biomass indicating a catch of 30,000 tons in 1990.

19. Squid in Subareas 3 and 4 (SCR Doc. 89/13, 16)

a) Introduction

Nominal catches of short-finned squid (*Illex illecebrosus*) in Subareas 3 and 4 peaked at 162,000 tons in 1978, and have declined to less than 2,000 tons since 1982. The reported catch in 1988 was 850 tons. Recent catches ('000 tons) and TACs are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	120	150	150	150	150	150	150	150	150	150	150
Catch	162	70	33	13	+	1	1	+	2[1]	1[1]	

[1] Provisional data.

b) Commercial Fishery Data

The offshore squid fishery in Subareas 3 and 4 continued to be mainly a by-catch fishery. Length frequency distributions of commercial samples of squid in inshore areas of Div. 3KL in 1988 were considerably smaller than in 1987 when the average size of the squid was unusually large.

c) Catch Projections

Because of the short life-span of squid and unpredicted variability in availability, no catch projection can be made for 1990.

20. Shrimp in Subareas 0 and 1 (SCR Doc. 89/28, 29, 38, 40, 41, 53)

a) Introduction

The nominal catch of shrimp in the offshore areas of Subareas 0 and 1 increased from less than 1,000 tons before 1972 to almost 43,000 tons in 1976, decreased to 27,000 tons in 1978 and 1979, and increased to about 38,000 tons annually in 1981-84. This was followed by further increases to about 42,000, 45,000 and 49,000 tons from 1985 to 1987, respectively. Preliminary statistics for 1988 indicated total catches of about 51,000 tons. The offshore fishery has been regulated by TAC since 1977. In addition, the new fishery north of 71°N yielded about 4,300 tons in 1985, increased to about 11,000 tons in 1986 and 1987 and then decreased to about 6,700 tons in 1988. This northern area is presently considered to be outside the fishing areas in Subareas 0 and 1, for which TACs have been advised in the past. The west Greenland inshore shrimp fishery has been relatively stable with estimated catches of 7,000-8,000 tons annually since 1972 (except 10,000 tons in 1974). Recent TACs and catches (tons) are as follows:

Catch	1979	1980	1981	1982	1983	1984	1985	1986	1987[1]	1988[1]
Subarea 0	1,129	874	5,284	1,812	5,413	2,142	2,640	2,995	6,140	5,881
Subarea 1 Inshore[2]	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Offshore (S of 71°N)	25,958	35,778	32,016	35,015	33,854	33,741	39,547	41,589	42,794	44,938
Offshore (N of 71°N)	-	-	-	-	-	-	4,349	11,045	10,700	6,660
Subarea 1, total	33,458	43,278	39,516	42,515	41,354	41,241	51,396	60,134	60,994	59,098
Subarea 0+1, total	34,587	44,152	44,800	44,327	46,767	43,383	54,036	63,129	67,134	64,979

Catch and TAC	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SA 0+1 Offshore Catch (S of 71°N)	27,087	36,652	37,300	36,827	39,267	35,883	42,187	44,584	48,934	50,819	-
SA 0+1 Advised Offshore TAC	29,500	29,500	29,500	29,500	29,500	29,500	36,000	36,000	36,000	36,000	44,000/50,000
SA 0+1 Effective Offshore TAC	29,500	29,500	35,000[3]	34,800[3]	34,625[3]	34,925[3]	42,120[4]	42,120[4]	40,120[4]	40,120[4]	45,295[5]

[1] Provisional data.
[2] Estimated from total landings.
[3] Includes TAC of 5,000 in Subarea 0.
[4] Includes TAC of 6,120 in Subarea 0.
[5] Includes TAC of 7,520 in Subarea 0.

The 1988 fishery in Subareas 0+1 occurred from January to December and in Div. 1A north of 71°N from May to December.

b) Input Data

i) Commercial fishery data

Catch rates. Catch and effort data for the shrimp fishery in 1988 were available from Canadian observer reports and vessel logs for Subarea 0 and from Greenland and Norwegian logbooks for Subarea 1.

Mean catch-rate indices for the July-September period from 1976-88 for the national fisheries in Div. 1B (standardized to 1976) and for the Canadian fishery in Div. 0A (standardized to the average of the other indices in 1980) are given in Table 12.

Table 12. Shrimp in Div. 0A and 1B: CPUE indices (July-September) from Greenland, Norwegian and French fisheries for shrimp in Div. 1B and the Canadian fishery in Div. 0A, 1976-88.

	Div.	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Greenland	1B	1.00	0.74	0.67	0.51	0.63	0.59	0.74	0.66	0.67	0.76	0.84	1.05	0.76
Norway	1B	1.00	0.84	0.60	0.47	0.60	0.43	0.57[1]	0.56	0.61[1]	-	-	-	-
France[2]	1B	1.00	1.13	0.61	0.48	0.58	0.80	0.60	-	-	0.62	1.01	0.67	-
Canada[3]	0A	-	-	-	-	0.60	0.66	0.78	0.63	0.64	0.61	0.67	1.31	0.93

[1] July only
[2] All French data are from July only except 1985 (August only) and 1986-87 (July and August).
[3] Div. 0A (1980 is average of the other 3 indices).

From 1984 to 1987, the Greenland index based on seven trawlers (six sister vessels of 721-857 GRT, built around 1970, and one trawler of about 1,000 GRT, build in 1982) increased by 57% while the Canadian index remained stable from 1984-86 and then increased sharply in 1987. In 1988, both

indices decreased, by 28% in the Greenland data and 29% in the Canadian data. No indices were available for 1988 from Division 1B from either Norway or France, but the Norwegian catch rates for the June-July period in Div. 1D decreased by 19% from 1987 to 1988.

Biological data. Length frequencies for the sampled catches in Div. 0A by month and depth showed a prominent mode about 25-26 mm carapace length (CL) which consisted primarily of female shrimp. Three modes of males were also present at roughly 18-19, 20-21 and 22-23 mm. The overall distributions were similar to those observed in 1987.

Commercial samples from Div. 1B in April, July and November showed high proportions of several size groups of males and juveniles. A high incidence of small males under 20 mm CL was also noted in the previous year.

At present, these observations cannot be linked to future recruitment.

Shrimp discards. The percentage of shrimp discards to Div. 0A estimated by observers showed that levels were similar to those observed in the previous two years, averaging just over 2%. There were no estimates of discards for the other fleets from Subarea 1.

By-catches. Observer data on catch composition from the Div. 0A fishery showed that the percentage by-catch of redfish and Greenland halibut by weight increased from about 2% in May to around 15% from July to September. The incidence of Greenland shark increased late in the year, comprising almost 30% of the observed November catch. Catch rates for redfish showed a substantial increase from 9 kg per hour in 1983 to 107 kg per hour in 1987 followed by a decline to 76 kg per hour in 1988. Greenland halibut catch rates have shown a gradually increasing trend from 4 kg per hour in 1985 to 13 kg per hour in 1988.

In response to the STACFIS recommendation from the June 1988 Meeting that a detailed study of the by-catch in the shrimp fishery be conducted, data from the July 1988 research survey in Subareas 0+1 were analyzed for catch composition. It was concluded that the level of by-catch, primarily redfish and Greenland halibut, in the offshore commercial shrimp fishery was high (about 20% of the total weight), which was in agreement with previous investigations in Subarea 1. However it was noted, that the distribution of research hauls did not reflect the distribution of the commercial fishery and that results from the July survey might not apply to the whole year.

ii) Research vessel survey

A stratified-random trawl survey was carried out in July 1988 in NAFO Div. 0A and 1A-1B (64°52'5"N-72°30'N) to assess the distribution and trawlable biomass of shrimp. The area was divided at 69°30'N into northern and southern parts. The southern part was stratified by area and depth, while the northern part due to lack of knowledge on topography was divided into commercial and non-commercial areas. A total of 139 stations was occupied during the survey. Shrimp biomass estimate was calculated by means of the swept area method.

The biomass estimate calculated for the area south of 69°30'N is 140,000 tons (± 29%) and for the northern area, about 25,000 tons (± 67%). Catches were generally very small especially between 69°N and 71°N. Low densities were observed almost continuously along the western slopes of the banks south of 67°N. However, it also was noted that estimates obtained by swept area methods are considered as minimum biomass estimates, which should be used as indices rather than absolute measures of abundance. A series of such estimates is required before any interpretations can be made concerning changes in stock abundance. It was also noted that factors other than depth might be important as a basis for the stratification (e.g. time-of-day, temperature, bottom type). It appears that the survey covered most of the shrimp distribution area and that parts of the northern regions might be omitted in future surveys.

c) Assessment Results

Figure 17 shows a comparison between the offshore catches in Subareas 0 and 1 (excluding catches in the Northwest Greenland fishery) and the catch-rate index for the Greenland trawlers in Div. 1B. The changes that have occurred in the

fishery over the past number of years (e.g. more efficient trawls, trawl positioning systems) have made it difficult to interpret the catch-rate series in terms of stock abundance. However, it is unlikely that the efficiency of the Canadian and Greenland trawlers decreased between 1987 and 1988 and the decrease in catch rates might reflect some decrease in abundance or availability between the two years.

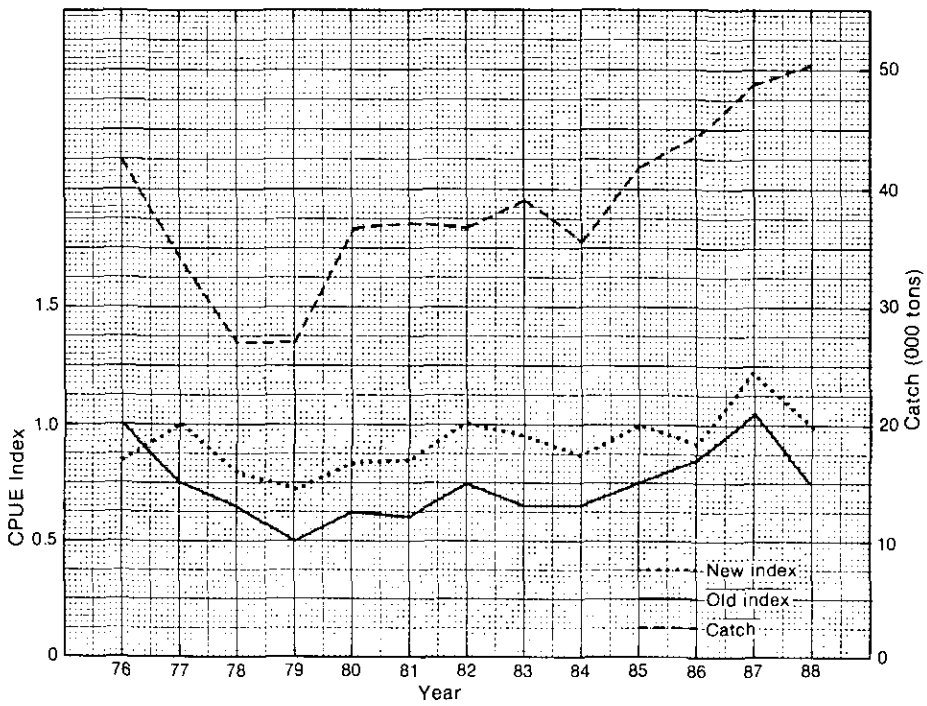

Fig. 17. Shrimp in Subareas 0 and 1: CPUE indices compared with total offshore catches (excluding catches in the Greenland trial fishery).
CPUE index for the July-September period (old index).
CPUE index for all months of the year (new index).

Because of the continued doubts about the reliability of the old CPUE index, and the possible changes in interpretation due to the inclusion of the 1988 value, a multiple regression analysis was carried out on the data for the seven Greenland trawlers from 1976 to 1988 in an attempt to derive an index which would be an improved representation of the performance of the fleet. The new index has some obvious benefits over the old July-September series in that all months of the year are considered and therefore more of the total catch is represented, interactions can be investigated and the model has some predictive capability.

The analysis showed that there are significant interactions between year-month, vessel-year and area-year. These interactions were included as random noise in the data and a final analysis was made with no interaction terms. The resulting index was similar to the old index (Fig. 17) in that it was possible to interpret a general increase from 1979 to 1987. However, a number of interpretations for either of the series was possible and these interpretations were strongly influenced by the 1988 point. The new analysis suggested that catch rates from 1982 to 1988 have been relatively stable, except for 1987 which was anomalously high. The series also can be interpreted to show two periods of increasing catch rates, 1979-83 and 1984-87. The 1989 data point, when available, should provide more insight into which of the interpretations is more likely.

Assuming that catch rates have been relatively stable over the past several years and that over the same period there have been continuing improvements in fishing performance, then it is possible that abundance is declining. Therefore, there is some concern for the status of the stock based on the CPUE data, but it is still uncertain how well such data reflect actual abundance.

d) Prognoses

It is clear from the catch and effort data for all countries that the catch rates in 1988 were substantially lower than those of 1987. The catch-per-unit of effort index of the seven Greenland trawlers for the July-September period shows a generally increasing trend since 1979, but the 1988 index is similar to levels of 1982, 1985 and 1986. STACFIS noted some inherent problems with this index, namely, the low representation of the total catch and effort, and only three months of the year were accounted for, which might not detect annual shifts in availability.

The new index based on the same vessels but including all months indicated that catch rates since 1982 were relatively stable with the exception of 1987. If over the same period there have been continued improvements in fishing technology, then it is possible that the abundance has actually been declining.

At the June 1988 meeting two options for increasing the TAC were discussed. It was advised that, should it be desired to investigate more vigorously the level of catch that can be sustained, controlling offshore catches at the 1986 level (44,000 tons) might be a safe approach. A higher catch level such as 50,000 tons would demonstrate more rapidly whether a higher yield could be maintained. At the present meeting, it was agreed that the catch-rate series is still inconclusive in terms of changes in stock abundance. Nevertheless concern was expressed about the decline in CPUE in 1988 and that the catch rates over the past several years might only have been stable. Although this concern is not considered conclusive yet, it was agreed to advise that catches in 1990 should not be allowed to exceed the present level (50,000 tons). This advice is for the offshore grounds in Subarea 1 south of 71°N and the adjacent parts of Subarea 0.

e) The Greenland Shrimp Fishery North of 71°N

A Greenland trial shrimp fishery was initiated north of 71°51'5"N in 1985 in an area not considered by STACFIS when advising on the shrimp fishery in Subareas 0 and 1 in previous years, and therefore not included in the quota regulation of the West Greenland shrimp fishery.

Nominal catches have been 4,349 tons in 1985 and 11,045 tons in 1986. In 1987, the southern limit of the area was changed to 71°N and the area was divided in two parts: a southern area from 71°N to 72°52'5"N, for which Greenland authorities did set a TAC of 11,500 tons, and a northern area in which the fishery was still considered a trial fishery. Nominal catches in 1987 were 10,626 tons in the southern area and 74 tons in the northern area. In 1988, the TAC remained at 11,500 for the area between 71°00'N and 72°52'5"N and the nominal catches were 6,660 tons. For 1989, the Greenland authorities set a TAC of 8,000 tons for the same area. STACFIS gave no advice for a TAC for the area north of 71°N but suggested in 1988 that a cautious approach to the exploitation of this shrimp stock be taken.

Logbook data from 30 trawlers were analyzed to show the overall distribution of trawling hours and mean catch rates in 1988. The 1988 fishery took place from June to December; meteorological observations indicated that the major fishing areas were ice-free during that period. Excepting three hours of fishing, no fishery was registered in the experimental area north of 72°52'5N. The distribution of the total effort has changed during the last three years, although the overall pattern of distribution in 1986 was still easily recognizable in the pattern of 1988. There was a more easterly and southerly distribution of effort in 1988 as compared to the previous years. Trawling activities tended to be highest in deeper water near the territorial base line. Currently with these changes of fishing pattern, mean CPUE values have shown a decline since 1986.

f) The Canadian Fishery for Shrimp in Division 0B

In the fall of 1988, a new fishery for shrimp was begun by Canada in Division 0B, east of Cumberland Sound. The fishing area was far removed from the traditional shrimp fishing grounds in Davis Strait and the sizes of shrimp occurring in the catches were large in comparison, with maximum sizes approaching those found at east Greenland. The fishery showed a seasonal pattern with low catch rates during October and November, followed by two periods of high but variable rates up to the end of the year. It is not certain if these major changes are more related to the movements of the fleet or the behaviour of the shrimp. Preliminary data suggest that there are biological differences between the shrimp in this area and in the traditional grounds. It is not known at present whether they constitute different stocks.

g) Future Research

Some recommendations made in June 1988 (*NAFO, Sci. Coun. Rep.* 1988, page 79) were addressed. A research trawl survey was conducted in Davis Strait in order to estimate the biomass of shrimp. New logbooks introduced in Greenland in 1986 have resulted in an improvement of the effort data by having the type and size of gear recorded for each set. However, it will take a number of years to build the data base and quantify the effects of new gear technology in the fishery. It was also noted that observer programs were expanded in 1988 providing a better coverage of the various fleets. Furthermore, a study was undertaken to investigate the usefulness of a multiplicative model for the Davis Strait fishery. There were other recommendations which were not met in 1988. Since no selectivity studies were carried out during 1988, STACFIS recommends that *selectivity studies be conducted for shrimp in Davis Strait to determine optimal mesh size.* Because data are insufficient to answer questions about the existence of separate, self-sustaining stocks, STACFIS recommends that *quantitative information on both abiotic factors and stock features such as temperature, egg mortality, frequency of berried females and survival rate of embryos be obtained in order to evaluate the reproductive potential of shrimp in the different areas.*

21. Shrimp Stock in Denmark Strait (SCR Doc. 89/18, 19, 36, 39, 50, 53)

a) Introduction.

The fishery started in 1978 with a catch of less than 400 tons and exceeded 8,200 tons in 1980 after the additional involvement of Danish, Faroese, French and Greenland vessels. Catches decreased to around 4,000 to 5,000 tons from 1981 to 1983 and since then have increased to about 12,500 tons in 1988. EEC-Denmark (Greenland), Faroe Islands, EEC-France, Iceland and Norway participate in this trawl fishery. A summary of catches and TACs is given in the following table (total for 1980 revised). The advised TAC for 1989 was 10,000 tons.

	1979	1980	1981	1982	1983	1984	1985	1986	1987[1]	1988[1]	1989
Advised TAC	-	-	-	4,200	4,200	4,200	5,000	-	-	-	10,000[2]
Effective TAC[3]	-	-	8,000	4,500	5,725	5,245	6,090	7,225[4]	7,225[4]	8,725[4]	9,025[4]
Total catch	1,285	8,405	4,792	4,902	4,175	6,731	8,110	10,964	12,178	12,549	

[1] Provisional data.
[2] Advised for a few years as a precautionary measure.
[3] On western side of midline only.
[4] Not including Greenland fishery north of 66°30'N.

The shrimp fishery in Denmark Strait takes place primarily in the area of Strede Bank and Dohrn Bank as well as on the slopes of Storfjord Deep. The total available ground depends upon the ice conditions. The main fishing area extends from approximately 65°20'N to 67°30'N and between 28°W and 32°W. In 1986, 59 vessels were engaged in the fishery, with occasional fishing by Icelandic vessels. In both 1987 and 1988, 60 vessels participated in the fishery on the western side of the midline and around 30 vessels on the eastern side of the midline.

b) Input Data

i) Commercial fishery.

Catch rates. In general, except for 1980, catch rates for the January to June period have been relatively stable from year to year at a level about 220 kg per hour (Fig. 18). Data from the Greenland fleet indicate declining catch rates during the early months of the season in most years, followed by an increase in the last quarter of the year. In 1988 peak catch rates early in the year did not reach the same level as in most other years, and on average there was a decline in catch rates compared to 1987. Ice conditions differed considerably from month to month throughout the years and thereby affected the distribution of the fishery, making the evaluation of CPUE data difficult. This difficulty was compounded by incomplete data on fishing effort for a substantial portion of the fleet in the years 1983-86. It was also noted, that there has been an increase in gear size for at

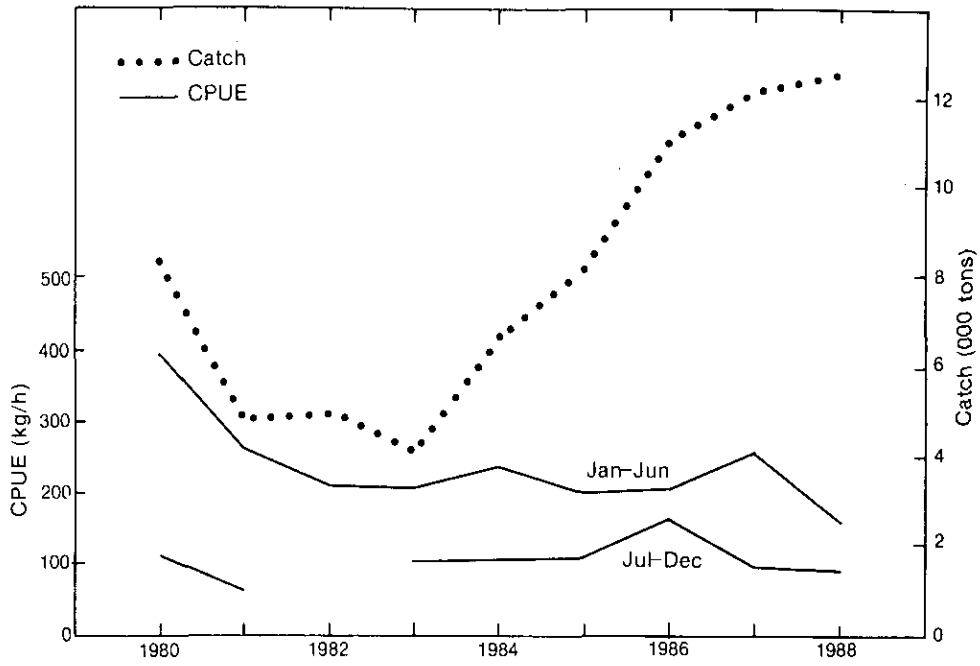

Fig. 18. Shrimp in Denmark Strait: CPUE for the January-June and July-December periods of 1980-88 compared with nominal catches.

least some of the fleets (e.g. Icelandic vessels have gradually changed the gear size from a mean of 1760 meshes in 1984 to about 2380 meshes in 1987). Given that different fleets showed different trends in the catch-rate data, and bearing in mind the difficulties with ice, gear improvement and lack of logbook information for many vessels, the Committee could not evaluate the changes in catch rates, that have been observed, in terms of stock abundance. It was recognized, however, that in 1988 catch rates declined substantially for all fleets from the 1987 level.

Biological data. Data on the biology of shrimp in Denmark Strait were available from Icelandic and Norwegian trawlers in 1988 and from a Greenland trawler in 1989. Data from a Norwegian trawler in March 1988 and a Greenland trawler in April 1989 showed that shrimp with a modal group around 30 mm carapace length (CL) was dominating as in samples from previous years for all countries. Icelandic data from August-September 1988 showed a similar dominance of a modal group around 31 mm CL. The samples showed the presence of both male and female shrimp in the catches and indicated three components of males at 21, 25 and 28 and at least one female component at 31 mm CL.

Shrimp discards. Observer data from one Norwegian trawler indicated a discard rate from 1.0 to 2.8% with an average of 2.2%. The discards consisted mostly of shrimp of sizes about 22 mm CL, indicating selective discarding of some of the smaller animals.

By-catches. Norwegian observer data from 1982 to 1988 indicated that the number of fish per kg of shrimp increased substantially in 1987 and 1988 compared to previous years. Small juvenile redfish was, by far, the main by-catch.

ii) Research vessel surveys

Since 1983 a Norwegian research cruise has been conducted in Denmark Strait every year in the autumn. The survey in September 1988 provided additional information on the biology of this stock. For the total surveyed area a slight increase in the proportion of males was indicated, but otherwise, the distribution of catches by sex was similar to that observed in previous years. Males were found in highest proportions in the western and northern parts of the region and in lowest numbers around Dohrn Bank. Most of the

females were ovigerous, while 25% were not expected to spawn. The proportion of non-spawning females was higher to the north than in the main fishing area. Mean shrimp size increased from north to south, with the smallest males being found mainly in the north and the proportion of females increasing towards the south.

The shrimp samples showed the presence of both males and females with four components of males at 20, 23, 25, and 28 mm CL as in the previous year. The length distribution of females had only one peak, about 30 mm.

Biomass calculations, using the swept-area method, gave an estimate of the minimum trawlable biomass of 49,600 tons for the investigated area. This was compared with estimates of 31,300, 44,200, and 25,200 tons for 1985, 1986, and 1987 respectively. The biomass estimates from these surveys were heavily influenced both by the proportion of randomly selected stations that fall in areas which were difficult to trawl, and by the weather conditions during the survey. Also with a short time series and doubt about the reliability of the estimates (due to low sample size in some areas in some years and annual changes in distribution and availability of shrimp), their value as indicators of stock size was limited at present.

In May to August 1987 an exploratory fishery for shrimp was carried out by a Greenland commercial vessel outside the commercially exploited fishing grounds (south of 65°30'N and north of 66°45'N) with a total of 266 hauls. In the area between 71°N and 77°36'N (113 hauls) no commercial concentrations of shrimp were observed. In the exploratory area between Cape Farewell and 71°N (with 153 hauls) some commercial concentrations were found. Biomass estimates were calculated for the area south of 71°N on basis of a post-stratification of the data applied to two depth zones, i.e. 200-400 meters and 400-600 meters. In a single stratum in one of the southernmost areas a very high density of shrimp was observed in two out of eight hauls, making up for 90% of the biomass calculated for the total exploratory area (7,400 tons). STACFIS noted, that very high variances are involved in the estimates from this exploratory fishery, and that the results should be treated with caution.

c) Prognoses

At the June 1988 Meeting, it was agreed that the catch-rate series for the individual countries were inconclusive in terms of indicating stock size. It also was noted that average biomass from 1985 to 1987 was estimated at 36,000 tons, and average catch over the same period was about 10,400 tons. It was generally agreed that the level of exploitation might be a safe level, especially since there had been no apparent change in stock composition over the years, and it was advised that shrimp catches in the Denmark Strait be maintained at approximately 10,000 tons for a few years as a precautionary measure until the data base is sufficient for an improved assessment of the stock.

In the context of the previous advice, it was agreed at this meeting that changes of that advice would only be required if the assessment of recent data indicated significant changes in interpretation from last year. The CPUE series for all nations showed, with the exception of 1980, fluctuation around a mean level of about 220 kg per hour with no obvious trend. It was noted, however, that the 1988 catch rates for all countries were substantially lower than those of 1987. The review of length-frequency data over the years showed no apparent effects of the fishery on the mean size of the dominant size-group of females. The inclusion of the 1988 biomass estimate of about 50,000 tons results in an average level of about 38,000 tons, slightly higher than the average of the three previous years. It was agreed that none of these factors provided a basis for a change in the advice provided in 1988. STACFIS therefore advises that shrimp catches in the Denmark Strait for 1990 be maintained at approximately 10,000 tons.

The Committee noted that the 1988 catch of about 12,500 tons was the highest obtained since the fishery began, however, there were no data at present to determine what short- and long-term effect this level of removal might have on the resource.

d) Future Research

Data on biological characteristics of shrimp in the Denmark Strait were available in reports from Greenland, Iceland and Norway, but their usefulness in assessing the stock was limited by the lack of full geographical coverage on a year-round basis. STACFIS noted that Norway had again carried out a research survey in 1988 and provided a biomass estimate for the stock. It was also noted that there was

still lack of knowledge on environmental variables and the distribution of shrimp larvae in the East Greenland area. Although no action was taken on these recommendations in 1988, it was agreed that they need not be reiterated, but left to the discretion of the various institutions to assign their priorities. However, it was agreed that other recommendations from the June 1988 Meeting (*NAFO Sci. Coun. Rep.*, 1988, page 81), which were not dealt with, should be reiterated. STACFIS therefore recommends that:

i) *the biological samples be obtained from all sectors of the shrimp fishery in Denmark Strait;*

ii) *research vessel surveys for shrimp in the Denmark Strait be continued and intensified.*

In an attempt to increase the usefulness of CPUE data, STACFIS further recommends that *all countries include gear type and size (no. of meshes) in vessel logs.*

e) The Management Policy at East Greenland of Separate Quotas for the Areas Outside the Main Fishing Area.

From a biological viewpoint, there were no immediate concerns over exploratory fishing for shrimp in entirely new areas except that the effects on the redfish stocks should be monitored. However, exploratory effort should be well separated by distance or depth from the supposed area of distribution of the traditionally exploited stock. After reviewing in detail the distribution of fishing effort in the area and the results of the 1988 research survey, it was agreed that the coordinates provided at the June 1988 meeting should be revised to reflect more accurately the area of distribution. Therefore, any new exploratory effort should be avoided within the area delimited on the north by 68°N from the Greenland coast to 23°W, on the south by 65°N from the Greenland coast to 30°W, and on the east by a line between 65°N 30°W and 68°N 23°W (see Fig. A, page 38), to avoid the possibility of additional fishing pressure on the stock.

f) The Possible Effect on Conservation of Shrimp as a Consequence of the Ice Coverage of the Water.

STACFIS agreed that it is difficult to determine the implications of ice coverage on conservation of shrimp. If shrimp were by some mechanism densely concentrated near the ice edge, then higher removals could be obtained at higher catch rates. On the other hand ice coverage might provide some protection for such concentrations if it restricted fishing in the area at the time. The collection of data and evaluation of these conditions would be difficult and compounded by factors such as the distribution of the stock over time, the variability in ice coverage and the possible influence of ice on shrimp distribution. However, if ice cover does not affect total removal then the stock will be unaffected.

22. Scallops in Subarea 1 (SCR Doc. 89/20)

The fishery on scallops (*Chlamys islandica*) started in 1983. The fishery takes place on narrow grounds in the coastal area by a few specialized boats. Annual catches peaked at 1,300 tons in 1985 but subsequently declined to the present level of 500 tons. Recent catches are as follows:

	1983	1984	1985	1986	1987[1]	1988[1]
Catch	+	1	1	1	1	1

[1] Provisional data.

III. RESPONSE TO FISHERIES COMMISSION REQUEST

1. Introduction

STACFIS suggests that the Scientific Council advise the Fisheries Commission that a more fruitful interaction would be prompted by framing inquiries in the context of the problems which the Fisheries Commission would wish to resolve. Very specific questions, as contained in item 3 of the Commission's request for advice, would elicit very specific answers, which may well be misleading in relation to the Commission's problems unless the questions were accurately formulated. More importantly, they did not provide the Scientific Council adequate opportunity to bring forward advice relevant to the

Commission's problems which might be outside the scope of these specific questions.

2. Cod in Divisions 2J, 3K and 3L (NAFO SCR Doc. 89/05, 34)

The Scientific Council was requested to: *continue to provide information, if available, on the stock separation in Div. 2J+3KL and the proportion of the biomass of the cod stock in Div. 3L in the Regulatory Area and a projection if possible of the proportion likely to be available in the Regulatory Area in future years. Information is also requested on the age composition of that portion of the stock occurring in the Regulatory Area.*

A comprehensive review of studies on discrimination of the various stock components of cod in Div. 2J+3KL was presented at the 1986 annual meeting (*NAFO Sci. Coun. Rep.* 1986, pages 121-124). Information on genetic variation, migrations, meristics, infestation by parasites, growth rates, ages and lengths at maturity and spawning time were discussed. It was reported at the 1986 meeting, that there was evidence from tagging, of a complex of spawning components. The adjacent groups of those overlap broadly in their distributions, particularly in coastal areas in summer. Biochemical, parasitological and meristic studies all indicated close similarities among cod in Subarea 2 and Div. 3K, but those and also the tagging studies indicated that cod in Div. 3L were a more heterogeneous group. It was also reported that, clearly, some of the cod occurring in Div. 3L, particularly those occurring in deep areas of eastern Div. 3L, were similar to those in more northern areas. However, cod on the northern slopes of the Grand Bank, especially in shallower water, showed affinities with those of Div. 3NO. From the point of view of assessing the stock in Div. 2J+3KL, in spite of some evidence for genetic subdivisions, the cod of Div. 2J, 3K and 3L were intermingled to a significant degree, especially inshore during the feeding season. It was noted that the pattern and degree of intermingling might vary, depending on environmental conditions such as ice coverage and water temperature. No new information on that topic was presently available and the conclusions remain unchanged. It was noted that while the data on stock structure of cod in Div. 2J and Subarea 3 was considerable, further analyses were continuing, for example, the results of substantial tagging programs. The ongoing analyses might provide insight as to whether smaller management units might be no more prone to mixing of fish with other management areas, than were the present management units.

To update estimates of the proportion of the biomass of cod in Div. 3L in the Regulatory Area, results from recent Canadian RV surveys in Div. 3L conducted during spring and autumn were added to previously analyzed data sets. The proportion of cod biomass in the Regulatory Area in Div. 3L relative to the biomass in the surveyed area in that Division ranged from 0.4 to 6.1% (average = 2.8%) during spring and 0.5 to 7.7% (average = 2.9%) during autumn. During winter, surveys conducted by Canada only in 1985 and 1986 suggested that about 25% of the Div. 3L cod biomass occurred in the Regulatory Area during that time of year.

Results of surveys conducted by the USSR since 1977 during spring indicated that the proportion of the Div. 3L biomass that occurred in the Regulatory Area ranged from 1% to 16% and averaged about 6.7%.

Data from autumn surveys conducted since 1981 in Div. 2J, 3K and 3L by Canada indicated the proportion of cod biomass in the Regulatory Area in Div. 3L relative to the biomass of the entire surveyed area in Div. 2J+3KL ranged from 0.1 to 1.5% (average 0.8%). The average divisional proportion of biomass derived from those surveys was about 40% for Div. 2J and 30% for each of Div. 3K and 3L. With the assumption that the relative distributions among divisions in autumn was similar to that of other times during the year, the previously reported conclusion that "the proportion of the entire Div. 2J+3KL cod biomass estimated to occur in the Regulatory Area is less than 10% in winter and less than 5%, on average, throughout the year" remained unchanged.

Results from both Canadian and Soviet surveys suggested no annual trends in the proportion of the Div. 3L cod biomass that occurred in the Regulatory Area and it might be reasonable to assume that proportions expected to occur be about the same as those observed.

Age compositions derived from Canadian surveys conducted in Div. 3L during spring and autumn for 1986-88 and during winter for 1985-86 were examined. Results from spring and autumn surveys, when only a small portion of the Div. 3L cod biomass occurred outside the Canadian 200-mile zone, indicated that a proportionately larger number of younger fish occurred in the Regulatory Area than in the entire division. During winter, when the maximum proportion of the Div. 3L biomass occurred in the Regulatory Area, age compositions for all of Div. 3L and that portion outside the Canadian zone were approximately the same.

Percent age compositions of cod in Div. 2J+3KL as a whole derived from autumn surveys conducted by Canada were similar to Div. 3L percent age compositions also derived from autumn surveys. The most abundant year-class in the 1988 surveys in Div. 3L (spring and autumn) and the whole of Div. 2J+3KL (autumn) was that of 1982 (age 6). In contrast the

most abundant year-classes in 1988 estimated in the Regulatory Area in Div. 3L were that of 1985 (age 3) for spring surveys and 1986 (age 2) for autumn surveys.

3. Cod in Division 3M

The Scientific Council was asked to: *advise on the levels of unavoidable by-catch of cod in directed fisheries for redfish and American plaice.* The Commission asked also for comments on: *the appropriateness of establishing a minimum target level for the spawning biomass, and to provide advice on options for establishing such a level.*

During 1988 the entire reported catch of cod (570 tons) taken on the Flemish Cap, was by-catch in redfish and flatfish plaice fisheries. A total of 429 tons was taken by EEC-Portugal, the USSR and Japan as by-catch in redfish directed fisheries while an additional 141 tons was taken by EEC-Spain as by-catch in the flatfish fishery. By-catch rates of cod in the redfish fisheries were: EEC-Portugal - 5.9%, the USSR - 0.3%, and Japan - 0.2% with a total by-catch rate for cod of 2.1%. The by-catch rate by EEC-Spain in the American plaice fishery was 8.8%. It was possible that those by-catch rates would increase as the biomass of cod in Div. 3M increased mainly from the growth of the relatively strong 1986 year-class.

No information has been provided on discarding.

The rationale for establishing a target spawning biomass was to maintain a stock size that would support a viable fishery without endangering the stock. It would assume that there was some relationship between spawning stock and resultant levels of recruitment. There was presently no documentation to indicate that a stock-recruit relationship existed for Div. 3M cod. Analyses have shown, that since the late-1950s, the average total stock biomass as well as the spawning stock biomass were highest in the mid-1960s but declined thereafter and have remained at low levels. Poor recruitment has occurred when spawning stock was large (e.g. 1964 year-class) while good recruitment (e.g. 1973 year-class) was produced from low spawning stock levels. While stock-recruit relationships have not been established for most cod stocks it has been shown that the probability of poor recruitment is less when spawning stock is high.

Scientific advice, since the early-1980s for the stock had been that no directed fishery should be allowed, to protect the remaining spawning stock and to reduce the loss in yield-per-recruit resulting from fishing incoming year-classes at early ages. The average biomass (age 3+) from 1960 to 1965 was estimated at about 200,000 tons and the spawning biomass (age 6+) about 65,000 tons. Stock biomass subsequently declined to low levels by the mid-1970s and have remained low to the present. Sequential population analyses had not been possible in recent years because of insufficient data, however, biomass estimates from research surveys had indicated that the stock was low. In 1986 the age 3+ biomass was estimated at 30,000-35,000 tons with a spawning biomass at about 10,000 tons.

TACs for the stock from 1984 to 1987 were based on a management strategy of the Fisheries Commission (NAFO FC Doc. 83/IX/4, revised), namely that "the TAC will not be increased beyond 12,965 metric tons until the Scientific Council advises that the age 3+ mean biomass has reached a level approximately equal to one-half the mean age 3+ equilibrium biomass associated with fishing at F_{max} and assuming long-term average recruitment levels". The estimate for one-half the mean age 3+ equilibrium biomass was estimated at 85,000 tons.

Target spawning biomass levels had not been included in past advice and data currently available did not provide a basis for establishing a reference target level. Survey data in 1988 indicated that the current total biomass was in the range of 10,000 to 30,000 tons with the age 3+ biomass much lower than that level. It is expected that the biomass would increase in 1989 with the growth of the relatively strong 1986 year-class. The spawning stock estimated from 1988 surveys would be low because the stock was mainly comprised of cod aged 2 and 3 years.

In principle a target spawning stock biomass, as an indicator of stock status, is an appropriate management strategy. With the data currently available, the appropriate target for Div. 3M cod cannot be evaluated, but it was clear that any target should be much larger than the current spawning stock size. For this stock, spawning biomass was defined as knife-edged at age 6 years, however, STACFIS recommended that *available maturity data be analyzed for the next assessment.*

4. Flounders in Divisions 3L, 3N and 3O

With respect to flounders in Div. 3LNO, the Scientific Council was requested to: *provide advice on the impact of recent increased catches of American plaice and yellowtail flounder from areas described by the Council in its 1988 report as being nursery areas for these species.*

Advice should also be provided on management options that would reduce the extent of the impact on the potential yield if it is concluded that the changes in catch distribution are reducing the potential yield.

Catches of yellowtail flounder (ages 1-4) in the juvenile surveys continue to be greatest in the Tail of the Bank with a major portion taken in the Regulatory Area of Div. 3N.

Historically age 4 on average (1968-87) contributed 2.3% (by number) to the commercial catch. In 1988, 25.6% of the catch overall was age 4. About 45% of the catch numbers in the Regulatory Area was age 4.

Fish at age 3 have seldom occurred in the catch matrix. However, in 1988 they comprised 11.1% of the catch numbers in the Regulatory Area.

Fish at age 5 comprised 27.7% of catch numbers in the Regulatory Area. Age 5 fish comprised 2.8% in the Canadian zone.

In 1988, Canada removed 19.5 million fish for a catch of 10,544 tons. In the Regulatory Area, EEC-Spain removed 24.0 million fish or 23% more than Canada for a catch of 3,205 tons or 70% less than Canada. The average weight of yellowtail flounder in the Spanish catch was about one-fourth of the weight of a yellowtail flounder in the Canadian catch.

The 1984 and 1985 year-classes were predicted to be relatively strong. However, considering recent removals in the Regulatory Area, these have already been under heavy fishing pressure. Should this continue, the potential yield to the fishery will have been drastically reduced.

The spawning stock is now at the lowest observed level since 1970. Should fishing pressure continue at present levels on young fish, potential recruitment to the spawning stock could be seriously jeopardized.

Surveys for juvenile American plaice show that a high proportion of young American plaice were found in the Regulatory Area of Div. 3NO. Little information was available on the distribution of juvenile American plaice in the Regulatory Area of Div. 3L.

With the recent increase in American plaice catches by some fleets in the Regulatory Area in Div. 3NO there has been a shift in the age composition of the catch towards younger fish. In 1986-88, ages 8 and younger contributed 31% on average to the catch numbers from the stock compared to 13% on average from 1981-85.

The youngest age in the Spanish catch in 1988 was 3 year olds, compared with 6 year olds in the Canadian catch. The mean weight of an American plaice in the Spanish catch in 1988 was 0.56 kg compared to 0.71 kg in the Canadian catch.

The 1985 year-class appeared to be relatively strong from the Canadian juvenile surveys. However, in Div. 3N, most of that year-class was still found outside the 200-mile limit, and had already shown up in commercial catches in the Regulatory Area. Its contribution to the population (and fishery) in subsequent years would depend on the level of the fishery in the Regulatory Area on that year-class in 1989-91. The potential exists for a substantial reduction in yield-per-recruit if catches of this year-class are high in 1989-91.

The population size of the stock is currently as low as it has been in the past 15 years. This is particularly so for Div. 3N and 3O. The adult (or spawning stock) biomass is also at a relatively low level. Apart from the obvious benefits in yield-per-recruit, there should be a benefit in allowing a higher proportion of the recruiting year-classes to enter the spawning stock.

STACFIS noted that there were considerable data available from fall surveys on the distribution of juvenile American plaice and yellowtail flounder in Div. 3NO, including the Regulatory Area. In order to advise on management options such as closed areas or seasons to protect these nursery areas, STACFIS recommended that *a detailed analysis of these data be made, in conjunction with information on distribution of flounders in the commercial fishery.*

STACFIS noted that most of the reported fishing activity by Contracting Parties in the Regulatory Area was by EEC (Spain and Portugal) and that most of the juvenile American plaice and yellowtail flounder appeared to be in that area. STACFIS therefore noted that information on the location of fishing effort on flounders in the Regulatory Area, on as fine a scale as possible, should be made available to facilitate the analysis.

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The eighth meeting of the Subcommittee on Environmental Research was held at the new headquarters of the NAFO Secretariat, Dartmouth, Nova Scotia, Canada, on 13 June 1989, with M. Stein (EEC) as Chairman. Annex 1 contains the detailed report of the meeting.

2. Review of Environmental Studies in 1988

A total of only 14 documents referred to environmental conditions in Subareas 0-6 during 1988. A correlation analysis showed relationship between November ocean temperatures and air temperatures 2-3 months earlier. It was suggested that the relatively strong increase in West Greenland air temperatures during winter might be due to CO_2-induced warming (i.e. the "Greenhouse effect"). A general warming trend of 0.1°C/year was reported for the slope waters off southwest Greenland between 1984 and 1988, but the magnitude and the pattern of the increase varied substantially between transects separated less than 400 km apart. In general, temperatures in Davis Strait, in the Labrador Current, and on the Newfoundland Shelf and the Grand Banks were near their long-term means (1957-71) and above their 1987 levels. Ice cover in Davis Strait was close to its normal extent but in the Labrador Sea was less than normal.

3. Overview of Environmental Conditions (SCR Doc. 89/67)

A review paper was presented based on several long-term oceanographic meteorological data sets as well as a summary of data and results from available research documents and research reports. In general, offshore surface temperatures collected from ships-of-opportunity showed positive anomalies in the north and negative in the south with the Scotian Shelf being the boundary between the two regions. An exception to that pattern was the Labrador Shelf where temperatures were below normal. Subsurface temperatures at Station 27 of St. John's, Newfoundland (Div. 3L), began to moderate towards the end of the year suggesting the possibility that the cold conditions which had persisted for the past 6 years may be ending. The number of icebergs crossing 48°N was reported by the US Coast Guard as 187, a drop of over 100 from last year and the lowest number recorded in the last six years. The dominant feature of the sea-surface pressure anomalies was the intensification of the Icelandic Low and Bermuda-Azores High in winter. This would produce stronger westerly winds over the northern North Atlantic.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Reports on the Otolith Exchanges

a) Silver Hake (SCR Doc. 89/11)

Results of an exchange of silver hake otoliths between USSR and Canadian age readers were reported. The analysis included estimates of both inter-reader and intra-reader agreement. Levels of agreement varied between 75% and 86% for the comparison but a bias was still apparent in the data. STACFIS recommends that *the silver hake otolith exchange between Canada, Cuba and the USSR be continued.*

b) American Plaice in Divisions 3L, 3N and 3O (SCS Doc. 89/15, 16)

An exchange of otoliths from American plaice caught in the Nose of the Bank area (Div. 3L) was conducted between age readers of Canada, EEC-Spain, and EEC-Portugal in 1988-89. The agreement among readers was not as high as that observed in the exchange of Div. 3N otoliths which took place in 1987-88. Some of the otoliths were in very poor condition after having been processed and read by the Canadian and then by the Spanish agers, and consequently could not be interpreted properly by the Portuguese ager. The Spanish and Portuguese agers also noted that the between-reader differences were more difficult to interpret for the Div. 3L samples, and that a further interchange of otoliths was required.

It was noted that the otoliths were read using 2 different techniques; the Canadian ager used reflected light, while the Spanish and Portuguese reader used transmitted light from below the otolith. The Spanish ager also used polarized light. It was agreed that a meeting of the agers from the three countries would be the ideal way to compare methods and readings and to resolve differences. However, it was not possible to arrange such a meeting within the next year. In the meantime, it was agreed that a further exchange of otoliths should take place, accompanied by photographs and descriptions where possible. It was also agreed that the exchange should include otoliths from both Div. 3M and Div. 3L.

c) Greenland Halibut in Subarea 1 (SCR Doc. 89/42)

An exchange of otoliths between Greenland and Canada had taken place in 1986, 1987 and 1989. The Greenland reader and the Canadian reader had met in 1987 to coordinate the age reading technique. There has been an improvement of the inter-reader agreement during the exchanges, and at the 1989 meeting it was noted that there does not now seem to be any biased discrepancy between the Greenland and the Canadian reader.

VI. GEAR AND SELECTIVITY STUDIES

1. Reports on Gear and Selectivity Studies

a) Trouser Trawl Method of Studying Selectivity in American plaice: Square *vs* Diamond Mesh Codends (SCR Doc. 89/47)

Selection studies were carried out using 2 types of groundfish otter trawls: Western IIA and a Nordsea 642 Nova redesigned with twin codends (trouser). The former used 140 mm square and diamond mesh codends, while the latter used 155 mm mesh size. L-50%, the selection ranges and the selection factors, calculated for both trawls, were higher for the diamond mesh codends. This indicated that square mesh codends retained more small American plaice than diamond mesh trawls.

b) The Fish Capture Process of a Groundfish Survey Trawl (SCR Doc. 89/46)

Three small trawl bags were attached underneath a multi-species groundfish survey trawl to study escapement of cod, American plaice, yellowtail flounder and thorny skate underneath the footgear. Net efficiency estimates (catch/catch + escapes) were calculated for each size group. 50% efficiency point was estimated to be around 27 cm for each species indicating that many small sizes were escaping underneath the trawl. Catchability coefficients derived for various species ranged from 0.26 to 0.56. Catchability was extremely size dependent. A video was shown outlining the experiment on escapement underneath the footgear of the survey trawl used (Engel's 145 High Rise Otter Trawl).

VII. REVIEW OF SCIENTIFIC PAPERS

STACFIS noted four research documents (SCR Doc. 89/1, 89/9, 89/45 and 89/59) presented at the meeting were not reviewed elsewhere in this report. Reviews of these research documents are given below.

1. Continuous Plankton Records (SCR Doc. 89/59)

Continuous plankton records using the Hardy CPR were presented. The paper described the 1988 situation. Anomalies for copepoda were all positive compared to the 1961-87 mean, while the "total phytoplankton" index showed negative anomalies. Neither of these anomalies were statistically significant. The phytoplankton seasonal dynamics were closely related to stability and mixing of the water column. The data analysis was based on the generation of a standardized time-space matrix with interpolated grid values. The technique seemed superior to methods used previously.

2. Food and Feeding Studies on Flemish Cap (SCR Doc. 89/9, 89/45)

The species investigated were redfish (*Sebastes mentella* and *S. marinus*), cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*). SCR Doc. 89/9 documented investigations over the 1981-88 period while SCR Doc. 89/45 provided data for 1988. The papers add to the general knowledge of the ecological conditions on Flemish Cap. The papers further add to the database required for multispecies assessment should such approaches become necessary for better assessments of the stocks in Div. 3M.

3. Patterns of Predation (SCR Doc. 89/1)

The paper discusses the basis of the understanding of the predator-prey process. The authors report on experiments, using hard clam (*Mercenaria mercenaria*) as a model organism, to elucidate predator mediated variations in prey mortality. They investigate if predations have effects on the individual, (decreased growth rates), patch and population scale, the two latter scales being an effect of mortality. The authors suggest that all these effects occur simultaneously and that avoiding predators weaken the hard clam to the extent that the prey become more susceptible to predation at a later time.

VIII. OTHER MATTERS

1. Review of Current Arrangements for Conducting Stock Assessment

STACFIS reviewed the arrangements made for the 1989 Meeting particularly the "designated expert" system. This system has not been entirely successful for the 1989 assessments. It was however considered that it could be improved and would be helpful in efficiently dealing with the workload. It was recommended that *the Scientific Council at the Annual (September) Meeting should assign, at least laboratories, if not named scientists, to stocks for the purpose of preparing preliminary assessments.* The designated expert should then approach, prior to the STACFIS June Meeting, laboratories which may have relevant information and those laboratories should, at their earliest convenience, supply the relevant information to the designated expert.

The Chairman also noted that a strict enforced timetable for the meeting would facilitate the work and would particularly help those experts who would have to run analyses during the meeting.

2. Impact of Changes of Survey Design on Assessment Results

No documentation was available for discussion. STACFIS noted, however, that the Working Group on Survey Design Procedures under STACREC met (see Appendix II, STACREC Report).

3. Review of Meeting Facilities, Especially Computing Facilities

The 1989 assessments used the ADAPT method (see Section I.5) for many stocks. This was the first time when STACFIS used ADAPT and it was therefore presented at the beginning of the meeting. ADAPT had previously been scrutinized in ICES and CAFSAC. However, it was recognized that the intensive use of computer packages brought to the meeting by individual scientists required documenting and vetting of these programs. It was agreed to keep the problem under constant review.

It was further agreed that ADAPT should be made available on a PC for the September 1989 Meeting and that scientists present at that meeting could bring a dataset of their own for some initial analysis.

Attention was drawn to the CAFSAC software catalog as a source of a set of vetted and documented programs for assessment.

4. Special Session, 6-8 September 1989

To date, a total of 15 contributions had been submitted and accepted for presentation at the Special Session of the Scientific Council of NAFO to be held in Brussels in September 1989. The contributions spanned a broad range of topics ranging from single species dynamics to changes in multispecies assemblages of fish populations in the Northwest Atlantic during the last several decades. Papers had been received from Canada, Spain, USSR, and USA.

Contributions dealing principally with changes in biomass and production of single species included papers on Atlantic herring (2 papers), yellowtail flounder, Atlantic cod, and American lobster. Those papers explore the role of environmental factors and/or harvesting on exploited populations. Multispecies interactions (particularly predator-prey dynamics) provide the focus for two contributions submitted to the Special Session including one paper on the role of predation by silver hake in the Scotian Shelf system and one on interactions among herring, mackerel and sand lance in the Georges Bank and Southern New England-Middle Atlantic regions. The remaining contributions treat changes in broad assemblages of fish species or smaller species-groups; these papers are based primarily on analysis of research vessel survey data.

Although the deadline date for submission of proposed presentations was 30 May 1989, STACFIS noted that additional contributions may, in fact, be forthcoming.

5. Special Session in September 1990

The Chairman was pleased to inform the Committee that Dr. John Shepherd from Lowestoft, U. K., had agreed to convene the Special Session on the agreed theme "Management Under Uncertainties Related to Biology and Assessments, With Case Studies on Some North Atlantic Fisheries".

6. Proposed Theme for a 1991 Special Session

The Chairman noted that two of the three possible themes identified in September 1988 still available for consideration were: (i) Atlantic Cod: Synthesis of the Understanding on Physiology, Dynamics, Ecology and Environmental Relationships, and (ii) Impact of

Marine Mammals on Commercial Fisheries in the North Atlantic.

There were no further suggestions at this meeting. The Chairman proposed that a topic would be selected at the Annual Meeting in September 1989 from those or any other themes that may be proposed for consideration.

7. Workshop on Age Determination of Shrimp in Reykjavik, 16-19 October 1989

The convener, U. Skúladóttir, informed STACFIS that arrangements were well underway and that about a dozen scientists had indicated their interest in participating. About 10 papers had been announced so far. Scientists who intended to participate in this workshop were requested to indicate their interest to either the convener, the Chairman (D. Parsons, Canada), or the NAFO Secretariat. The subjects for discussion at the meeting are: (i) new methods of age determination; (ii) application of various known methods and individual experiences in using these; and (iii) if possible, results will be included in stock evaluation (e.g. virtual population analysis or similar methods) and these compared with the results of other methods (e.g. stock production models or 'swept area' methods used in stratified bottom sampling) in order to evaluate the correctness of the age determination.

8. Adjournment

As there were no further items on the agenda, the meeting was closed on 21 June 1989. The Chairman thank the participants for their contributions, in particular, those who had acted as "designated experts". The Chairman further thanked the Secretariat for their very efficient services.

ANNEX 1. REPORT OF THE SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH

Chairman: M. Stein Rapporteur: K. Drinkwater

The Subcommittee met at the new headquarters of the NAFO Secretariat at 192 Wyse Road, Dartmouth, Nova Scotia, Canada, on 13 June, 1989, to consider environment-related topics and report on various matters referred to it by STACFIS. Scientists attended from Canada, Cuba, Denmark (Greenland), EEC, Iceland, Japan, USSR, and USA.

The Subcommittee reviewed the following documents: SCR Doc 89/3, 10, 13, 57, 58, 63, 64, 65, 66, and 67; SCS Doc. 89/4, 5, 8, and 14.

1. Election of Chairman to Subcommittee

During the meeting of the Scientific Council in September 1988, STACFIS overlooked nominating a Chairperson for the next two-year term. Since the former Chairman (M. Stein, EEC) indicated his willingness to serve for another two-year term, it was the unanimous decision of STACFIS to accept this offer, and elected M. Stein as Chairman of the Environmental Subcommittee.

2. Chairman's Report

During the September 1988 Special Session, it was recommended that NAFO initiate contact with scientists in charge of the World Ocean Climate Experiment (WOCE) and the Scientific Council invited the Chairman of the Environmental Subcommittee to explore the avenues for such contacts. The Chairman informed the Subcommittee that correspondence with scientists in charge of WOCE had been done, and that he had invited the Director of the International WOCE Planning Office, Dr. K. P. Koltermann, to give a lecture on WOCE during the Subcommittee's meeting. As agreed, during the Special Session in September 1988, correspondence was to be initiated with researchers working in the field on long-term moorings in the North Atlantic Ocean, to explore the availability of data sets which might reveal any propagating anomaly signal. There was little response to that correspondence, except the fact that a recently published paper on the "Great Salinity Anomaly in the Northern North Atlantic 1968-1982" was brought to the attention of the Chairman. As in former years, the Chairman had addressed individual laboratories to submit environmentally-related papers for the June 1989 Meeting of the Environmental Subcommittee. The Chairman expressed his disappointment that only 10 research documents were presented during the Subcommittee's meeting.

3. Marine Environmental Data Service (MEDS) Report for 1988 (SCR Doc. 89/66)

a) Data Collected in 1988

Approximately 9,460 oceanographic stations were occupied within the NAFO area during 1988, of which data for 3,805 were sent directly to MEDS and 4,193 were received through IGOSS (Integrated Global Ocean Services System). Of the latter, over 1,000 stations are duplicates of the data sent directly to MEDS. The total number of stations occupied and the numbers received directly and through IGOSS declined from last year by 8, 27 and 31%, respectively. Last year, however, there was an unusually high number of stations occupied and the 1989 level was consistent with those prior to 1987. Most of the data received by MEDS had been processed and archived.

b) Historical Data Holdings

Data from a total of 13,955 historical hydrographic stations were received by MEDS in 1988 which was approximately 200 stations less than last years total.

c) Drift-buoy Data

A total of 71 drift-buoy tracks were received by MEDS during 1988 representing 135 buoy months. Both totals are approximately a 2.5 fold increase over last year. A study of storm generation off the east coast of North America (termed ERICA (Evolution of Rapidly Intensifying Cyclones in the Atlantic)) contributed substantially to that increase. An annual report containing drift tracks and other information on the buoys would be available shortly.

d) Current-meter Data

Current-meter data collected in 1988 within the NAFO area included 25 sites, 48 instruments, and a total of approximately 62 meter-months.

e) Wave Data

There was a slight increase in the number of wave spectra collected this year relative to last year. A total of 26,192 spectra were received but only 0.5% were directional.

f) Environmental Conditions

A review of monthly sea-surface temperature anomalies for each of the NAFO Subareas for 1989 was presented, based on a MEDS analysis, temperature anomaly maps from the TOGA (Tropical Ocean Global Atmosphere) centre and the US, and monthly reports published by the BIO (Bedford Institute of Oceanography). Of particular note were the cold conditions in the mid-Atlantic Bight region (Div. 6). Differences between the analyses were noted, in particular it appeared that the BIO anomalies were slightly higher than those recorded by the other agencies.

The Subcommittee was informed that MEDS had acquired a new computer system. It was anticipated that there might be some delays in the retrieval of data and the processing of new data during the coming year as MEDS switched from the old to the new system.

4. Review of Environmental Studies in 1988

a) Subareas 0 and 1 (SCR Doc. 89/3, 57, 58; SCS 89/5, 14)

The Danish Research Report (SCS Doc. 89/14) noted that hydrographic observations were collected during 1988 along the standard sections off West Greenland. Surface layer temperatures were slightly above normal in the first half of the year but well below normal in the latter half. Off the banks at medium depths there was evidence of an increased influence of East Greenland polar water during spring and early summer. Below 200 m between September and November temperature and salinity data suggested a stronger inflow of warm, high-salinity Irminger water than has been recorded in recent years. A paper was presented (SCR Doc. 89/3) on the possible prediction of trends in the temperature of the upper 200 m over Fylla Bank from air temperatures recorded nearby at Nuuk/Godthaab in West Greenland. A correlation analysis showed a statistically significant relationship between November ocean temperatures and air temperatures 2-3 months earlier. It was noted there was a relatively strong increase in the Godthaab air temperatures during winter (December to February) over the period 1876 to present (0.03°C/y). It was suggested that this might be due to CO_2 induced warming (i.e. the "Greenhouse effect").

The temporal and spatial scales of the variability in West Greenland waters were described (SCR Doc. 89/57). These ranged from the large scale influences (North Atlantic circulation, decadal time scales) to small scale (meanders, eddies and fronts between water masses with time scales of days to months). The effects of various forcing mechanisms such as solar heating, ice, wind and tides on the variability were also briefly discussed. The characteristics of the deep water off West Greenland from data collected between 1984 and 1988 were described (SCR Doc. 89/58). A general warming of these waters occurred during the period of the study but the magnitude and the pattern of the increase varied substantially between transects separated less than 400 km apart. The Canadian Research Report (SCS Doc. 89/5) noted the successful recovery and redeployment of current meters at five sites in Baffin Bay and Davis Strait.

b) Subareas 2 and 3 (SCR Doc. 89/10, 13; SCS Doc. 89/5, 8)

The environmental studies listed in the Canadian Research Report were noted. Those included current meter moorings on the Labrador Shelf, on the Southeast Shoal of the Grand Banks, and over the southeast Newfoundland Ridge. Field studies of the pack ice off Labrador and Newfoundland (LIMEX) were continuing.

During 1988 the USSR conducted extensive hydrographic surveys throughout Subareas 2 and 3 (as well as in Subarea 1 (SCR Doc. 89/10; SCS Doc. 89/8)). In general, temperatures in Davis Strait, in the Labrador Current, and on the Newfoundland Shelf and the Grand Banks were near their long-term means

(1957-71) and above their 1987 levels. Ice cover in Davis Strait was close to its normal extent but in the Labrador Sea was less than normal.

Bottom temperatures in 10 m of water at a nearshore station off Holyrood, Newfoundland, in Conception Bay had been monitored over the past three years as part of a study of squid biology. Seasonal trends in 1988 were similar to the preceding two years although it was cooler in the early part of the summer and warmer during the autumn (SCR Doc. 89/13).

c) Subareas 4, 5 and 6 (SCR Doc. 89/63, 64, 65; SCS Doc. 89/4, 5)

The Canadian Research Report noted extensive physical oceanographic studies being carried out in Jacques Cartier Passage in the Gulf of St. Lawrence (Div. 4S). This included current meter moorings, subsurface tide gauges and hydrographic data. Another study was conducted on Georges Bank to investigate circulation and mixing in the vicinity of the tidal front on the northern flank of the Bank. Current meters and thermistor chains were moored for approximately 4 months, drifting buoys were deployed several times during this period, turbulence profiles were obtained, and extensive hydrographic data were collected. A paper on the life histories of warm-core rings in the Slope Water region west of 60°W was presented (SCR Doc. 89/64). The number of rings during 1988 were higher than in any of the previous 2fourteen reporting years. In 1988, the surface positions of the shelf water front between Georges Bank and Cape Hatteras followed the long-term (1974-83) seasonal pattern (SCR Doc. 89/63). Larger excursions than normal occurred at short-time scales associated with the passage of warm-core rings. The annual average was near the long-term mean or slightly offshore while the variability was similar to, or less than, the long-term mean.

During the year, water temperatures on the shelf in the New York Bight area were colder-than-normal (SCR Doc. 89/65). In contrast, bottom temperatures on the upper continental slope remained high (>12°C) for the fourth consecutive year. Distinct changes in bottom temperatures on the outer shelf and upper slope were associated with the presence of warm-core rings.

5. Overview of Environmental Conditions in 1988 (SCR Doc. 89/67)

A review paper was presented based on several long-term oceanographic and meteorological data sets as well as a summary of data and results from available research documents and research reports. Highlights not covered in Section 2 are listed below:

a) Coastal sea temperatures at Halifax, St. Andrews, and Boothbay Harbour were below their 1951-80 means. The annual average at St. Andrews was the lowest recorded in 50 years.

b) In general, offshore surface temperatures collected from ships-of-opportunity showed positive anomalies in the north and negative anomalies in the south with the Scotian Shelf being the boundary between the two regions. An exception to that pattern was the Labrador Shelf where temperatures were below normal.

c) Subsurface temperatures at Station 27 off St. John's, Newfoundland (Div. 3L), began to moderate towards the end of the year suggesting the possibility that the cold conditions which have persisted for the past 6 years may be ending.

d) Significant wave heights in the Labrador Sea, on the Grand Banks and on the Scotian Shelf were more severe than the long-term mean (1970-80). The number of occurrences of large waves was near normal at the two southernmost sites but was near maximum in the Labrador Sea.

e) The duration of sea ice in the Gulf of St. Lawrence and off Newfoundland was near normal. While the ice appeared earlier than normal off Newfoundland, it also left earlier than usual.

f) The number of icebergs crossing 48°N was reported by the US Coast Guard as 187, a drop of over 100 from last year and the lowest number recorded in the last six years.

g) Annual air temperatures throughout the region were weak. Negative anomalies occurred off southern Baffin Island, along the Labrador coast, and off northern Newfoundland. Elsewhere in the Northwest Atlantic air temperatures were slightly

above normal.

h) The dominant feature of the sea-surface pressure anomalies was the intensification of the Icelandic Low and Bermuda-Azores High in winter. This would produce stronger westerly winds over the northern North Atlantic.

6. Marine Environment and Ecosystems Subcommittee of CAFSAC

The Marine Environment and Ecosystems Subcommittee (MEES) is a part of the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC). Its mandate is to examine environmental and ecosystem issues relevant to fisheries and to provide advice to Canadian fisheries managers. A short verbal report on MEES was presented. The primary activity was a meeting held to consider and discuss biological and oceanographic knowledge relevant to the proposed fixed link across Northumberland Strait between New Brunswick and Prince Edward Island (Div. 4T).

7. Other Matters

a) The Subcommittee was informed of two changes in the names of national representatives who are responsible for submitting oceanographic data to MEDS. They are Y. Uozumi (Japan) and G. Withee (USA). The remaining representatives are R. Keeley (Canada), R. Dominguez (Cuba), E. Buch (Denmark), Ch. Brockmann (Federal Republic of Germany), Mr. Francois (France), W. Thiele (German Democratic Republic), R. Leinbo (Norway), A.J. Paciorkowski (Poland), G.I. Luka (USSR), and P. Edwards (United Kingdom).

b) Environmental changes were usually expressed as anomalies from a "normal" or base period. Comparison of anomalies of the same variable between studies is often made difficult if the base periods were not similar. The NAFO Scientific Council had recommended that a 30-year base period (1951-80) be used where possible and, if not, to use a 20- or 10-year period. Often this was not possible, or published means were available from sources that do not conform to the above standards. This problem was discussed and the Subcommittee recommends that *an investigation be carried out to compare averages calculated over different base periods.* Where authors had sufficient data to calculate means over those different periods, they should do so and calculate their anomalies relative to them.

c) World Ocean Circulation Experiment (WOCE)

Dr. K. P. Koltermann presented a lecture on WOCE to the Subcommittee. WOCE is a global study designed to improve our understanding of the oceans' circulation, its variability and its role in climate change. Dr. Koltermann outlined the objectives and goals of the program and discussed the required resources. The field component will include hydrographic data, current meter moorings, drifting buoys, and satellite information on winds, sea temperatures and the topography of the ocean's surface and will begin at the end of 1989. It is scheduled to continue for at least 5 years. He made a plea for the continuance of long-term oceanographic data sets collected for fisheries purposes. He also requested that these data be made available to WOCE scientists and that future data that are collected be processed rapidly (WOCE is hoping to have data processed within 30 days of a ship's return to port). In addition, he asked scientists having or knowing of historical data sets that are not readily accessible, if they could, to make the data available to WOCE scientists.

8. Acknowledgements

The Chairman, noting that there was no further business, thanked the participants for their contributions and cooperation.

APPENDIX II. REPORT OF STANDING COMMITTEE ON RESEARCH COORDINATION (STACREC)

Chairman: A. Vazquez Rapporteur: A. Fréchet

The Committee met at the NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada, on 10 and 16 June 1989. Representatives attended from Canada, Cuba (16th meeting only), Denmark (Greenland), EEC, Japan, USSR (16th meeting only), and an observer attended from the USA.

1. Adoption of Agenda

The provisional agenda was adopted without modifications.

2. Fishery statistics

a) Progress Report on Secretariat Activities in 1988/89

i) Acquisition of STATLANT 21A and 21B reports for recent years

STACREC expressed concern about the deterioration in the provision of STATLANT 21A and STATLANT 21B reports since 1986, despite numerous reminders sent from the Secretariat to Contracting Parties. Over the last year only one country had provided the STATLANT 21B reports for 1986 to the Secretariat, leaving still 3 countries (or components) to report. For the 1987 fishery, 10 countries (or components) had not sent the STATLANT 21B forms. The deadline for submission of provisional statistics in the STATLANT 21A reports for 1988 was 15 April 1989. As of June 1989 data were outstanding from 11 countries.

ii) Publication of statistical information

The Committee was informed that the publication of the 1986 Statistical Bulletin was delayed because data were still outstanding from 3 countries (including Romania, not believed to have fished in the area). It was reported that errors recently found in the CAN-N database were being corrected and should be available to the Secretariat shortly, while Faroe Islands had not provided the STATLANT 21B reports to the Secretariat. It was therefore decided to proceed with the publication of the Statistical Bulletin (Vol. 36) for 1986 data after the CAN-N database was received, and to include preliminary catch values (STATLANT 21A) from Faroe Islands as an alternative if the STATLANT 21B forms were not received by September 1989.

iii) Updating the fishery statistics database

STACREC was informed that the updates of catch and effort data since 1963 was completed on the new IBM (compatible) PC system at the Secretariat. Those data (one disc/year) could be made available on PC diskettes on request. The data storage and recovery system was recognized as a very effective method by CWP (October, 1988) for other statistical offices.

b) Review of Reporting Requirements for Submission of STATLANT 21A and 21B Statistics

The Committee was uncertain about how to refer to statistical data reported and belonging to France-St. Pierre and Miquelon. Up to 1982 inclusive, fisheries statistics for France were all reported under two headings: E/FRA-M (meaning FRANCE metropolitan) and E/FRA-SP (meaning FRANCE St. Pierre). From 1983 to 1985 statistical data reported by France were all under the heading E/FRA. On 23 August 1988, NAFO received for the first time, a copy of the European Council Decision 86/283/EEC of 30 June 1986 from which, under its Article I, it was clear that "Saint Pierre and Miquelon" was a territorial collectivity of the French Republic and did not belong to the EEC. The last statistical information reported by EEC for 1986 included E/FRA-M and E/FRA-SP data separately. The designation of E/FRA-SP seemed in conflict with the decision of EEC transmitted to NAFO and the EEC representative was requested to elucidate this point.

c) Fourteenth Session of CWP, February 1990

As recommended (*NAFO Sci. Coun. Rep.*, 1988) the Assistant Executive Secretary attended the CWP *ad hoc* consultation held in Bergen in October 1988. The purpose of that meeting was to review developments since the last CWP Session and to draw up a provisional agenda for the 14th Session of CWP and a summary of the consultation was presented to STACREC. The 14th Session is to be held in February 1990 in Miami, Florida. Mr. D. Cross, Deputy Secretary of CWP, informed STACREC of the provisional agenda for that session. The Committee considered the provisional

agenda and proposed that NAFO be represented at the 14th session by the Assistant Executive Secretary, the chairman of STACREC as well as one representative from a Contracting Party. It was recommended that *Cuba provide a representative to the CWP Meeting and USSR be invited to provide a substitute if necessary.*

Mr. Cross indicated that a handbook on fishery statistics definitions would be published shortly by FAO. STACREC agreed on the usefulness of this document and it was recommended that *relevant sections of the FAO publication should be reproduced by the NAFO Secretariat as SCS documents.*

d) Boundary Between Subareas 4 and 5 and Designation of 5Zc and 5Zu

Since the General Council agreement in 1986 (NAFO GC Doc. 86/2, 2nd revision) that fishery statistics should be presented separately, STACREC had not considered this matter. It was noted that in conformity with the Scientific Council decision prior to this (*NAFO Sci. Coun. Rep.*, 1986, page 101), that catch and effort statistics had been presented in the Statistical Bulletins in separate columns for 5Zu (statistics from the USA waters) and 5Zc (statistics from Canadian waters) without reference to 5Ze. It was agreed that the Bulletins should include a note that total catch and effort from these two units correspond to the Subdivision 5Ze. A modification of the map illustrating the NAFO Divisions and Subdivisions was also proposed and is presented in Figure 1. STACREC suggests that Contracting Party representatives verify that any charts being produced that show NAFO statistical areas reflect changes in the boundary between Subarea 4 and Subarea 5 adopted by the General Council and also show the division being used for statistical reporting between the Canadian and USA waters.

3. Biological Sampling

a) Progress Report on Activities in 1988/89

STACREC noted that a list of biological sampling was prepared by the Secretariat for 1987 (NAFO SCS Doc. 89/10). The Committee was informed that the Inventory of Sampling Data for the period 1979-84 was published in 1988. It was agreed that the next publication should cover the period 1985-89.

b) Forms and Deadlines for Submission of Data

The Committee noted that no sampling information was available for the Canada (Gulf) region.

4. Biological Surveys

a) Review of Survey Activity in 1988

An inventory of biological surveys in 1988 was presented by the Secretariat (Table 1) and included information from 10 countries (or components).

b) Survey Plans for 1989 and Early 1990

An inventory of surveys planned for 1989 and early 1990 had been prepared by the Secretariat covering 10 countries (Table 2). As was the case last year, Canada (Gulf) was not found in this list nor in the one for 1988 survey activity as well as sampling information . STACREC agreed that this information should be obtained and forwarded to the Secretariat as soon as possible and that Canadian representatives should identify the contacts to facilitate the collection of this information.*

c) Review of Stratification Schemes

No new information on the stratification of the Divisions 2G and 2H were available. It was reported the estuary of the St. Lawrence River (NAFO Div. 4T) had been stratified recently and that two additional strata had been added in the 30 to 50 fathom depths off western Newfoundland (NAFO Div. 4R) following a recommendation from CAFSAC. This documentation should be prepared for the next meeting of STACREC.

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* Canada (Gulf) submitted the information to the Secretariat subsequent to the June Meeting, and those were included in Table 2.

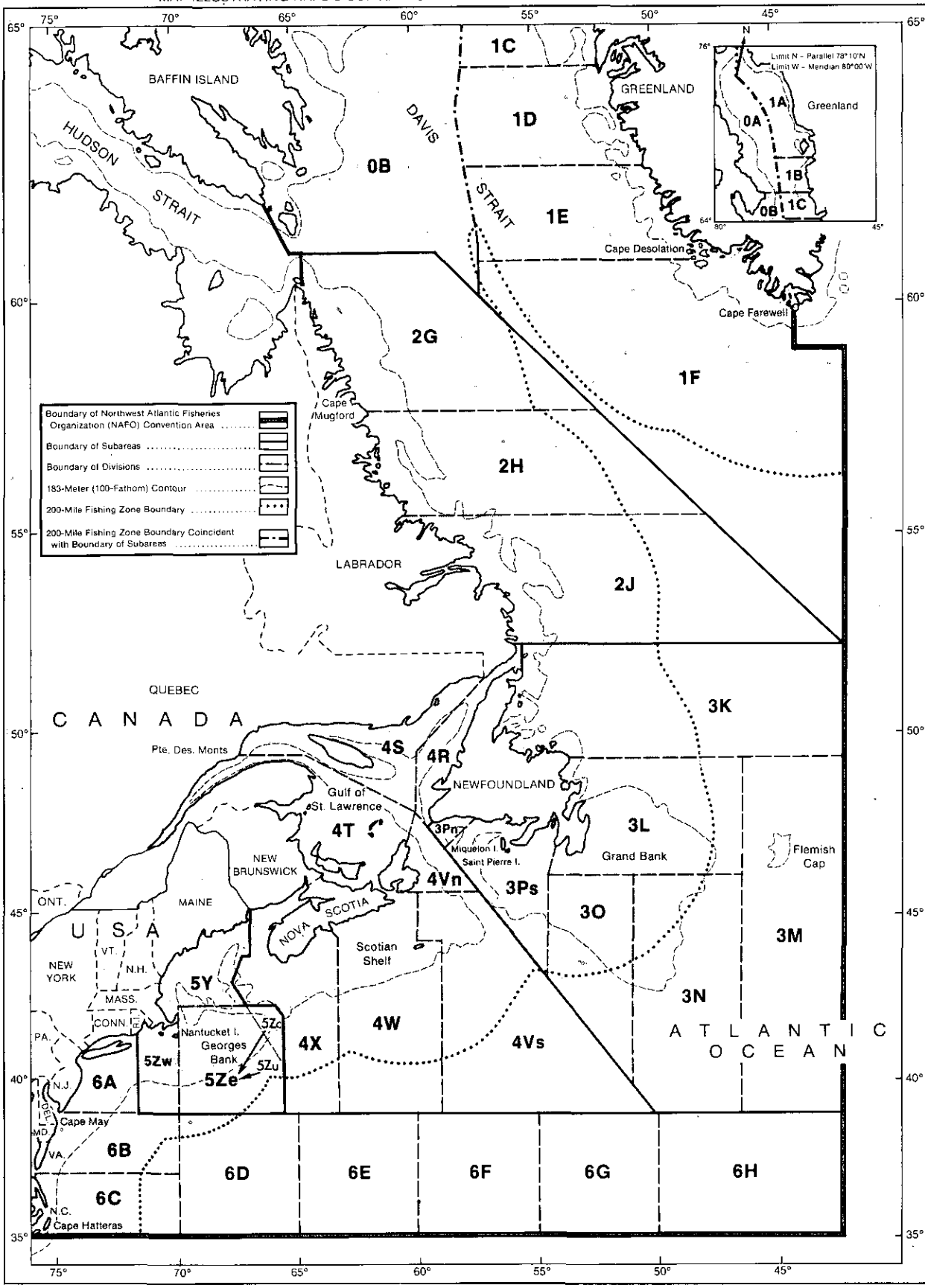

Fig. 1. Modification to Subdivision 5Ze to take into account the Canadian side of 5Ze (5Zc) and the USA side of 5Ze (5Zu).

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1988.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
			STRATIFIED-RANDOM SURVEYS		
E. Greenl.		E/DEU	9-10	Groundfish	140
0	B	SUN	10	Trawl: G halibut, Grenadier	62
0+1	ABCD	DEN-G	7-8	Shrimp trawl survey	139
1	ABCD	JPN		Groundfish	109
	BCD	SUN	10	Trawl: G halibut, Grenadier	51
2	G	SUN	9-11	Trawl: G halibut, Grenadier	83
	GH	CAN-N	8-9	Groundfish	137
	H	SUN	9	Trawl: G halibut, Grenadier	36
	J	CAN-N	11	Groundfish	93
2+3	HJK	CAN-N	7	Shrimp	179
3	K	CAN-N	11-12	Groundfish	112
		SUN	4-5	Trawl & acoustic: groundfish	107
		SUN	9,11	Trawl: G halibut, grenadier	28
	L	CAN-N	4	Groundfish	38
		CAN-N	5	Groundfish	126
		CAN-N	10-11	Groundfish	189
		SUN	4	Trawl & acoustic: groundfish	126
	LNO	CAN-N	4-5	Groundfish	203
		CAN-N	8-9	Juvenile flatfish	170
	M	E/ESP	7	Groundfish survey	120
		SUN	6	Trawl & acoustic: groundfish	124
	N	SUN	3-4	Trawl & acoustic: groundfish	79
	O	SUN	3-4	Trawl & acoustic: groundfish	88
	Ps	CAN-N	1-2	Groundfish	153
		CAN-N	4-5	Scallop	225
		FRA-SP	2-3	Groundfish survey	73
3+4	PnRST	CAN-Q	1	Groundfish	131
4	RST	CAN-Q	8	Groundfish	206
		CAN-Q	8-10	Shrimp	107
	T	CAN-G	7	Groundfish	56
		CAN-G	9	Groundfish	167
	VW	CAN-SF	3	Groundfish (cod)	69
		CAN-SF	7	Groundfish	95
	VWX	CAN-SF	7	Groundfish survey	186
		CAN-SF	10	Redfish survey	80
		SUN	10-11	Juvenile silver hake	111
	VsW	CAN-SF	2-3	Groundfish	134
		CAN-SF	5	Shrimp survey	30
		CAN-SF	9	Shrimp survey	30
4+5	VWXZ	CAN-SF	5	Scallop survey	127
	VWY	CAN-SF	7	Groundfish	91
	VWZ	CAN-SF	6	Juvenile	46
	XYZ	USA	4	Spring bottom trawl	66
		USA	10	Fishing power comparison	89
		USA	10	Autumn bottom trawl	89
		USA	10-11	Larval herring	85
	XZ	USA	8	Sea scallop	254
	XZe	USA	3-4	Spring bottom trawl	91
5	Y	USA	4	Spring bottom trawl	24
	Z	CAN-SF	3	Groundfish	142
		CAN-SF	7-8	Scallop survey	150
		USA	10	Autumn bottom trawl	57
	Ze	USA	12	Icelandic scallop	46
5+6	YZ	USA	9	Autumn bottom trawl	164
	Zw+A	USA	7	Sea scallop	225
6	A	USA	5,6,7,8	Pelagic blue fish	139
		USA	6,7	12-mile dumpsite	23
		USA	7	Sea scallop	139
	AB	USA	1	MARMAP I: Ichtyhyo & Zooplankton	63
	ABC	USA	3	Spring bottom trawl	140
			OTHER SURVEYS		
1+ E.Greenl.	DEF	DEN-G	8	Young fish survey	38
1	A	DEN-G	9	Heavy metal	35
	ABCD	DEN-G	11	Hydrography	40
	B	DEN-G	9	Scallop	96
	BD	DEN-G	5, 6	Scallop	115
	BDF	DEN-G	7, 8	Young cod	189
	CDE	DEN-G	10, 11	Cod inshore	88
	D	DEN-G	1-12	Hydrography	1
		DEN-G	10	Hydrography, young fish	69
	DEF	DEN-G	6, 7	Hydrography, plankton	69
	F	DEN-G	1	Hydrography	1
		DEN-G	1, 2	Greenland halibut	29
		DEN-G	?	Heavy metal	17
		DEN-G	8	Heavy metal	46
2	J	CAN-N	7-8	Cod sampling	
2+3	JK	CAN-N	2	Groundfish	63
		CAN-N	10	Capelin (acoustic)	
		CAN-N	11	Groundfish	95
		SUN	10-11	Acoustic: capelin	15
	JKL	CAN-N	8	Oceanography	
		CAN-N	9-10	Salmon	
	JKLMN	SUN	9-11	Acoustic: myctophidae	77
3	K	CAN-N	5,6,8,9,10	Hydrography	
	KL	CAN-N	6	Cod (acoustic)	
		CAN-N	9,10,11	Pelagic (acoustic)	
	L	CAN-N	2,4,5,6,8,		
		CAN-N	9, 10	Crab	236
		CAN-N	3	Cod tagging	
		CAN-N	3,4,5,8,9	Oceanography	
		CAN-N	5	Capelin (acoustic)	
		CAN-N	6,7,8,9	Hydrography	
		CAN-N	6,7,10,11	Cod tagging (acoustic)	
		CAN-N	10	Bottom sampling	
	LN	CAN-N	10	Gear trials	74
	LO	SUN	4-6	Acoustic: capelin	28
	LPs	CAN-N	5, 6	Capelin tagging	
	NO	CAN-N	6, 7	Capelin (acoustic)	
	OPs	CAN-N	5, 6	Squid	148
	Fs	CAN-N	5	Toxicology	
		CAN-N	7, 8	Redfish (acoustic)	
		CAN-N	8, 9	Cod tagging	
		CAN-N	8, 10	Scallops	118
4	R	CAN-N	4	Crab	4
	S	CAN-Q	5-6	Crab tagging	56
	T	CAN-G	8-11	Snow crab biomass	158
		CAN-G	7	Herring acoustics	18
		CAN-G	9	Inshore demersal studies	27
		CAN-G	11	Herring acoustics	8
		CAN-G	12	Herring acoustics	15
		CAN-Q	7	Gear trials	24
		CAN-Q	7-8	Shrimp abundance	222
		CAN-Q	8	Fish habitat	
	TVn	CAN-Q	5	Crab behaviour	
		CAN-Q	6-7	Mackerel larvae	67
		CAN-Q	7-8	Scallop abundance	87
		CAN-Q	9	Shrimp abundance	240
		CAN-Q	9	Live cod, aquaculture	
	VW	CAN-SF	5	Haddock tagging	150
		CAN-SF	6	Acoustic	23
	VWX	CAN-SF	2	Deep Ichthyofauna trawling	39
		CAN-SF	4	Square-diamond comparison	76
		CAN-SF	7	Clam tagging	
		CAN-SF	8	Square-diamond comparison	38
		CAN-SF	10	Redfish	70
		CAN-SF	10	Square-diamond comparison	48
		CAN-SF	10	Deep Ichythyofauna trawling	57
		CAN-SF	11	Sealworm inventory	3
		CAN-SF	11, 12	Deep Ichthyofauna trawling	46
		SUN	5-9	Adult silver hake	374
	W	CAN-SF	1	Herring acoustics	
		CAN-SF	6	Live halibut collection	
		CAN-SF	11-12	Mesopelagic	46
	WX	CAN-SF	2	International Observer Training	
		CAN-SF	2	Mesopelagic	39
		CAN-SF	3	Groundfish acoustics	
		CAN-SF	10	Mesopelagic	59
	X	CAN-SF	1	Acoustic	14
4+5	VWXZ	CAN-SF	6	Pollock survey	23
	WXZ	CAN-SF	4	Live fish collections	
	XY	CAN-SF	10-11	Larval herring	206
	XZ	CAN-SF	8	Lobster larvae	100
		CAN-SF	9	Lobster trawling (offshore)	
		CAN-SF	10	Scallop larvae	128
		CAN-SF	10, 11	Larval herring	193
		CAN-SF	10-11	Plankton herring	87
5	Y	CAN-SF	5-6	Herring	47
	YZ	USA	5	Law enforcement	
	Z	CAN-SF	6	Juvenile gadoid survey	130
		USA	10	Sand lance	
	ZWX	CAN-SF	7	Ichthyoplankton, oceanography	150
	Ze	CAN-SF	7	Plankton	140
	Zw	USA	8	Gear testing: trawl vs doors	
6	A	USA	1-12	12-mile dumpsite	168
		USA	11	Oceanography & sediment	8
	AB	USA	9, 10	Ship wake measurements	
	B	USA	9	Distribution of blue crab larvae	43

Table 2. Biological surveys planned for the NAFO Area in 1989 and early 1990.

Country	Area	Type of Survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1989	
CAN-N	2GHJ+3K	Shrimp	Jul 6-26
	3L	Groundfish	Oct 13-31
	3LNO	Redfish	Jan 16-29
		Groundfish	Apr 19-May 29
		Scallop	Aug 16-28
		Juvenile flatfish	Aug 24-Sep 2
	3NO	Groundfish	Nov 8-27
	3P	Scallop	Apr 27-May 9
CAN-Q	3Pn+4RST	Groundfish	Aug 7-27
	4RST	Shrimp	Aug
CAN-SP	4VsW	Groundfish survey (cod)	Mar 13-21
		Shrimp survey	Sep 25-Oct 6
	4VWX	Scallop survey	May 15-25
	4VWX+5Z	Groundfish survey	Jul 3-27
	4	Groundfish	Feb 21-Mar 23
	4+5	Groundfish	Jul 3-Aug 2
	5Z	Groundfish	Feb 22-Mar 7
		Scallop survey	Aug 1-25
CAN-G	4T	Groundfish	Sep 1-21
		Herring acoustics	Nov 1-30
		Herring acoustics	Dec 5-20
DEN-G	E.Greenl.	Shrimp trawl survey	Sep 3-23
	1ABCD	Shrimp trawl survey	Jul 23-Aug 19
F/DEU	E.Greenl.	Groundfish	Sep 5-Oct 12
	1BCDEF	Groundfish	Oct 15-Dec 2
FRA-SP	3Ps	Groundfish	Feb 15-Mar 18
JAP	E.Greenl.	Bottom trawl survey	Sep-Oct
	SA1	Bottom trawl survey	Apr-May
F/ESP	3M	Groundfish survey	Jul
SUN	0B	Trawl:G.halibut, grenadier	Oct
	1BCD	Trawl:G.halibut, grenadier	Oct
	2G	Trawl:G.halibut, grenadier	Sep-Nov
	2H	Trawl:G.halibut, grenadier	Nov
	2J+3K	Trawl:G.halibut, grenadier	Aug-Sep
	3K	Trawl&acoustic: groundfish	May-Jun
	3L	Trawl&acoustic: groundfish	Apr-May
	3M	Trawl&acoustic: groundfish	Jun-Jul
	3N	Trawl&acoustic: groundfish	Mar-Apr
	3O	Trawl&acoustic: groundfish	Mar-Apr
	4VWX	Juvenile silver hake	Oct-Nov
USA	4X+5YZ+	Spring bottom trawl	Feb 27-28
	6ABC		Mar 1-17
			Mar 20-31
		Autumn bottom trawl	Sep 11-29
			Oct 1-13
			Oct 16-25
	5YZ	Larval herring	Jan 4-20
		Larval herring	Oct 30-31
			Nov 1-10
	5YZ+6AB	Larval herring/sand lance	Nov 27-30
			Dec 1-8
	5Z+6AB	Clam-ocean quahog	Jun 26-30
			Jul 1-7
			Jul 10-21
			Jul 24-31
			Aug 1-4
		Sea scallop	Jun 30
			Jul 1-14
			Jul 25-31
			Aug 1-9
	6A	12-mile dumpsite	Aug 12-23
		OTEER SURVEYS - 1989	
CAN-N	2J	Cod sampling	Jul 26-Aug 22
	2J+3K	Cod (acoustics)	Jun 2-19
		Capelin (acoustics)	Oct 11-31
	2J+3KL	Groundfish	Nov 2-Dec 13
	2J+3KLMNOP	Oceanography	Jul 20-Aug 15
	2+3	Salmon tagging	Sep 22-Oct 11
	3L	Oceanography	Apr 3-12
		Acoustic trials	Apr 20-26
		Capelin tagging	Apr 25-May 8
		Crab survey	Apr 28-May 10
		Crab studies	May 22-26
		Capelin (acoustic)	May 11-29
		Herring (mid-water)	May 12-19
		Oceanography	May 15-24
		Crab survey	May 18-28
		Crab studies	May 22-26
		Oceanography	May 29-Jun 2
		Oceanography	Jun 5-16
		Oceanography	Jun 19-24
		Oceanography	Jun 27-Jul 14
		Oceanography	Jul 17-24
		Oceanography	Jul 24-30
		Crab survey	Aug 1-15
		Crab survey	Aug 28-Sep 1
		Oceanography	Sep 5-9
		Oceanography	Sep 11-22
		Oceanography	Sep 12-26
		Cod tagging (acoustic)	Sep 25-Oct 9
CAN-N	3L	Crab studies	Oct 9-13
		Oceanography	Nov 2-6
	3LN	Gear trials	Nov 29-Dec 11
	3LPs	Capelin survey	May 26-Jun 27
	3NO	Capelin (acoustic)	Jun 21-Jul 4
	3Ps	Toxicology	Jun 30-Jul 13
		Redfish (acoustic)	Jul 28-Aug 14
		Cod tagging	Aug 17-Sep 8
CAN-Q	4R	Herring hydroacoustics	Nov 13-Dec 14
	4RS	Shrimp/redfish gear trawls	Sep 2-15
	4RT	Mackerel larvae	Jun 16-Jul 4
	4S	Crab growth (7 trips)	Apr-Sep
	4T	Toxic algae,ichthyoplankton	Jul 19-28
		Mackerel juveniles	Jul 28-Aug 10
		Scallop survey	Aug 1-15
		Live fish, aquaculture	Nov 9-13
CAN-SP	3	Capelin larvae	Sep 5-18
		Capelin larvae	Nov 13-Dec 1
	4VsW	Live halibut collection	Jun 29-Jul 8
		Juvenile gadoid survey	Sep 23-Oct 4
	4VW	Haddock tagging	May 5-16
	4VWX	Sealworm survey	Feb 7-16
		Groundfish acoustics	Mar 13-23
		Deep ichthyofauna trawling	Apr 11-22
		Square-diamond comparisons	Apr 26-May 11
		Sealworm inventory	Jun 5-15
		Deep ichthyofauna trawling	Jun 5-16
		Deep ichthyofauna trawling	Aug 9-19
		Square-diamond comparisons	Aug 28-Sep 7
		Sealworm inventory	Oct 6-16
		Square-diamond comparisons	Oct 10-19
	4W	Herring acoustics	Jan 6-26
		Inter. observer training	Feb 3-6
		Clam survey (offshore)	May 29-Jun 8
	4WX	Acoustics	Mar 13-23
	4X	Lobster trawling	Apr 10-20
		Ichthyoplankton	May 18-Jun 1
	4X+5Z	Larval herring	Oct 18-Nov 9
	4	Acoustics	Jan 4-24
		Mesopelagic	Apr 18-28
		Larval/juvenile	May 20-Jun 2
		Mesopelagic	Jun 5-16
		Mesopelagic	Aug 8-18
		Juvenile fish	Sep 19-Oct 2
		Herring larvae	Oct 16-Nov 3
		Herring larvae	Oct 23-Nov 10
	4+5	Juvenile herring	Jun 1-16
		Herring spawning	Aug 14-Sep 2
	5Z	Lobster larvae	Jul 10-28
CAN-G	4T	Snow crab biomass	Jul-Oct
		Sealworm studies	Jul 4-12
		Juvenile cod/herring	Jul 14-29
		Icelandic scallop	Aug 30-Sep 18
		Seasonal groundfish	Dec 4-15
DEN-G	E.Greenl.	Cod tagging/hydrography	Aug 13-Sep 2
		Salmon and Greenl. halibut	Sep 3-Oct 7
		Greenl. Sea Project (GSP)	Sep 10-30
	1A	Greenland halibut	Aug 20-Sep 9
		Heavy metal	Sep 10-23
	1ABCDE	Hydrography	Jun 18-Jul 8
	1ABCDEF	Whale photo-ID, biopsy	Aug 6-19
	1BCD	Cod survey	Oct 15-Nov 4
	1BCDEF	Young cod	Jul 12-29
	1DEF	Marine mammals marking	Jun 4-17
		Cod tagging/hydrography	Aug 13-Sep 2
	1E	Heavy metal	Jun 18-Jul 1
	1F	Heavy metal	Jul 30-Aug 5
JPN	SA1	Pelagic fishes	Sep-Oct
SUN	2GH	Acoustic: myctophidae	Sep
	3LNO	Acoustic: capelin	Apr-May
		Capelin larvae, temperature & salinity	Nov-Dec
	3M	Eggs, larvae, temperature, salinity, zooplankton	Jun-Jul
USA	5Y	Harbor porpoise	Jul 17-28
	5Ze	Juvenile fish	Jul 31
			Aug 1-11
	5Z	Trawl door testing	Dec 11-19
	5Z+6ABC	Apex predators-sharks	Apr 17-31
			May 1-30
			Jun 1-2
	6A	12-mile dumpsite	Jun 6-20
		12-mile dumpsite	Jan-Sep
	6B	106-mile dumpsite	Nov 13-22
		SURVEYS PLANNED FOR EARLY 1990	
CAN-N	3L	Oceanography	Mar 5-16
	3LPs	Herring survey	Jan 15-Mar 2
	3P	Groundfish (stratified)	Feb 1-20
CAN-Q	3Pn+4RST	Groundfish (stratified)	Feb 1-20
CAN-SP	4VsW	Herring acoustics	Mar 13-23
	4VWX	Sealworm inventory	Feb 1-14
	4X	Acoustic trials	Mar 15-30
	5Z	Pollock tagging	Jan 2-12
		Stratified groundfish	Feb 19-Mar 9

d) Consideration of Coordination of Surveys

The Committee was informed that groundfish surveys conducted by EEC-Federal Republic of Germany outside territorial waters of West Greenland were coordinated with longline surveys conducted by Greenland inside territorial waters.

e) Survey Design Procedures (Working Group Report)

A report on the comparability of USSR surveys from 1983 onwards to those from 1971-82 was presented by the *Ad hoc* working group. After the examination of spatial coverage, sampling intensity and comparisons of abundance indices of yellowtail flounder in Div. 3LNO and American plaice in Div. 3L with those from Canadian surveys, the report concluded that the USSR surveys of 1971-82 should be considered comparable to the USSR surveys of 1983 to the present for the purpose of deriving indices of abundance for these species. STACREC noted that surveys from both these time periods were currently being used to derive an index of abundance for cod in Div. 3NO. Alternative approaches to produce indices of abundance from these surveys using a method known as kriging, was deemed inappropriate, mostly because of the mobility of the resources being measured and generally low sampling intensity. Other techniques such as contouring and spline approximation were not considered, mainly because such methods are not currently employed by STACFIS to derive abundance indices from surveys. As this working group's mandate has now been achieved, STACREC recommended that *all survey documentation which were discussed by the Working Group on Survey Design Procedures be made available as a SCS document.*

The Chairman recognized the valuable work done by this working group.

5. Review of Initiatives with Respect to the Annual Scientific Program and Evaluation of Progress (FC Doc. 88/8, revised, page 21)

STACREC reviewed progress in the Annual Scientific Program for the Regulatory Area and recent initiatives. Information on the statistical reporting and sampling coverage as presented last year on a stock by stock basis (SCS Doc. 88/19 and Sci. Coun. Rep. 1988, p. 96) were considered to reflect present status of knowledge on stocks in the area.

STACREC noted the increased effort in survey coverage in the Regulatory Area, mainly by the EEC groundfish survey on Flemish Cap. That survey was expected to be conducted annually for at least four more years.

STACREC recognized major deficiencies in the acquisition of statistical reports for recent years (item 2.a(i)). Timely submissions of statistical national reports were not only necessary for publication of the Statistical Bulletin but were also essential for stock assessments. The deficiencies have worsened even further in recent years.

6. Other Matters

a) List of Fishing Vessels for 1989

STACREC was informed that a list of fishing vessels had been prepared by the Secretariat for 1986. It was agreed that data for 1989 should be collected and compiled by the Secretariat for the next triennial publication.

b) Tagging Activities Reported for 1988

A review of tagging information was presented by the Secretariat. It was noted that data for CAN-Q was submitted during this meeting (described in Circular Letter 89/40), and that any other outstanding information should be made available to the Secretariat. A document will be issued by the Secretariat (SCS Doc. 89/06, revised) when data were compiled.

c) Review of Relevant SCR and SCS Documents (not considered in Items 1 to 5 above)

No new information was available on this topic.

d) Other Business

Separate Fishery Statistics for the Regulatory Area

STACREC considered the usefulness of obtaining catch and fishing effort statistics separately for the fisheries that take place within the Regulatory Area. This

information would be particularly useful for assessments of fish stocks currently exploited in Div. 3LNO. The Committee seeked guidance from the Scientific Council on means by which the catch and fishing effort statistics could be reported separately inside or outside the Regulatory Area to the Secretariat.

7. Acknowledgements

There being no other business, the Chairman thanked the rapporteur and the participants and extended special thanks to the NAFO Secretariat for their assistance in the preparation of information for this meeting. The meeting was then adjourned.

APPENDIX III. REPORT OF STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

Chairman: Sv. Aa. Horsted Rapporteur: W. R. Bowering

The Committee met at NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada on 10 and 20 June, 1989. In attendance were Sv. Aa. Horsted (Chairman), W. R. Bowering (Canada), P. Kanneworff (Denmark/Greenland), J. Messtorff (EEC), V. A. Rikhter (USSR), A. Vazquez (EEC) and the Assistant Executive Secretary (T. Amaratunga), and the Executive Secretary (J. C. E. Cardoso) attended on the morning of 20 June. Upon the invitation of STACPUB, R. G. Halliday and R. K. Mohn in their capacity as Associate Editors attended an informal meeting on 13 June.

1. Review of STACPUB Membership

P. Kanneworff (Denmark/Greenland) was welcomed to the Committee replacing S. Kawahara (Japan) who had resigned shortly before this meeting of the Scientific Council.

2. Review of Scientific Publications Since June 1988

a) Journal of Northwest Atlantic Fishery Science

Volume 8 containing 7 papers and 4 notices (84 pages) was published as planned with a publication date of December, 1988.

Six papers had been processed for publication since Volume 8, and another was in its final stages of preparation. It was proposed that these papers be published in Volume 9(1), which could be circulated in summer, 1989.

Although the responses from authors of nominated SCR documents in 1988 have been few, indications were that sufficient papers could be processed for publication of Volume 9(2) by the end of 1989.

It was noted that with one exception the concept "volume" had covered and was meant to cover one calendar year's publications whether in one or more bound "subvolumes". STACPUB advises that such "subvolumes", which contain contributions intended to be issued inside a calendar year, be given the volume number pertaining to that year, also in cases when the actual date of issue may be delayed into the next year.

b) NAFO Scientific Council Studies

Eight papers were currently being processed. There were now sufficient papers to consider publishing both Number 13 and Number 14 within the next few months. The present aim was to compile Number 13 with the papers that were ready for publication by late summer 1989.

c) NAFO Statistical Bulletin

Despite the deadline date of 30 June 1987 for the submission of final statistical data for 1986, data from 2 countries were still outstanding, and consequently the publication of Volume 36 for 1986 data had been delayed.

d) NAFO Scientific Council Reports

The volume (149 pages) containing reports of the 1988 meetings of the Scientific Council in June and September was published and distributed in December 1988. The Chairman complimented the Assistant Executive Secretary and the Secretariat for their effort in preparing and distributing that report in such a short time after the meetings.

e) List of Fishing Vessels

This triennial publication was published soon after the June 1988 Scientific Council meeting (published in July 1988) when all outstanding data were received. "List of Fishing Vessels, 1986" (47 pages) contains 1986 and previous years' data.

f) Index and Lists of Titles

The provisional index and lists of titles of 100 research documents (SCR Doc.) and 23 summary documents (SCS Doc.) which were presented at the Scientific Council meetings during 1988 were compiled and presented in SCS Doc. 89/11 (20 pages).

g) Inventory of Sampling Data

The first publication under the aegis of NAFO was published in April 1989. The "Inventory of Sampling Data 1979-84" (250 pages) was prepared in the same format as the previous ICNAF Inventory.

3. Production Costs and Revenue for Scientific Council Publications

Production costs and revenues for the various publications related to the activities of the Scientific Council were reviewed by the Committee. No significant departures from those of previous years were observed.

It was noted that Vol. 4 of the Journal still attracts interest and is by far the most sold volume of the Journal.

4. Promotion and Distribution of Scientific Publications

a) Publicity and Response Regarding the Journal

It was noted that Journal subscriptions have remained relatively stable over the last 5 years and a wider distribution did not materialize in 1988 despite further advertising efforts. It was agreed that in the further interests of promoting the Journal the Assistant Executive Secretary look into the possible steps of improving its appearance and report back to STACPUB with recommendations at the September 1989 Meeting of the Scientific Council.

b) Invitational Papers for the Journal

A positive response on an invited paper by A. T. Pinhorn and R. G. Halliday had been received by the Assistant Executive Secretary, and STACPUB was informed that this paper will be submitted for publication within the year. It was agreed by the Committee that such papers be given special status depending upon volume and content. In order to encourage authors of invited papers it was recommended that *they be informed of the possibility of special status with the letter of invitation. The Chairman and the Assistant Executive Secretary should pursue this matter.*

c) Scope of the Journal and Further Discussion on Possible Combination of Journal and Studies

The distinction between the Council's Studies and the Journal with regard to editorial standards was reviewed by STACPUB and three of the Journal's Associate Editors. Concern was expressed that there may be problems maintaining consistent criteria for judging the suitability of papers. The provision of appropriate guidelines was one way proposed in order to alleviate the problems. However, it was the view of some members and the Associate Editors that it is the area where submissions are marginally acceptable that creates the major problem and defining specific guidelines in this area may be just as problematic. It was generally agreed that a more practical solution to this problem for the present be considered. It was proposed that when the Associate Editors encounter papers which they feel were marginally acceptable, they should contact other Associate Editors for their opinions. In this way, a more standard editorial approach can be employed. This was agreed with the proviso that further solutions to such problems be explored.

Considerable discussion took place with respect to the possible combining of the Journal and Studies. While a variety of considerations were discussed, it was generally agreed that both the Journal and Scientific Council Studies should be preserved. Concern was expressed that combining the two would lower the high quality standard of the Journal. As well, many biological investigations worthy of preserving in Scientific Council Studies may not be acceptable for the Journal and would become lost in the Scientific Council Research (SCR) Document series. It was also proposed that papers recommended for the Scientific Council Studies should be dealt with quickly for editorial presentation only. Further analyses of data should not be required unless the author(s) wish to do so of their own accord. In this way, issues could be produced reasonably quickly which could highlight special papers considered during the Scientific Council proceedings.

5. Editorial Matters Regarding Scientific Publications

a) Review of General Editorial Process

The discussion with the Associate Editors revealed no serious problems with the present arrangement for editing submissions to the Journal (*NAFO Sci. Coun. Rep.*, 1987, pages 100 and 102).

b) Review of Editorial Board

i) Consideration of necessity for a second Associate Editor for Vertebrate Fisheries Biology

During an informal session between STACPUB and 3 Associate Editors on June 13, 1989 it was concluded that under the present workload, the appointment of another Associate Editor for Vertebrate Fisheries Biology was unnecessary at this time.

ii) Appointment of Associate Editor for Biological Oceanography (Dr. Colebrook has resigned)

Some members expressed the view that they were considering nominations of experts in the field of biological oceanography in their respective countries. However, they felt they should contact these experts to determine their interest before officially nominating them. It was agreed that these members report the results of their contact at the September 1989 Meeting. Other members were also encouraged to give further consideration to the filling of this position.

c) Use of the Term "Editorial Board"

At the request of STACPUB the Assistant Executive Secretary had investigated the appropriate use of the term "Editorial Board" for the group of the Associate Editors and the Technical Editor. After some discussion it was concluded that the Journal had been applying the term correctly and would continue to apply it in the same fashion.

6. Papers for Possible Publication

a) Review of Proposals for 1988 Meetings

The submission of nominated papers from 1988 was relatively low with only 6 of the 20 nominated papers submitted so far. There were indications, however, that two additional papers may be submitted at a later date. The submissions for 1987 nominated papers improved further with the Secretariat receiving 3 more papers during 1988. This increased the submission rate to 73% for 1987, well above the average of 65% reported for the 1980-86 period.

b) Review of Contributions to the 1989 Meeting

The Committee reviewed all SCR and SCS Documents presented to this meeting, including SCR Doc. 88/97, 99 and 100 for nomination. The Committee requested the Assistant Executive Secretary to invite the authors of the following 13 documents to submit their papers in a suitable form for consideration for publication in the Journal or Studies: SCR Doc. 88/97, 99, 89/01, 03, 09, 20, 25, 26, 32, 46, 58, 67 and 71.

7. Microfiche Projects

a) Review of Requests for Microfiche of ICNAF Documents

The ICNAF Microfiche Project covered the documents produced during 1951-79 and was completed in November 1986. The Secretariat purchased 30 sets of the fiche and to date have sold 12 sets (7 sets in 1987, 3 sets in 1988 and 2 sets in 1989). As reported in 1988 NAFO distributed over 1,000 brochures to mailing lists provided by the librarian at BIO and the Chairman of STACPUB (1987) and continues to advertise the fiche in the Journal and Studies.

b) Question of Microfiching NAFO Documents

The Executive Secretary was requested to make whatever progress was possible with microfiching NAFO Documents should opportunities arise within annual budgets. However, the view was continued that a specific sum should not be requested in the publications budget for this item until the ICNAF microfiche project breaks even. This requires that eight more sets are sold (disregarding capital interest).

8. Other Matters

The Assistant Executive Secretary informed the Committee that there were at present many microfiches archived at the Secretariat. These include incomplete sets of Canadian Technical Reports of Fisheries and Aquatic Sciences, Canadian Data Report of Hydrography and Ocean Sciences, Canadian Technical Report of Hydrography and Ocean Science, Canadian Contractor Reports of Hydrography and Ocean Science, and PMSR Hochseefischerei Information.

These will be retained in the Secretariat only if NAFO scientists were likely to find them of value for their reference work. Scientists were encouraged to make their interests known.

9. Acknowledgements

The Chairman thanked the Rapporteur (W. R. Bowering) for excellent records of the meeting and the Assistant Executive Secretary for preparing background working papers for the consideration of STACPUB. There being no other business the Chairman then adjourned the meeting.

PART B

Scientific Council Annual Meeting, September 1989

CONTENTS

REPORT OF SCIENTIFIC COUNCIL

Annual Meeting, September 1989

Chairman: J. S. Beckett Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at Albert Borschette Conference Centre, Brussels, Belgium, during 11-15 September 1989, to consider and report on various matters listed in the agenda (see Part D, this volume). Representatives attended from Canada, Denmark (Greenland), European Economic Community (EEC), German Democratic Republic (GDR), Japan and the Union of Socialist Republics (USSR). The Assistant Executive Secretary was in attendance.

The meeting was preceded by the 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" which was held during 6-8 September 1989 with M. J. Fogarty as Convener and participation by scientists from Canada, Cuba, Denmark (Greenland), EEC, GDR, Japan, USA and USSR.

The opening meeting was called to order on 11 September 1989 at 1020 hr.

The Chairman welcomed the representatives to Brussels and to the 11th Annual Meeting. The Assistant Executive Secretary was appointed the general rapporteur. The Council adopted the agenda recognizing that the General Council or the Fisheries Commission might have specific requests that the Council would have to address.

The Provisional Report of the Scientific Council, June 1989 was then reviewed and comments from the floor taken for the preparation of a corrigendum to the Report.

The session was adjourned at 1115 hr.

On 13 September 1989, the meeting was called to order at 1400 hr.

The Scientific Council was requested by the Fisheries Commission at its meeting on 13 September 1989, to provide a draft resolution on data required on catches and discards of juvenile flatfish on the Tail of the Grand Bank area.

The Scientific Council reviewed a working paper and adopted the following text*:

"In order to advise on areal and seasonal concentrations of juvenile American plaice and yellowtail flounder on the Grand Banks (Div. 3LNO), the Scientific Council recommends that:

a) *Member countries provide the Scientific Council with catch statistics for both landings and discards broken down on as fine a scale as possible, preferably by unit areas no larger than 1° latitude and 1° longitude, summarized on a monthly basis.*

b) *Length sampling be enhanced for both nominal landings and discards. The sampling intensity should be on the same scale as given above, i.e. preferably by unit areas no larger than 1° latitude and 1° longitude summarized on a monthly basis.*

c) *Surveys on juvenile flatfish be conducted on a seasonal basis for at least one year throughout the entire stock area.*

The Scientific Council recognizes that the means of collecting these data would be determined on a fleet by fleet basis. It is further recognized that to achieve a) and b) above would require increased observer coverage by all countries concerned."

The Council was also asked by the Fisheries Commission to provide the $F_{0.1}$ mortality rate and corresponding catch levels for Capelin in Div. 3NO.

The Council noted that values for $F_{0.1}$ had been generated in the mid-1970s and had not been estimated since then. The Council continued to be concerned about the implications for the spawning stock based on exploitation at the $F_{0.1}$ value.

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* This text is as revised and adopted during the Session of the Scientific Council on 14 September 1989.

The session was adjourned at 1500 hr.

On 14 September 1989, the meeting was called to order at 1415 hr.

In response to a question by the Fisheries Commission on monitoring and sampling the by-catch of cod on the Flemish Cap, the Council forwarded the following text:

"The low biomass and predominance of very young cod on the Flemish Cap led to the adoption by NAFO in 1988 of a moratorium on fishing for cod in Div. 3M. In order to assess the effects of cod by-catches in the redfish and flatfish fisheries, the Scientific Council recommends that:

1. *statistics on discards of cod taken in the redfish and flatfish fisheries on the Flemish Cap be reported to the Scientific Council, in addition to the normal reports of landings.*

2. *length sampling of cod, taken in the redfish and flatfish fisheries on the Flemish Cap, be collected for the two components separately. It is important that depth information accompany each sample.*"

In response to the Fisheries Commission request on the appropriateness of indicator fisheries in providing information on the stock status of cod in Division 3M, the Council forwarded the following text**:

"the Council noted that indices of stock abundance as provided by commercial catch-rate data, are important to the understanding of stock status. Where data on catch and on age composition are suitable for virtual population analysis (VPA), a commercial catch-rate series can be important for tuning the analysis, particularly if it represents fishing in most of the stock area. When a VPA is not possible due to factors such as poor catch statistics (a situation thought to exist for Div. 3M cod), a commercial catch-rate series may still provide useful information on trends in stock size.

With respect to cod in Division 3M, the last VPA was conducted in 1984, but this was tuned on abundance indices from research surveys, because data were not available either to update the trawl catch-rate data after 1980, or the longline catch-rate data after 1981, except for the small Norwegian longline fishery. It is unlikely that addition of Faroese longline data for 1981-87, which is now known to be available, would alter this situation, as there is considerable doubt about the completeness of total catch statistics in recent years.

The Scientific Council has available the data from the annual USSR bottom-trawl survey, and while highly variable from year to year, these have provided some indication of stock size. The initiation in 1988 of an annual EEC survey, and the addition of acoustic capability to the USSR survey, should enhance the ability of the Council to monitor trends in stock abundance.

The latest review of stock status (June 1989) indicates that the total biomass remains very low compared to historical values, and likely below 30,000 tons for all age groups with only 5-10% being older than 3 years in 1988. The 1986 year-class appears, however, to be relatively strong.

The Council has advised that there should be no commercial fishery in 1990 in order to allow recent year-classes to contribute to the rapid rebuilding of the biomass. This poses the question as to the level of biomass at which a fishery may be safely reintroduced, and thus also the ability of the Scientific Council to determine the actual value of the stock size. The Council agrees that once the stock is rebuilding, additional indices of abundance could be useful in the quantitative evaluation of the extent of rebuilding. Such indices might be provided by new values for catch-rate series that existed up to the introduction of the moratorium. The Council considers, however, that given the expected higher cod by-catch rates in 1990 due to the growth of cod in the 1986 year-class, and the increase in fishing effort in the redfish fishery due to the much higher (2-1/2 fold) redfish TAC, the likely levels of removal of cod as by-catch (perhaps 2,000 tons) in the redfish and American plaice fisheries together with catches by non-

** The Council reviewed and adopted the following text on 15 September 1989.

members will represent a significant level of fishing mortality. Adding mortality as a result of introducing an indicator fishery that would have to take in excess of 2,000 tons would therefore likely result in total fishing mortality approaching target levels used in managing directed fisheries for other stocks. The Council considers that fishing mortality on this stock should be kept as low as possible, at least until the 1986 year-class has spawned. It is noted, however, that this conclusion can be reviewed on an annual basis as additional research surveys provide information as to the strength of year-classes subsequent to 1986 and also provide further data on the 1986 and earlier year-classes. In the mean time, the Council would welcome receipt of data that have not been previously made available on the commercial fishery prior to the moratorium, and will consider further the extent to which the resultant catch-rate series appears to have been indicative of stock status."

The Council then adopted the reports of the Standing Committees: Appendix I, Report of Standing Committee on Fishery Science (STACFIS), Appendix II, Report of Standing Committee on Research Coordination (STACREC), Appendix III, Report of Standing Committee on Publications (STACPUB).

The session was adjourned at 1840 hr.

The concluding session of the Scientific Council was called to order at 0915 hr on 15 September 1989.

The draft report of the Council meetings during 11-14 September was adopted. The Council then addressed the only outstanding agenda item, the Election of Officers.

Brief summaries of these reports and other matters considered by the Council are given below in Sections II-VIII. The agenda, the list of participants and the list of research (SCR) and summary (SCS) documents are given Part D of this volume.

The meeting was adjourned at 1030 hr.

II. FISHERY SCIENCE (see STACFIS Report APP. I)

1. Special Session on Changes in Fish Populations

The Council endorsed the general discussions and conclusions presented to STACFIS by the Convener, M. J. Fogarty (USA), at the end of the Special Session. The Council made special note that participants considered the Special Session to be a very successful meeting and congratulations were extended to the convener for a job well done.

The Council endorsed the STACFIS recommendation that more detailed analysis of the changes in fish growth and its importance in productivity of these marine fish community systems be undertaken.

2. Future Special Sessions

a) Workshop on Silver Hake Database

The Council noted that a comprehensive outline was drawn up by STACFIS for the proposed meeting to be held in January 1990.

b) Special Session in September 1990

The Council noted that some guidelines for the meeting were received by STACFIS from the Convener, J. Shepherd, and an outline would be prepared by the STACFIS Chairman and the Assistant Executive Secretary and circulated in the near future.

c) Proposed Theme for Special Session in September 1991

The Council was very pleased to learn that R. Wells (Canada) had consented to be the Convener of the Special Session to be held in September 1991 entitled "Atlantic Cod: the Understanding on Physiology, Dynamics, Ecology and Environmental Relationships", and invited him to develop an outline and format for the meeting.

3. Other Matters

a) Designated Experts

The Council concurred with the general tasks described by STACFIS for designated experts and hoped that the early nomination of experts would expedite the work of

STACFIS during the assessment meetings in June 1990.

The Council endorsed the selection of laboratories where the preliminary assessment of various stocks would be undertaken, and noted that designated experts would be chosen by the respective laboratories and communicated to the Assistant Executive Secretary before the end of November 1989.

b) Capelin in Division 3L

The Council concurred with the incorporation of the amended assessment results to its June 1989 Report.

c) Acknowledgements

The Council thanked the Chairman of STACFIS for his hard work and contributions to the work of the Council during the year.

III. RESEARCH COORDINATION (see STACREC Report APP. II)

1. Fishery Statistics

a) Acquisition of STATLANT 21A and 21B Reports

The Council noted with grave concern that deficiencies still exist in data due to delays in submission of some national STATLANT 21B reports for 1986 and 1987. The Council endorsed the STACREC recommendation to bring the matter to the attention of the Fisheries Commission.

b) Publication of Statistical Information

The Council endorsed the STACREC recommendation that the publication of the Statistical Bulletin (No. 36 for 1986) should not be delayed any further.

2. Separate Fishery Statistics for the Regulatory Area

The Council noted STACREC's view that the requirements for requesting statistics separately for the Regulatory Area needed to be clearly defined, and agreed that the matter should be held open for further definition by the representatives of the justification of the effort that would be required to change the present reporting scheme.

3. Other Matters

The Chairman on behalf of the Council thanked the outgoing Chairman of STACREC for his valuable contributions to the Council's work, particularly recognizing the difficulties STACREC was faced with in acquisition of data.

IV. PUBLICATIONS (see STACPUB Report APP. III)

1. Review of Editorial Board

The Council welcomed the appointment of G. Krause of the Alfred Wegener Institut fur Polar und Meeresforschung, Federal Republic of Germany, to the position of Associate Editor for Biological Oceanography, and extended its appreciation to R. Misra (Canada) for his interests in the Journal's Editorial Board.

2. Invitational Papers

The Council was pleased to note that another paper, in addition to the one announced to STACPUB in June 1989, was likely to be submitted for consideration for a special issue of the Journal.

3. Review of Papers for Possible Publication

The Council was pleased to note the quick response and the significantly large number of positive responses from authors of the papers nominated at the June 1989 Meeting of STACPUB.

The Council noted the long deliberations by STACPUB on the publication of papers presented at the Special Session and endorsed its views that a single issue of the Journal be considered for their publication by mid-1990. The Council noted that STACPUB would review the status of that publication in June 1990.

4. Other Matters

The Council invited attendees to participate in STACPUB's selection of a new cover to the Journal in order to promote the Journal.

The Chairman, on behalf of the Council, thanked the outgoing Chairman of STACPUB for his valuable contributions during his 2 years in office.

V. ADOPTION OF REPORTS

1. Provisional Report of Scientific Council in June 1989

The Council reviewed the Provisional Report and issued a corrigendum to accommodate minor modifications before adopting the report. It was noted that the modification of the assessment of Capelin in Div. 3L would be identified with footnotes in the appropriate sections of the report.

2. Committee Reports of Present Meeting

As stated above (see Plenary Sessions) the Council adopted the reports of the Standing Committees as presented by the respective Chairmen on 14 September 1989.

VI. FUTURE SCIENTIFIC MEETINGS

1. Workshop on Shrimp Ageing, October 1989

The Council was pleased to note that arrangements for the meeting in Iceland were progressing well and as planned.

2. Workshop on Silver Hake, Early 1990

The Council noted that the details of the workshop on silver hake had been discussed and reported to STACFIS, and the tentative dates were 8-12 January 1990.

3. June 1990 Meeting of Scientific Council

The Council confirmed its earlier decision to meet at the NAFO Headquarters in Dartmouth, Nova Scotia, during 6-20 June 1990. The meeting would deal with the usual requests for scientific advice on fisheries management and other fishery-related research, publication and statistical activities.

4. Special Session and Annual Meeting, September 1990

The Council reaffirmed its earlier decision that the Annual Meeting of the Scientific Council would be held during 10-14 September 1990 in Halifax, Nova Scotia. The meeting would be preceded by the Special Session from 5-7 September 1990.

5. June 1991 Meeting of Scientific Council

The Council agreed on the tentative dates of 7-21 June 1991 for the meeting of the Scientific Council.

6. Special Session and Annual Meeting, September 1991

The Council noted that the proposed dates for the beginning of the Annual Meeting would fall on Labour Day (a national holiday in Canada). The Council accordingly agreed on a tentative plan to hold the Special Session immediately after the Annual Meeting (rather than preceding the meeting).

VII. NOMINATION AND ELECTION OF OFFICERS

1. Officers for 1989-91

The Chairman noted that the offices open for election to two-year terms beginning immediately after the 11th Annual Meeting were: Chairman of Scientific Council, Vice-Chairman of Scientific Council, Chairman of STACREC, and Chairman of STACPUB and it was recognized that the Vice-Chairman of the Scientific Council would become *ex officio* Chairman of STACPUB. The position of Chairman of STACFIS (H. Lassen) had been filled as of September 1988 for a two-year term ending in September 1990. The Chairman noted that

the six Contracting Parties present (Canada, Denmark (Greenland), EEC, GDR, Japan and USSR) and the two proxies held by the Executive Secretary (Iceland and Norway) constituted a quorum in accordance with the Rules of Procedure. The Chairman then called for nominations for the Office of Chairman of Scientific Council. B. Jones (EEC), who had been nominated at the June 1989 Meeting to the Scientific Council, agreed to stand for election. Sv. Aa. Horsted was also nominated, however, he declined stating that he was grateful to be nominated but was pleased not to have an election to that office.

There being no other nominations, B. Jones was duly declared the incoming Chairman of the Scientific Council. He thanked members for the confidence they had placed in him and hoped they would bear with him in executing his duties especially in view of his limited experience with NAFO in recent years. Sv. Aa. Horsted, recognizing B. Jones was very new to NAFO although he had experience elsewhere, hoped the Council would help the new Chairman through the very trying times as had been recently experienced. The Chairman on behalf of the Council wished him well.

The Chairman then called for nominations for the Office of Vice-Chairman of the Scientific Council. V. P. Serebryakov (USSR) was nominated. There being no other nominations, V. P. Serebryakov was duly declared the incoming Vice-Chairman. The Council conveyed a welcome to him and offered its assistance to him as he assumed the duties of that office as well as those of Chairman of STACPUB.

For the Office of Chairman of STACREC, W. B. Brodie (Canada) was nominated. There being no other nominations, W. B. Brodie was duly declared the incoming Chairman of STACREC. The Council extended a warm welcome to him recognizing his significant contributions to the Council in the past.

VIII. OTHER BUSINESS

1. Questions by the Fisheries Commission

With regard to the comment made by the Council to the Fisheries Commission in its June 1989 Report that a more fruitful interaction would be prompted by framing inquiries in the context of the problems which the Fisheries Commission would wish to resolve, the Council found it difficult to propose specific formulations of questions. The difficulty was particularly because the Council could not pose specific questions such as that with respect to Cod in Div. 2J+3KL, as the Fisheries Commission should decide such matters.

Responses to several questions from the Fisheries Commission forwarded to the Council during the meeting are given above (see Plenary Sessions).

2. Proposal for Joint ICES/NAFO Working Group on Seals

The Chairman had communicated with the General Secretary of ICES and had received a letter that identified ways of developing terms of reference for meeting of the Working Group. The Council agreed that the Chairman should respond positively by letter to the ICES proposal that questions would initially be posed to the organization with responsibility for the particular area. The response would note that once the Joint Working Group was established, the Council would normally expect to refer to it, requests for analysis of information on seals that were received according to the NAFO procedures.

IX. ADJOURNMENT

The Chairman adjourned the meeting by thanking all participants for their help to him over his term of office. He made specific mention of the work of the Assistant Executive Secretary, and of the support of the Secretariat. Without them, and their long hours of work, the meetings of the Council would become almost impossible to complete.

J. Messtorff, as the senior member of the Council, thanked the outgoing Chairman for his able guidance of the Council through his term, and hoped that he would continue to help the Council.

APPENDIX I. REPORT OF STANDING COMMITTEE ON FISHERY SCIENCE (STACFIS)

Chairman: H. Lassen Rapporteurs: Various

The Committee met at the Albert Borschette Conference Centre, Brussels, Belgium on 11-14 September 1989, to consider and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (Greenland), EEC, GDR, Japan and USSR.

The meeting was preceded on 6-8 September 1989 by the Special Session on "Changes in Fish Populations". Matters which were considered at both meetings are outlined below.

I. SPECIAL SESSION ON CHANGES IN FISH POPULATIONS

STACFIS received the report of the Special Session from the convener M. Fogarty (USA), which is given below. STACFIS recommended that *more detailed analyses of the changes in* (fish) *growth and its importance in the productivity of these* (marine fish community) *systems be undertaken,* as contained in the report which follows.

1. Introduction

The Special Session on "*Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes*", with M. Fogarty (USA) as convener, was held at the Centre des Conferences Albert Borschette, Brussels, Belgium, during 6-8 September 1989. A total of 18 presentations were made: 16 papers (SCR Doc. 89/62, 89/72 and 89/74 to 89/87) and two oral presentations. The Session was attended by scientists from Canada, Cuba, Denmark (Greenland), EEC, GDR, Japan, USA and USSR.

2. Specific Topics

The response of fish populations to sustained perturbations such as harvesting or pollution and habitat degradation is dependent on the regulatory mechanisms (i.e. compensatory responses) characteristic of each population. The nature and relative importance of the compensatory mechanisms governs the stability and resilience of populations to natural and man-made disturbances. Species with little or no compensatory capacity will be particularly vulnerable to exploitation or other perturbations. The principal objective of the Special Session was to explore the available information on responses of fish populations in the Northwest Atlantic to exploitation and variability in *the biotic and abiotic environment.* The deliberations of the group were centred around stabilizing factors in fish populations and their dynamic ecological setting. These problems were examined from both a single species and a multiple species perspective.

A total of eight presentations dealt specifically with the effects of exploitation on the abundance of individual species or groups of species. Seven papers provided information principally on environmental effects on fish populations and two presentations involved biotic interactions (primarily predator-prey dynamics). An overview paper provided a general framework for discussion of the role of anthropogenic and natural factors on *exploited populations.*

Dramatic shifts in the biomass levels and species composition were documented for several systems throughout the NAFO convention area. The nature of these changes and their possible causes are described in the following discussion which reflects both the presentations made during the session and comments made during the final discussion period.

a) Exploitation Effects

The role of exploitation on the structure of marine fish communities was examined in several papers. Biomass declines under increasing exploitation rates with the arrival of distant water fleets were documented for Georges Bank, Southwest Nova Scotia, Gulf of St. Lawrence, Newfoundland, and the Grand Banks. Recovery of biomass levels in these areas was noted following implementation of extended jurisdiction although on Georges Bank, the biomass of commercially desirable species has since continued to decline. Comparisons of biomass levels inside and outside of the two hundred mile limit on the Grand Bank also show a reduction in abundance under exploitation. Exploitation effects were implicated in the declines of a diverse array of species.

Changes in relative species composition were also apparent for the Georges Bank, Grand Bank, and Flemish Cap based on analyses of changes in fish assemblages, aggregate biomass, or abundance of selected groups of species. Analyses of

species assemblages indicate the composition and spatial configuration of the groups tends to remain relatively constant but that the abundance levels of the component species and the assemblage as a whole can vary widely. Structural changes in the Georges Bank system, with a current domination by elasmobranches is a particularly striking example of a change in relative species composition. These changes appear to be related to selective harvesting of marketable species.

The nature of the changes expected in each system may be highly dependent on its underlying structure. For example, a system characterized by low diversity may exhibit qualitatively different responses than higher diversity systems to a reduction or deletion of one or more species (e.g. replacement effects may not be observed). If a stock is reduced to a critical level in a productive system, it may continue to exist in the system at a low level. Conversely, in a system characterized by low productivity, the species may be forced to local extinction.

Although considerable evidence for changes in biomass levels was provided, the question of overall changes in productivity was not addressed. In particular, the role of changes in growth rates was not explored. This component of production can conceivably exert considerable influence in overall production rates in the system. It is recommended that more detailed analyses of the changes in growth and its importance in the productivity of these systems be undertaken. With respect to the importance of recruitment to production rates, a distinction between changes in base levels of recruitment should be distinguished from short term fluctuations.

b) Biotic Interactions

The role of intraspecific interactions was described for several stocks. Cannibalism was shown to be a potentially important factor in the regulation of silver hake and herring stocks. In addition, density-dependent survival rates of herring eggs in egg beds were described. Interspecific interactions between cod and several species were also suggested in an exploratory correlation analysis.

The possibility of interactive effects between predation and environmental effects on growth were noted. If growth rates decline under sub-optimal environmental conditions, the larvae may be vulnerable to predation stress for a longer period of time, resulting in increased mortality rates. Thus, subtle interactions between abiotic and biotic factors can be important.

It was noted that a critical lack of information exists for the earliest life stages. Specifically, time series of abundance estimates for the egg and larval stages are not generally available. It is therefore not possible to partition the sources of variability in pre-recruit survival into specific developmental periods.

Comparisons between Northeast and Northwest Atlantic systems can be instructive, however, the general exploitation on smaller sizes and a broader diversity of component species in the Northeast Atlantic prohibit direct comparisons of system response to exploitation and predation effects in these two systems.

Changes in the relative abundance of predators can alter pathways of energy flow in systems in indirect ways. For example, the depletion or removal of a predator can result in a change in benthic-pelagic coupling, disrupting energy transfer among certain components of the system.

The apparent dominance of elasmobranches in the Georges Bank region in recent years may signal a fundamental change in the system. These species are important piscivores and may exert considerable predation pressure on commercially desirable species. If current selective harvesting patterns are maintained, the synergistic effects of exploitation and predation may result in continued low biomass levels of harvestable species.

c) Environmental Effects

The importance of identifying the relevant spatial and temporal scales for integration of biological and physical processes was discussed. In particular, the linkage between physical processes and their potential effects on biological systems is crucial to the correct selection of scales in time and space.

Specification of the underlying mechanisms (or hypothesized mechanisms) relating environmental factors to growth and survival of fish at different life stages is critical to advancing from empirical relationships based on correlational studies to a full understanding of environmental effects on fish populations.

The potential implications of global climate change on fish populations were discussed. Clear evidence of warming trends have been obtained from water temperature records for West Greenland. Sustained trends of this type are likely to have much different implications for fish populations than short-term variability. These changes may fundamentally alter the production characteristics of boreal-temperate systems which are expected to be more strongly impacted by global warming than lower latitudes.

It was noted that collaboration between physical oceanographers and fishery ecologists on the effects of small-scale variability in oceanographic processes on larval fish survival and growth has been very fruitful.

d) Conclusions

Clear evidence of changes in biomass levels and relative species compositions in response to exploitation has been obtained in the Northwest Atlantic during the last three decades. The observed response of fish populations to disturbances such as fishing has immediate implications for fishery management. These observations can also provide insights into basic ecological processes and structuring mechanisms in marine ecosystems. The broad spatial and temporal scales over which fisheries operate represent major perturbations to these systems. The relative strength of the perturbation can be measured and the responses of systems to these disturbances can be determined. Basic ecological questions such as the possible existence of alternate stable states in system configurations can be addressed by measuring changes in the structure of fish communities with changes in exploitation rates and patterns.

Exploitation can dramatically alter the biomass levels in marine systems. This effect was unequivocally shown in a number of systems considered during the Special Session and for a broad range of species or species groups. Interesting comparisons between lower diversity, higher latitude systems can be instructive. The effects of exploitation on productivity of these systems, however, is less clear because the relevant comparisons have not often been attempted.

Changes in fish populations under exploitation are embedded in a complex physical setting and it may not always be possible to clearly distinguish between the effects of harvesting and environmental effects in the short term. Accordingly, it is crucial that consistent time series of relevant biological, physical and fishery-related information be maintained and that these sources of information be synthesized into an overview of system response to the factors affecting the component species.

The papers presented during the Special Session provided valuable case studies of the importance of exploitation, environmental factors, and biotic interactions on marine systems. It is recommended that papers presented during the Special Session be considered for publication collectively in an issue of the *Journal of the Northwest Atlantic Fishery Science*, as appropriate.

II. FUTURE MEETINGS

1. Workshop on Silver Hake Database

The Scientific Council recommended at its June 1989 meeting that a workshop be held on "silver hake assessment data and analysis" and that the workshop should be held in early 1990.

The chairman suggested that a small group should prepare an outline of the workshop for consideration by STACFIS. The group met on the afternoon of 11 September 1989. The results were then discussed by STACFIS and the final outline is as follows:

The objective of the workshop would be to review data available for silver hake assessment, resolve the apparent discrepancies and establish an agreed database.

Six topics were identified:

a) Sampling for Length and Ageing Material

Discrepancies between length frequencies collected by several countries have been noted. Therefore sampling methods for all countries should be reviewed (e. g. sample size, randomization scheme, equipment used and measurements taken).

b) Ageing Methods

Results of the otolith exchange programs between Canada and USSR were reported in June 1989, and a bias was still apparent in the data. The workshop should therefore attempt to resolve those problems.

c) Methods Used in the Construction of Yearly Catch Compositions

Procedures for aggregating age and length data should be reviewed, particularly stratification schemes. The database at present only went back to 1977. While data for the 1962-76 period were available, they had not been analyzed yet.

d) Commercial Catch Rate Data Series

There was a break in the nature of the data series so two periods needed to be addressed: 1970-85 and 1986-89.

e) Research Vessel Survey Data

Stratification schemes, sampling and raising procedures should be reviewed. The ageing and length measurement problems referred to above would also influence the survey results.

f) Assessment Methods

The methods which were currently employed to assess silver hake should be reviewed and new methods should be evaluated before they were used in assessments.

Output of the Workshop

For items a-e listed above, the agreed database and how it was constructed should be fully documented. Further, effects on the assessment as a consequence of any changes in the database should be documented.

For item f, validation of the methods should be sought.

Standard methods of sampling, stratification, length measurement etc. should be established wherever possible.

Place and Time of the Workshop

The time constraints on the laboratories were quite severe, but it was agreed that 8-12 January 1990 might be the earliest possible dates. The chairman of STACFIS (Hans Lassen) should convene the workshop and the services of the Assistant Executive Secretary would be required for the workshop.

2. Special Session in September 1990

Regarding the Special Session on "Management Under Uncertainties Related to Biology and Assessments, with Case Studies on Some North Atlantic Fisheries", STACFIS received a telefax from the convener John Shepherd (Lowestoft, UK) giving some guidelines for the meeting which should be included in the flyer to go out with invitations to the meeting. STACFIS discussed the guidelines and asked the Assistant Executive Secretary with assistance of the chairman of STACFIS to prepare the flyer and invitation.

3. Special Session in September 1991

STACFIS discussed possible topics for 1991 and decided on "Atlantic Cod: The Understanding on physiology, Dynamics, Ecology and Environmental Relationships".

The chairman asked the committee to consider an appropriate convener, who the Chairman of the Scientific Council would then approach. The outline for the meeting would be reviewed at the June 1990 Meeting of the Scientific Council, in the light of the convener's input.

III. OTHER MATTERS

1. Designated Experts

STACFIS discussed the assignment of designated experts for the June 1990 meeting. The designated expert should arrange to receive all data pertinent to an assessment, prior to the STACFIS meeting from all parties investigating a given stock. The designated expert should then provide STACFIS with a preliminary assessment for its consideration. The

designated expert should further act as rapporteur for that particular section of the STACFIS report. It was pointed out that the success of the scheme depended critically on the data made available to the expert in due time. It was not acceptable that data submission to the relevant designated expert be delayed until the beginning of the STACFIS meeting. That would put the designated expert under pressure and prevent the person from participating in the general review of other assessments.

It was further noted that the system was established to expedite the work of STACFIS. While the designated expert was expected to provide a preliminary assessment for STACFIS, consideration of input from other members, preferably in the form of research documents, were essential for a full discussion of the assessments at STACFIS.

STACFIS identified the laboratories which would provide designated experts and they are listed below. The general principle was to choose laboratories which were holding a significant amount of the data on the relevant stock and were actively engaged in the research.

List of Laboratories which would provide designated experts for various stocks

Species	Area	Laboratory
Cod	SA 1	Greenland[1]
	Div. 3M	Vigo[2]
	Div. 3NO	St. John's[3]
Redfish	SA 1	Hamburg[4]
	Div. 3M	PINRO[5]
	Div. 3LN	St. John's
Silver hake	Div. 4VWX	Dartmouth[6]
American plaice	Div. 3M	Vigo
	Div. 3LNO	St. John's
Witch flounder	Div. 3NO	St. John's
Yellowtail flounder	Div. 3LNO	St. John's
Greenland halibut	SA 0+1	Greenland
	SA 2 + Div. 3KL	St. John's
Roundnose grenadier	SA 0+1	St. John's
	SA 2+3	St. John's
Wolffish	SA 1	Greenland
Capelin	Div. 3L	St. John's
	Div. 3NO	St. John's
Squid	SA 3+4	St. John's
Northern shrimp	SA 0+1	Greenland
	Denmark Strait	Greenland

[1] Greenland Fisheries Research Institute
Tagensvej 135, 1, DK-2200 Copenhagen N, Denmark
[2] Instituto Investigaciones Marinas
Muelle de Bouzas, Vigo, Spain
[3] Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland, Canada
[4] Institut fur Seefischerei
Palmaille 9, D-2000 Hamburg 50, Federal Republic of Germany
[5] Polar Research Institute of Marine Fisheries and Oceanography (PINRO)
6 Knipovich Street, Murmansk, 183763, USSR
[6] Bedford Institute of Oceanography, Marine Fish Division
P. O. Box 1006, Dartmouth, Nova Scotia, Canada

STACFIS chairman would, in the case of additions to the stocks listed above, contact laboratories likely to provide designated experts. Conversely, the Chairman would contact the laboratories if some stocks listed above might not be required. STACFIS agreed that laboratories notify the Assistant Executive Secretary at NAFO Headquarters, of the names of the designated experts well in advance of the June meeting, preferably before the end of November 1989. The list would then be circulated by the Secretariat.

2. Capelin in Division 3L

NAFO SCR Doc. 89/52 which was presented at the June 1989 Meeting, was resubmitted with an addendum to indicate an error in calibration of the hydroacoustic equipment. It was agreed that the resulting changes to the assessment would be incorporated in the Report of the June 1989 Meeting of the Scientific Council and those changes be indicated with footnotes.

3. Yellowtail Flounder in Divisions 3LNO

In response to a question regarding the wording in the Provisional Report of the Scientific Council, June 1989, with respect to how much of the juvenile stock (ages 1-4) occur in the Regulatory area, the same database that was available in June 1989 was reviewed. The wording in the Scientific Council report was slightly amended. It was agreed that the new phrasing be incorporated in the report of the June Meeting.

4. Review of Scientific Papers

Two papers submitted during the meeting, titled "Results of parasitological investigations as an index of stock delimitations concerning occurrences of Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in the Northwest Atlantic" by L. W. Reimer and P. Ernst (SCR Doc. 89/73), and "Yield-per-recruit of American plaice in Div. 3LNO" by J. Bertrand and R. Noé (SCR Doc. 89/88), were found to be relevant to stock assessments, and STACFIS agreed to review those documents at the June 1990 Meeting, when the assessments would be carried out.

5. Acknowledgements

In closing the meeting, the Chairman thanked the members of the Committee for their contributions, the Assistant Executive Secretary and the staff of the NAFO Secretariat for the most efficient assistance to STACFIS.

APPENDIX II. REPORT OF STANDING COMMITTEE ON RESEARCH COORDINATION (STACREC)

Chairman: A. Vazquez Rapporteur: Various

The Committee met at the Albert Borschette Conference Centre, Brussels, Belgium, on 11 and 14 September 1989 to consider and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (Greenland), EEC, GDR, Japan and USSR.

1. Fishery Statistics

a) Acquisition of STATLANT 21A and 21B Reports

The Committee was informed by the Assistant Executive Secretary that no new statistical information was received since the June Meeting. Consequently, the deficiencies in STATLANT 21B national reports for 1986 and 1987 as well as in STATLANT 21A provisional catches for 1988, as pointed out in the June report, still remained. STACREC reiterated the necessity of accurate statistical information for the Scientific Council objectives. STACREC recommended that *since the submission of statistical information was worsening, the Scientific Council bring the matter to the attention of the Fisheries Commission.*

Provisional nominal catches in NAFO Convention Area for 1988 were still incomplete due to the lack of France and Faroe Islands data. It was agreed that a table containing nominal catches for 1987 and 1988 with indications of its deficiencies should be included in the Scientific Council Report.

b) Publication of Statistical Information

Information was received that the STATLANT 21B report for 1986 from Canada (N) would be available very shortly.

The Committee observed that the proposed publication date of September for the Statistical Bulletin (No. 36) for 1986 as proposed at the June Meeting,was not realized. STACREC recognized the need to obtain those necessary data and recommended that *the publication should not be delayed any further and every attempt be made to publish as soon as possible.*

2. Separate Fishery Statistics for the Regulatory Area (SCS Doc. 89/18)

The implication of requesting statistics separately for the Regulatory Area was considered. The Committee reviewed the relevant sections of the Convention in relation to catch and effort data submission by Contracting Parties (SCS Doc. 89/18). It was pointed out that such new requirements might involve important changes in current routines for acquisition, reporting and editing statistical data. The changes were judged to be serious disturbances to those routines. It was agreed that objectives to be achieved by obtaining separate fishing statistics for the Regulatory Area were at present not sufficiently defined to justify the effort implied to change the present statistical reporting requirements and that STACREC would not at present pursue a request for separate fishery statistics.

3. Other Matter

There being no other business, the Chairman thanked the participants and the Assistant Executive Secretary for their contribution to the meeting.

APPENDIX III. REPORT OF STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

Chairman: Sv. Aa. Horsted Rapporteur: T. Amaratunga

The Committee met at the Albert Borschette Conference Centre of the EEC in Brussels, Belgium on 12 September 1989. In attendance were Sv. Aa. Horsted (Chairman, Denmark/Greenland), W. R. Bowering (Canada), J. Messtorff (EEC), V. A. Rikhter (USSR), A. Vazquez (EEC) and the Assistant Executive Secretary (T. Amaratunga).

1. Review of Editorial Board

The Committee noted the need for the appointment to the position of Associate Editor for Biological Oceanography. The Committee was informed that Gunther Krause of the Alfred Wegener Institut fur Polar und Meeresforschung, Federal Republic of Germany and Raj Misra of the Department of Fisheries and Oceans, Canada, had agreed to be nominated to serve on the Editorial Board.

In view of the present needs of the Board and the desirability to maintain the international nature of the Board, the Committee elected to appoint G. Krause to the position of Associate Editor for Biological Oceanography.

STACPUB expressed its appreciation to both eminent scientists for their interest in the Journal and hoped that it might have the opportunity to draw on R. Misra's expertise at a later date.

2. Invitational Papers

M. Stein (EEC) had indicated his interest in presenting a review paper in 1990. STACPUB welcomed the prospects of receiving that paper, in addition to the one announced in June 1989 by R. G. Halliday and A. T. Pinhorn for the latter part of 1989, for consideration for publishing special issues of the Journal.

3. Review of Papers for Possible Publication

a) Review of Responses to Proposals From Past Meetings

The Committee was pleased to note that the Secretariat had responses from authors of 9 of the 13 papers, which included 2 submissions, nominated in June. All papers, except one, were intended for consideration for the Journal. In addition, there was one further response from the nominations in 1988.

b) Papers From the September 1989 Special Session

In reviewing papers presented at the Special Session, the Committee noted the recommendation made in the *Convener's report* that a single issue of the Journal for publication be considered, and recognized the importance of keeping the papers together.

After extensive discussion on the standards of papers received at the meeting and the possible approaches that could be taken, STACPUB agreed to invite and act on the views of the convener. STACPUB accordingly agreed to invite the authors of all papers presented at the meeting, to respond with their intentions within one month. The submitted papers would be reviewed in the normal process, and with the assistance of the convener and the Assistant Executive Secretary, to aim at publishing a single issue of the Journal by mid 1990. STACPUB would review the progress of this publication in June 1990.

c) Other Contributions

There were no contributions to be considered.

4. Other Matters

a) Publication of Statistical Bulletin No. 36

STACPUB noted with concern that the publication in September of the Statistical Bulletin No. 36 for 1986 was not achieved as defined by the Scientific Council in June 1989, because certain necessary data had not yet been submitted to the Secretariat.

b) Promotion of the Journal

In response to the Committee's request from the June 1989 Meeting, the Assistant Executive Secretary presented a selection of designs for the proposed cover of the Journal. STACPUB agreed that the selection be shown to representatives of the Scientific Council and assigned the task of determining the most suitable cover, to the Assistant Executive Secretary.

c) Acknowledgements

The Chairman thanked the members of the Committee and the Assistant Executive Secretary for their good cooperation and contribution to the work of the Committee through the two years when he had been in the Chair. The Committee and the Assistant Executive Secretary expressed their appreciation to the Chairman for his good service through his term as Chairman of the Committee.

PART C

CONTENTS

WORKING GROUP ON PROGRESS IN AGE DETERMINATION OF *PANDALUS*

The Working Group on Progress in Age Determination of *Pandalus* met at the Marine Research Institute, Reykjavik, Iceland, during 16-19 October 1989. The meeting was convened by U. Skúladóttir (Iceland) and chaired by D. G. Parsons (Canada). A total of 15 scientists attended the meeting representing Canada, Greenland (Denmark), Iceland, Norway, Sweden and USA, and 10 papers were presented (NAFO SCR Doc. 89/89 to 89/98, inclusive). In addition, there were demonstrations of various software packages as well as digital calliper data collection systems.

The objective of the meeting was to determine what progress had been made in age determination of *Pandalus* since the 1981 workshops held in Canada in May and November. At the 1988 June Meeting of the Scientific Council, it was agreed that the meeting should take the form of a working group rather than a workshop, with the presentation of prepared papers and that attendance would include the participants of the 1981 workshop as well as others who might have relevant information to present.

The Report of the Working Group would be reviewed by the Scientific Council at its meeting in June 1990. The list of documents presented at the meeting, and the list of attendees are given in Part D of this volume.

PART D

Miscellaneous

CONTENTS

AGENDA I. SCIENTIFIC COUNCIL MEETING - JUNE 1989

I. Opening (Chairman: J. S. Beckett)

1. Appointment of rapporteur
2. Adoption of agenda
3. Plan of work
4. Report of proxy votes and election of STACFIS Chairman (Executive Secretary)

II. Fishery Science (STACFIS Chairman: H. Lassen)

1. General review of catches and fishing activity in 1988

2. Review of relevant recommendations from 1988 meetings (see NAFO Sci. Coun. Rep., 1988, pages 147-149 and Circular Letter 89/08)

3. Tuning methods to calibrate terminal Fs (NAFO Sci. Coun. Rep., 1988, pages 108-114)

4. Stock assessments

a) Review of new format of report (NAFO Sci. Coun. Rep., 1988, pages 85 and 110)

b) Stocks within or partly within the Regulatory Area, as requested by the Fisheries Commission with the concurrence of the Coastal State (Annex 1):

- Cod (Div. 3NO; Div. 3M)
- Redfish (Div. 3LN; Div. 3M)
- American plaice (Div. 3LNO; Div. 3M)
- Witch flounder (Div. 3NO)
- Yellowtail flounder (Div. 3LNO)
- Capelin (Div. 3NO)
- Squid (Subareas 3 and 4)
- [Note also Annex 1, Item 3 concerning cod in Div. 2J+3KL, Item 4 concerning cod in Div. 3M, and Item 5 concerning flounders in Div. 3LNO]

c) Stocks within the 200-mile fishery zone in Subareas 2, 3 and 4, as requested by Canada (Annex 2):

- Greenland halibut (Subarea 2 and Div. 3KL)
- Roundnose grenadier (Subareas 2 and 3)
- Silver hake (Div. 4VWX)
- Capelin (Div. 3L)

d) Stocks within the 200-mile fishery zone in Subarea 1 and at East Greenland, as requested by Denmark on behalf of Greenland (Annex 3):

- Cod (Subarea 1)
- Redfish (Subarea 1) (if possible, by species)
- Wolffish (Subarea 1) (if possible, for spotted and striped)
- Northern shrimp (East Greenland)
- Other finfish and invertebrates (Subarea 1)

e) Stocks overlapping the fishery zones in Subareas 0 and 1, as requested by Canada and by Denmark on behalf of Greenland (Annexes 2 and 3):

- Greenland halibut (Subareas 0 and 1)
- Roundnose grenadier (Subareas 0 and 1)
- Northern shrimp (Subareas 0 and 1)

5. Environmental Research (Subcommittee Chairman: M. Stein)

a) Election of Chairman of Subcommittee
b) Chairman's report
c) Marine Environmental Data Service Report for 1988
d) Review of environmental studies in 1988
e) Overview of environmental conditions in 1988
f) Marine Environmental Ecosystems Subcommittee of CAFSAC (report)
g) National representatives
h) Other matters

6. Ageing techniques and validation studies

   a) Reports on the otolith exchanges on Silver hake and American plaice (Div. 3LNO)
   b) Other ageing and validation studies reported

7. Gear and selectivity studies

   a) Reports on gear and selectivity studies (if any)
   b) Drawbacks in stock assessments due to lack of information on gear performance and selectivity
   c) Proposals for gear and selectivity studies

8. Review of research documents not considered in items (1) to (7) above

9. Other matters

   a) Review of current arrangements for conducting stock assessment (NAFO Sci. Coun. Rep., 1988, pages 84 and 149)
   b) Impact of changes of survey design on assessment results
   c) Review of meeting facilities, especially computing facilities (NAFO Sci. Coun. Rep., 1988, pages 108, 114 and 149)
   d) Progress report on contributions for the Special Session, Brussels, September 1989 (M. Fogarty, USA convener)
   e) Preparation for Special Session in September 1990 on "Management Under Uncertainties Related to Biology and Assessments, With Case Studies on Some North Atlantic Fisheries"
   f) Proposed theme for Special Session in September 1991
   g) Preparation for the Workshop on Age Determination on Shrimp, Reykjavik, October 1989 (U. Skuladottir, Iceland, convener)
   h) Other business

III. Research Coordination (STACREC Chairman: A. Vazquez)

1. Adoption of agenda

2. Fishery statistics

   a) Progress report on Secretariat activities in 1988/89

      i) Acquisition of STATLANT 21A and 21B reports for recent years
      ii) Publication of statistical information
      iii) Updating of fishery statistics database

   b) Review of reporting requirements for submission of STATLANT 21A and 21B statistics

   c) Fourteenth Session of CWP, February 1990

   d) Boundary between Subareas 4 and 5 and designation of 5Zc and 5Zu

3. Biological sampling

   a) Progress report on activities in 1988/89
   b) Forms and deadlines for submission of data

4. Biological surveys

   a) Review of survey activity in 1988
   b) Survey plans for 1989 and early 1990
   c) Review of stratification schemes
   d) Consideration of coordination of surveys
   e) Survey design procedures (Working Group report)

5. Review of initiatives with respect to the Annual Scientific Program and evaluation of progress (FC Doc. 88/8, revised, page 21)

6. Other matters

   a) List of fishing vessels for 1989
   b) Tagging activities reported for 1988
   c) Review of relevant SCR and SCS documents (not considered in Items 1 to 5 above)
   d) Other business

IV. Publications (STACPUB Chairman: Sv. Aa. Horsted)

1. Review of STACPUB membership

2. Review of scientific publications since June 1988

3. Production costs and revenues for Scientific Council publications

4. Promotion and distribution of scientific publications

   a) Publicity and response regarding the Journal
   b) Invitational papers for the Journal
   c) Scope of the Journal and further discussion on possible combination of Journal and Studies

5. Editorial matters regarding scientific publications

   a) Editorial activities

   b) Review of general editorial process

   c) Review of "Editorial Board"

      i) Consideration of necessity for a second Associate Editor for Vertebrate Fisheries Biology, and, if so decided, appointment of an Associate Editor
      ii) Appointment of Associate Editor for Biological Oceanography (Dr. Colebrook has resigned)

   d) Use of the term "Editorial Board"

6. Papers for possible publication

   a) Review of proposals for 1988 meetings
   b) Review of contributions to the 1989 meeting

7. Microfiche projects

   a) Review of requests for microfiche of ICNAF documents
   b) Question of microfiching NAFO research documents

8. Other matters

V. Rules of Procedures

VI. Collaboration with other Organizations

1. Consideration of NAFO participating in ICES working group on seals
2. Fourteenth Session of CWP, February 1990

VII. Adoption of Reports

1. Committee reports from this meeting (STACFIS, STACREC, STACPUB)
2. Distribution of the Provisional Reports of the Scientific Council

VIII. Arrangements for Special Sessions

[See under fishery Science, Section 9(d), 9(e), 9(f) and 9(g)]

IX. Future Scientific Council Meetings, 1989 and 1990

X. Nomination and election of Officers to the Scientific Council and its Standing Committees

XI. Other Matters

XII. Adjournment

ANNEX 1. FISHERIES COMMISSION REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1990 OF CERTAIN STOCKS IN SUBAREAS 3 AND 4

1. The Fisheries Commission with the concurrence of the Coastal State requests that the Scientific Council, at a meeting in advance of the 1989 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 1990:

Cod (Div. 3NO; Div. 3M)
Redfish (Div. 3LN; Div. 3M)
American plaice (Div. 3LNO; Div. 3M)
Witch flounder (Div. 3NO)
Yellowtail flounder (Div. 3LNO)
Capelin (Div. 3NO)
Squid (Subareas 3 and 4)

2. The Commission and the Coastal State request the Scientific Council to consider the following options in assessing and projecting future stock levels for those stocks listed above:

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As general reference points the implications of fishing at $F_{0.1}$, F_{1987} and F_{max} in 1989 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options. Opinions of the Scientific Council should be expressed in regard to stock size, spawning stock sizes, recruitment prospects, catch rates, and TACs implied by those management strategies for 1990 and the long term. Values of F corresponding to the reference points should be given and their accuracy assessed.

b) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference points should be the level of fishing effort or fishing mortality (F) which is calculated to be required to take the MSY catch in the long term and two-thirds of that effort level.

c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence of stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds of the virgin stock.

d) Spawning stock biomass levels that might be considered necessary for maintenance of sustained recruitment should be recommended for each stock.

e) Presentation of the result should include the following:

i) for stock which analytical dynamic-pool type assessments are possible:

- a graph of yield and fishing mortality for at least the past 10 years.
- a graph of spawning stock biomass and recruitment levels for at least the past 10 years.
- a graph of catch options for the year 1990 over a range of fishing mortality rates (F) at least from $F_{0.1}$ to F_{max}.
- a graph showing spawning stock biomasses at 1.1.1991 corresponding to each catch option.
- graphs showing the yield-per-recruit and spawning stock pre-recruit values for a range of fishing mortality.

ii) for stocks for which advice is based on general production models, the relevant graph of production on fishing mortality rate or fishing effort.

In all cases the three reference points, actual F, F_{max} and $F_{0.1}$ should be shown.

3. The Fisheries Commission with the concurrence of the Coastal State requests that the Scientific Council continue to provide information, if available, on the stock

separation in Div. 2J+3KL and the proportion of the biomass of the cod stock in Div. 3L in the Regulatory Area and a projection if possible of the proportion likely to be available in the Regulatory Area in future years. Information is also requested on the age composition of that portion of the stock occurring in the Regulatory Area.

4. With respect to cod in Div. 3M, the Scientific Council is asked to advise on the levels of unavoidable by-catch of cod in directed fisheries for redfish and American plaice. The Council is asked also to comment on the appropriateness of establishing a minimum target level for spawning biomass, and to provide advice on options for establishing such a level.

5. With respect to flounders in Div. 3LNO, the Scientific Council is requested to provide advice on the impact of recent increased catches of American plaice and yellowtail flounder from areas described by the Council in its 1988 report as being nursery areas for these species.

Advice should also be provided on management options that would reduce the extent of the impact on the potential yield if it is concluded that the changes in catch distribution are reducing the potential yield.

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1990 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1989 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1990:

Greenland halibut (Subarea 2 and Div. 3K and 3L)
Roundnose grenadier (Subareas 2 and 3)
Silver hake (Div. 4V, 4W and 4X)
Capelin (Div. 3L)

It is also suggested that, subject to the concurrence of Denmark (Greenland), the Scientific Council, prior to the 1989 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1990 of the following stocks:

Shrimp (Subareas 0 and 1)
Greenland halibut (Subareas 0 and 1)
Roundnose grenadier (Subareas 0 and 1)

2. Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for those stocks listed above:

a) For those stocks subject to analytical dynamic-pool assessments, the status of the stock should be reviewed and the implications of continuing to fish at $F_{0.1}$ in 1990 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those to be expected at the $F_{0.1}$ level in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. All results should be expressed in terms of stock sizes, catch rates and TACs implied for 1990 and the long term.

b) For those stocks subject to general production-type assessments, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference point should be the level of fishing effort (F) which is two-thirds that calculated to be required to take the MSY catch in the long term.

c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence on stock status should, however, be weighted against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stocks.

P. Meyboom
Deputy Minister
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 3. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT OF CERTAIN STOCKS IN 1990

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1989 Meeting to provide advice on the status of the stocks and on the biological basis for management in 1990 and as many years onward as the data allow for the following stocks:

   a) Stocks occurring in Subarea 1

      i) Atlantic cod
      ii) Redfish (by species, is possible)
      iii) Wolffish (by species (*A. minor* and *A. lupus*), if possible)
      iv) Any other stock (of commercial interest) of invertebrates and finfish in Subarea 1 for which data allow a status report

   b) Stocks overlapping Subareas 0 and 1 (subject to the concurrence of Canada)

      i) Greenland halibut
      ii) Roundnose grenadier
      iii) Northern shrimp (*Pandalus borealis*)

2. In the analyses on which management advice will be based, the following should be included:

   a) For cod in Subarea 1, the current stock size and its age composition and distribution should be analyzed and form the basis for management options in which catch and catch composition (by age-groups) and the resultant stock size and spawning stock size are to be given, with the following examples of options:

      i) F = (0.1) from 1990 onwards
      ii) F = F(max) from 1990 onwards
      iii) F from 1990 onward equal to that F-value for 1989 corresponds to the set TAC for that year of 90,000 tons
      iv) A steady catch level from 1990 onward with the annual catch equal to the catch for 1990 by options I, II and III, respectively, and a steady catch level of 90,000 tons
      v) Same options as in iv) above except that F-values not be allowed to exceed 0.60

      The above mentioned analyses should be based upon a catch in 1989 equal to the set TAC of 90,000 tons. Special attention should be paid to the sizes of the 1984 and 1985 year-classes. The size of these year-classes should be quantified, if necessary by upper and lower limits, and their expected spatial distribution in 1989 and 1990 described. Likewise, the expected length distribution of the fishable stock in 1989 and 1990 should be described, especially in relation to distribution below 40 cm, between 40 and 55 cm, and above 55 cm (total length) if possible by gear type.

   b) For redfish the implications upon stocks of a continued catch equal to the TAC for 1989 (19,200 tons) should be analyzed. By-catches of redfish (including discards) in fisheries for species other than redfish, especially the fisheries for shrimp and cod, should be taken into account.

   c) For Greenland halibut, the analyses should incorporate description of the spatial distribution of the fisheries and the implications of local fisheries (Subarea 1) on the local stock components as well as on the total stock complex (Subareas 0+1). (Canada may wish to give further guidelines).

   d) For northern shrimp, the Scientific Council is requested to evaluate the possible recruitment relationships between the stock components north and south of 71°N and their implications on stocks and fisheries management. An attempt to quantify discards of shrimp should again be made, and the implications on the stocks and advice on catch levels inside safe biological limits should be analyzed.

3. As in the past, advice on status of stock and management options for shrimp at East Greenland should also be provided in cooperation with ICES. The advice should also concern the recent Greenland management policy at East Greenland with regard to the setting of separate quotas for areas outside the main fishing area. The possible effect on conservation of shrimp as a consequence of the ice coverage of the water should be evaluated.

4. The Scientific Council should feel free to report on such other invertebrates and finfish stocks in Subarea 1 and on such other scientifically-based management options for the above-mentioned Subarea 1 stocks as it feels applicable.

Jens Paulsen
Greenland Home Rule Authorities
Nuuk, Greenland

ANNEX 4. TELEX FROM EEC REGARDING PROVISIONAL AGENDA FOR JUNE 1989 MEETING

019-31475 NORTHWEST ATLANTIC FISHERIES ORGANISATION
NOVA SCOTIA, CANADA

ATTN. CAPT. J.C. ESTEVES CARDOSO, EXECUTIVE SECRETARY

SUBJECT : MEETING OF THE NAFO SCIENTIFIC COUNCIL, JUNE 1989
- REQUESTED AGENDA ITEM

IN REPLY TO YOUR TELEX OF 29 MARCH 1989, THE COMMUNITY WISHES THAT THE FOLLOWING ITEM RELATING TO SCIENTIFIC ADVICE BE INCORPORATED IN THE AGENDA OF THE SCIENTIFIC COUNCIL FOR THE JUNE MEETING.

THE COMMUNITY REQUESTS THAT THE SCIENTIFIC COUNCIL SHOULD PROVIDE "ON ITS OWN INITIATIVE" IN ACCORDANCE WITH ARTICLE VI.I(D) OF THE CONVENTION SCIENTIFIC ADVICE INCORPORATING A RANGE OF MANAGEMENT OPTIONS ON THE COD 2J+3KL STOCKS.

EXPLANATORY NOTE

THE FISHERIES COMMISSION HAS, FOR THE PAST FOUR YEARS, ANNUALLY ADOPTED A REGULATORY MEASURE FOR THAT PART OF THE 2J+3KL COD STOCKS OCCURRING IN THE REGULATORY AREA NOTWITHSTANDING THE ABSENCE OF SCIENTIFIC ADVICE OR RECOMMENDATION FROM THE SCIENTIFIC COUNCIL FOR SUCH A MEASURE. AGAINST THIS BACKGROUND, IT IS INCUMBENT ON THE SCIENTIFIC COUNCIL TO PROVIDE THE ABOVEMENTIONED ADVICE ON THE STOCKS SO AS TO ENABLE THE FISHERIES COMMISSION TO FULFIL ITS RESPONSIBILITIES FOR THE MANAGEMENT AND CONSERVATION OF THE FISHERY RESOURCES IN THE REGULATORY AREA, IN ACCORDANCE WITH ARTICLE XI OF THE CONVENTION, ON THE BASIS OF ADEQUATE SCIENTIFIC ADVICE.

THE COMMUNITY REQUESTS THAT THIS ITEM FOR INCLUSION ON THE AGENDA OF THE SCIENTIFIC COUNCIL MEETING IN JUNE NEXT BE COMMUNICATED TO THE CHAIRMAN OF THE SCIENTIFIC COUNCIL AND STACFIS AS WELL AS TO ALL CONTRACTING PARTIES.

E. GALLAGHER
DIRECTOR GENERAL
COMEUR
NNNN

ANNEX 5. LETTER FROM CANADA REGARDING PROVISIONAL AGENDA FOR JUNE 1989 MEETING

J.C. Esteves Cardoso (Capt.)
Executive Secretary
Northwest Atlantic Fisheries Organization
P.O. Box 638
Dartmouth, Nova Scotia
B2Y 3Y9

MAY MAI 29 1989

Dear Sir:

Subject: Provisional Agenda of NAFO
Scientific Council Meeting - June 1989

I refer to NAFO Circular Letter 89/20 of April 7, 1989 to which was attached the provisional agenda for the June 1989 Scientific Council Meeting and which also included as Annex IV a telex from Mr. E. Gallagher of the European Community.

Mr. Gallagher has requested that the Scientific Council, at its June meeting, provide scientific advice on the 2J3KL cod stock "on its own initiative", as it is permitted to do under Article VI(1)(d) of the Convention.

I believe Mr. Gallagher's request should not be transmitted to the Scientific Council, as it is inconsistent with the terms of the Convention, which make clear that, in acting under Article VI(1)(d), the Scientific Council must act on its <u>own</u> initiative and not on the initiative of a member state. It is, of course, open to any scientist who participates in the Scientific Council to propose a Council initiative in accordance with Article VI(d), and it would then be up to the Scientific Council to consider the action it wished to take.

Assuming the procedure is followed correctly, I would note that Article VI(1)(d) requires the Council to consider whether any initiative it considers taking is "required for the purposes of the Commission". In this respect the Council would wish to note that the question of what scientific information on the 2J3KL cod stock the Fisheries Commission requires for its purposes was exhaustively discussed at the September 1988 meeting. The Fisheries Commission did not accept the EC's proposal that a full scientific assessment be requested, and decided instead to request the Scientific Council to provide other information. I believe it would be inappropriate for the Scientific Council to disregard the Commission's own decision on what it requires, and what it does not require, for its purposes.

I would be grateful if copies of this letter could be distributed to all Contracting Parties and to the Chairmen of the Scientific Council and STACFIS.

Yours sincerely,

P. Meyboom

AGENDA II. SCIENTIFIC COUNCIL ANNUAL MEETING - SEPTEMBER 1989

I. Opening (Chairman: J. S. Beckett)

1. Appointment of rapporteur
2. Adoption of agenda
3. Plan of work

II. Fishery Science (STACFIS Chairman: H. Lassen)

1. Report of Special Session on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes" (6-8 September 1989 with M. J. Fogarty as Convener).

   a) General theme

   Fish populations in the Northwest Atlantic have undergone dramatic changes during the last thirty years in response to environmental effects, exploitation and other anthropogenic factors. The primary objective of the session is to document changes in abundance, production and community composition and to examine hypotheses regarding underlying mechanisms. The principal focus will be on the northwestern Atlantic but comparative studies from other regions will be welcome.

   b) Specific topics

   Community-level change
   Exploitation effects
   The biotic environment
   The physical environment
   Other anthropogenic effects
   Indirect and secondary effects

2. Future Special Sessions

   a) Workshop on silver hake, early 1990, on input data and analyses

   b) Special Session in September 1990, on management under uncertainties related to biology and assessments, with case studies on some North Atlantic fisheries

   c) Proposed theme for Special Session in September 1991

3. Other matters

III. Research Coordination (STACREC Chairman: A. Vazquez)

1. Fishery statistics

   a) Acquisition of STATLANT 21A and 21B reports
   b) Publication of statistical information

2. Separate Fishery Statistics for the Regulatory Area

3. Other matters

IV. Publications (STACPUB Chairman: Sv. Aa. Horsted)

1. Review of Editorial Board

2. Invitational papers

3. Review of papers for possible Publication

   a) Review of responses to proposals from past meetings
   b) Papers from the September 1989 Special Session
   c) Other contributions

4. Other matters

V. Adoption of Reports

1. Provisional Report of Scientific Council, June 1989
2. Committee Reports of present meeting

VI. Review of Future Meeting Arrangements

1. Workshop on shrimp ageing, October 1989
2. Workshop on silver hake, Early 1990
3. June 1990 Meeting of the Scientific Council
4. Special Session and Annual Meeting, September 1990
5. June 1991 Meeting of Scientific Council

VII. Nomination and Election of Officers for 1989-91

1. Scientific Council
2. Standing Committees (excluding STACFIS)

VIII. Other Business

IX. Adjournment

LIST OF RESEARCH AND SUMMARY DOCUMENTS, 1989

RESEARCH DOCUMENTS (SCR)

Doc. #	Ser. #	
89/01	N1565	AUSTER, P. J., R. MALATESTA, and B. HASKELL. Bivalves as model organisms to elucidate patterns of predation. (12 pages)
89/02	N1566	TIZOL, R. Fishery and biological aspects of silver hake (*Merluccius bilinearis*) in Div. 4W, 1986-87. (11 pages)
89/03	N1567	STEIN, M., and E. BUCH. Are subsurface ocean temperatures predictable at Fylla Bank/West Greenland? (14 pages)
89/04	N1568	PETROV, V. N., and S. V. CHECHENIN. Results from acoustic capelin surveys in NAFO Div. 3KLNO in spring 1988. (6 pages)
89/05	N1569	BULATOVA, A. Yu., S. A. KUZMIN, V. N. PETROV, and S. V. RATUSHNY. Assessment of cod stock in the NAFO Subarea 3 based on the 1988 trawl-acoustic survey data. (23 pages)
89/06	N1570	VASKOV, A. A., G. B. RUDNEVA, and I. A. OGANIN. Estimation of the stock status and TAC for redfish in Div. 3M and 3LN for 1990. (23 pages)
89/07	N1571	KUZMIN, S. A. Estimation of witch stock in Div. 3LNO according to the data on 1983-88 trawl surveys. (9 pages)
89/08	N1572	SAVVATIMSKY, P. I. Dynamics of roundnose grenadier catch in the Northwest Atlantic. (11 pages)
89/09	N1573	ALBIKOVSKAYA, L. K., and O. V. GERASIMOVA. Feeding and food interrelations between cod (*Gadus morhua morhua* L.) and beaked redfish (*Sebastes mentella* T.) on Flemish Cap. (15 pages)
89/10	N1574	BOROVKOV, V. A., and I. I. TEVS. Overview of oceanographic conditions off the Northwest Atlantic in 1988. (16 pages)
89/11	N1579	HUNT, J. J. Results of a silver hake otolith exchange between Canada and the USSR. (5 pages)
89/12	N1580	RIKHTER, V. A., and V. V. PETEROPSH. On the question of optimum numbers of ageing the Scotian Shelf silver hake. (11 pages)
89/13	N1581	BECK, P. C., E. G. DAWE, and J. DREW. An update of the fishery for short-finned squid (*Illex illecebrosus*) in the Newfoundland area during 1986-88 with descriptions of some biological characteristics and temperature trends. (16 pages)
89/14	N1590	RIKHTER, V. A. Preliminary assessment of the Scotian Shelf silver hake stock size (Div. 4VWX) for 1988 and prospects for 1990. (11 pages)
89/15	N1591	RIKHTER, V. A. On the change of total and fishing mortality rate for older silver hake age-groups in Div. 4VWX by fishing period. (4 pages)
89/16	N1592	RIKHTER, V. A., and V. F. TUROK. Distribution of silver hake, other fish species and squid in 1988 on the Scotian Shelf Slopes from data obtained by USSR observers. (17 pages)
89/17	N1593	FUONG, N. On rates of linear and weight growth of Scotian silver hake (*Merlucclus bilinearis* Mitch.). (13 pages)
89/18	N1594	SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (*Pandalus borealis*) in East Greenland waters in 1988. (12 pages)
89/19	N1595	SMEDSTAD, O. M. Preliminary report of a cruise with M/T *"Håkøy-II"* to East Greenland waters in September 1988. (11 pages)
89/20	N1596	PEDERSEN, S. A. Inshore scallop resources, *Chlamys islandica*, in the Nuuk Area West Greenland. (16 pages)

89/21 N1597 NYGAARD, K. H., K. M. LEHMANN, and H. HOVGÅRD. Young cod distribution and abundance in West Greenland inshore areas, 1988. (6 pages)

89/22 N1598 HOVGÅRD, H., and F. RIGET. An estimation of the size of the 1984 year-class of cod off West Greenland from CPUE data in the trawl fisheries. (9 pages)

89/23 N1599 RIGET, F., and H. HOVGÅRD. Expected length distribution of cod in West Greenland waters, 1989-91. (5 pages)

89/24 N1600 RIGET, F., and H. HOVGÅRD. Recaptures by year-class of cod in East Greenland/Icelandic waters from tagging experiments at West Greenland. (7 pages)

89/25 N1601 RIGET, F., and J. BOJE. An analysis of meristic characters of Greenland halibut (*Reinhardtius hippoglossoides* W.) in the Northwest Atlantic. (11 pages)

89/26 N1602 BOJE, J., F. RIGET, and V. SIMONSEN. An analysis of genetic differentiation in Greenland halibut (*Reinhardtius hippoglossoides* W.) in the Northwest Atlantic. (8 pages)

89/27 N1603 BOJE, J., and F. RIGET. The fishery for Greenland halibut in Subarea 1. (8 pages)

89/28 N1604 PARSONS, D. G., and P. J. VEITCH. Observations on the new Canadian fishery for shrimp (*Pandalus borealis*) in NAFO Division 0B in 1988. (11 pages)

89/29 N1605 PARSONS, D. G., and P. J. VEITCH. The Canadian fishery for northern shrimp (*Pandalus borealis*) in Division 0A, 1988. (12 pages)

89/30 N1607 YATSU, A., and O. JØRGENSEN. West Greenland groundfish biomasses estimated from a stratified-random trawl survey in 1988. (7 pages)

89/31 N1606 YATSU, A., and O. JØRGENSEN. Distribution, abundance, size, age, gonad index and stomach contents of Greenland halibut (*Reinhardtius hippoglossoides*) off West Greenland in September/October 1988. (12 pages)

89/32 N1608 HOVGÅRD, H., F. RIGET, and H. LASSEN. Modelling cod migration from Greenland to Iceland. (18 pages)

89/33 N1609 HOVGÅRD, H., H. LASSEN, K. M. LEHMANN, K. NYGAARD, and F. RIGET. Distribution and abundance of the inshore component of the West Greenland cod stock in autumn 1988. (12 pages)

89/34 N1610 BAIRD, J. W., and C. A. BISHOP. Estimates of biomass and age compositions for that portion of the Division 2J+3KL cod stock beyond the Canadian 200-mile fishery zone. (11 pages)

89/35 N1611 BAIRD, J. W., and C. A. BISHOP. The assessment of the cod stock in NAFO Div. 3NO. (61 pages)

89/36 N1613 SKÚLADÓTTIR, U. A review of the shrimp fishery, *Pandalus borealis*, in Denmark Strait. (14 pages)

89/37 N1614 BRODIE, W. B., and W. R. BOWERING. An assessment update for the American plaice stock in Divisions 3LNO. (62 pages)

89/38 N1615 LUND, H. Greenland fishery for shrimp (*Pandalus borealis* Kr.) in NAFO Division 1A, (Greenland Management Areas NV1 and NV2) in 1988. (19 pages)

89/39 N1616 LEHMANN, K. Report on commercial trial fishery for shrimp at East Greenland in 1987. (10 pages)

89/40 N1617 CARLSSON, D. M., and P. KANNEWORFF. Report on a stratified-random trawl survey for shrimp (*Pandalus borealis*) in NAFO Subareas 0+1 in July 1988. (16 pages)

89/41 N1618 PEDERSEN, S. A., and K. LEHMANN. By-catch of redfish and Greenland halibut in the shrimp fishery off West Greenland, 1988. (12 pages)

89/42 N1619 BOJE, J., F. RIGET, and W. R. BOWERING. Results of the 1986, 1987 and 1989 Greenland-Canada Greenland halibut otolith exchange. (3 pages)

89/43 N1620 NAKASHIMA, B. S., and R. W. HARNUM. The inshore capelin fishery in NAFO Div. 3L in 1988. (12 pages)

89/44 N1621 NAKASHIMA, B. S. Capelin school surface area index for NAFO Div. 3L in 1988. (6 pages)

89/45 N1622 JAVIER PAZ CANALEJO, F., F. JAVIER VAZQUEZ ALVAREZ, ANXO FERNANDEZ ARROYO, J. MIGUEL CASAS SANCHEZ and ENRIQUE DE CARDENAS. The feeding of American plaice (*Hippoglossoides platessoides*), redfish (*Sebastes marinus*) and cod (*Gadus morhua*) in the Flemish Cap during July, 1988. (15 pages)

89/46 N1624 WALSH, S. J. The fish capture process of a groundfish survey trawl. (15 pages)

89/47 N1625 WALSH, S. J., C. COOPER, and W. HICKEY. Trouser trawl method of studying selectivity of American plaice: square *vs* diamond mesh codends. (13 pages)

89/48 N1626 WALDRON, D. E., M. C. BOURBONNAIS, and M. A. SHOWELL. Size of the Scotian Shelf silver hake population in 1988 with projections to 1990. (36 pages)

89/49 N1627 HORSTED, Sv. Aa. Status of Subarea 1 cod and the fisheries. (20 pages)

89/50 N1628 SKÚLADÓTTIR, U. The Icelandic shrimp fishery (*Pandalus borealis*) in Denmark Strait. (6 pages)

89/51 N1630 MESSTORFF, J., AND H. P. CORNUS. Survey biomass and abundance estimates for redfish (*Sebastes marinus* and *S. mentella*) off West Greenland (NAFO Subarea 1), 1982-88, and off East Greenland (ICES Div. XIV.b), 1980-88. (12 pages)

89/52 N1631 MILLER, D. S., and J. E. CARSCADDEN. Biomass estimates from two hydroacoustic surveys for capelin (*Mallotus villosus*) in NAFO Divisions 3L and 3N and observations of the Soviet fishery for capelin in Divisions 3NO. (15 pages + addendum)

89/53 N1633 CARLSSON, D. M., and P. KANNEWORFF. The shrimp fishery in NAFO Subarea 1 in 1988. (30 pages)

89/54 N1634 ATKINSON, D. B., and D. POWER. Redfish in NAFO Divisions 3LN. (26 pages)

89/55 N1635 ATKINSON, D. B., and D. POWER. An update on the status of roundnose grenadier in NAFO Subareas 0+1 and 2+3. (26 pages)

89/56 N1636 POWER, D., and D. B. ATKINSON. Status of redfish in NAFO Div. 3M. (12 pages)

89/57 N1637 STEIN, M. Scales of variability in West Greenland waters. (7 pages)

89/58 N1638 STEIN, M., and G. WEGNER. Recent observations on the deep waters off West Greenland. (15 pages)

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89/84* N1668 BAIDALINOV, A. P. On the influence of long-term changes of environmental factors on the state of some fish population stocks in the Northwest Atlantic. (16 pages)

89/85* N1669 SIGAEV, I. K. On possible causes of the Scotian silver hake abundance fluctuations. (5 pages)

89/86* N1670 SEREBRYAKOV, V. P., A. K. CHUMAKOV, and I. I. TEVS. Spawning stock, population fecundity and year-class strength of Greenland halibut from the Northwest Atlantic in 1969-1988. (13 pages)

89/87*	N1671	BOROVKOV, V. A., A. Yu. BULATOVA, A. K. CHUMAKOV, P. I. SAVVATIMSKY, and I. I. TEVS. Bottom water effects on the distribution and density of bottom fish in NAFO Subarea 3. (16 pages)
89/88	N1674	BERTRAND, J., and R. NOE. Yield-per-recruit of American plaice in Div. 3LNO. (4 pages)
89/89	N1689	ANDERSSON, P. J. Estimates of age, growth, and mortality of an Alaskan stock of *Pandalus borealis* Kröyer. (22 pages)
89/90	N1690	BERGSTRÖM, B. I. Preliminary results on growth and age determination of *Pandalus borealis* (Kröyer) in periodically enclosed fjord populations. (11 pages)
89/91	N1691	BOUTILLIER, J., D. A. FOURNIER, and J. R. SIBERT. An application of the MULTIFAN method for estimating growth parameters and age composition from multiple length frequency samples to the pink shrimp (*Pandalus jordani*). (22 pages)
89/92 (Revised)	N1692	MOHN, R. K., and L. SAVARD. Length based population analysis of Sept-Iles shrimp (Gulf of St. Lawrence). (12 pages)
89/93	N1693	PARSONS, D. G., and L. SAVARD. Some observations on modal analysis of shrimp length frequency distributions. (6 pages)
89/94	N1694	SAVARD, L., D. G. PARSONS, and D. M. CARLSSON. Age and growth of northern shrimp (*Pandalus borealis*) in Davis Strait (NAFO SA 0+1). (14 pages)
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* Special Session Papers - September 6-8, 1989

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Doc. #	Ser. #	
89/01	N1575	MEYBOOM, P. Canadian request for scientific advice on management in 1990 of certain stocks in Subareas 0 to 4. (1 page)
89/02	N1576	PAULSEN, J. Denmark (Greenland) request for scientific advice on management of certain stocks in 1990. (2 pages)
89/03	N1577	GALLAGHER, E. EEC request for scientific advice on management of certain stocks in 1990. (1 page)
89/04	N1578	BOYAR, H. C., and F. M. SERCHUK. United States research report for 1988. (14 pages)
89/05	N1582	SCOTT, J. S., L. W. COADY, G. M. HARE, and A. FRÉCHET. Canadian research report, 1988. (24 pages)

89/06 N1583 NAFO SECRETARIAT. Tagging activities reported for the Northwest Atlantic in 1988. (4 pages)

89/07 N1584 NAFO SECRETARIAT. Historical catches of selected species by stock area and country for the period 1977-87. (38 pages)

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89/09 N1586 PACIORKOWSKI, A. J. Polish research report, 1988. (12 pages)

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89/11 N1588 NAFO SECRETARIAT. Provisional index and list of titles of research and summary documents for 1988. (20 pages)

89/12 N1589 NAFO SECRETARIAT. Notes on statistical activities and publications since June 1988. (2 pages)

89/13 N1612 UOZUMI, Y. Japanese research report for 1988. (3 pages)

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89/17 N1652 NAFO. Provisional Report of Scientific Council, June 1989 Meeting. (147 pages + corrigendum)

89/18 N1659 NAFO EXECUTIVE SECRETARY. Sections of the Convention relevant to reporting statistics separately for waters within the Regulatory Area and for Convention waters under Coastal State jurisdiction. (2 pages)

89/19 N1676 ERNST, P., and R. EGGERS. German Democratic Republic research report for 1988. (16 pages)

89/20 N1685 NAFO. Report of Scientific Council, Annual Meeting, September 1989. (28 pages)

89/21 N1699 NAFO SECRETARIAT. Provisional nominal catches in the Northwest Atlantic, 1988. (44 pages)

88/22 N1700 PARSONS, D. G. Report of the Working Group on progress in age determination of *Pandalus*. (6 pages)

LIST OF PARTICIPANTS IN SCIENTIFIC COUNCIL MEETINGS, 1989

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LIST OF RECOMMENDATIONS IN 1989

PART A

Scientific Council Meeting, June 1989

SCIENTIFIC COUNCIL REPORT

Cod in Division 3M (Pages 17 and 112)

With the data currently available, the appropriate target for Div. 3M cod cannot be evaluated, but it was clear that any target should be much larger than the current spawning stock size. For this stock, spawning biomass was defined as knife-edged at age 6 years, however, STACFIS recommended that *available maturity data be analyzed for the next assessment.*

Flounders in Divisions 3L, 3N and 3O (Pages 25 and 113)

STACFIS noted that there were considerable data available from fall surveys on the distribution of juvenile American plaice and yellowtail flounder in Div. 3NO, including the Regulatory Area. In order to advise on management options such as closed areas or seasons to protect these nursery areas, STACFIS recommended that *a detailed analysis of these data be made, in conjunction with information on distribution of flounders in the commercial fishery.*

Rules of Procedure (Page 42)

Regarding the provisions of Subparagraph 3.c of Rule 2 of the Rules of Procedure, which specifies that the Chairman should identify the Contracting Parties from which the Executive Secretary shall seek authorization to cast a vote of abstention, should that Contracting Party not otherwise be represented at the meeting, the Council by adopting the resolution, recommended that *in this regard the Executive Secretary routinely approach Contracting Parties who do not regularly send representatives for the full period of the relevant meeting of the Scientific Council.*

STACFIS REPORT

Cod in Divisions 3N and 3O (Page 57)

At the June 1988 meeting of STACFIS it was recommended that analyses be completed using alternate methods to determine directed fishing effort for the Canadian fleet. Data were not made available to complete that analysis for the current assessment, therefore STACFIS again recommends that *the analysis for the current assessment be completed, using the percentage cod catch of the total groundfish on a more disaggregated basis than month, for the next assessment of this stock.*

Silver Hake in Divisions 4V, 4W and 4X (Page 72)

STACFIS recommends that *the marked differences found between Canadian and USSR length frequencies of silver hake samples be investigated.* STACFIS emphasized its recommendation to continue the otolith ageing exchange as outlined under "Ageing Techniques and Validation Studies" in this report.

Silver Hake in Divisions 4V, 4W and 4X (Page 76)

STACFIS notes that disagreements and doubts persist about many of the input data and derived indices and parameters and recommends that *a workshop be held on silver hake stock assessment data and analysis. This workshop should be convened early in 1990.*

American Plaice in Divisions 3L, 3N and 3O (Page 81)

Although STACFIS felt that the short-term averages were likely to be representative of the fishery in the near future, it was reluctant to accept the new Y/R analysis without a more detailed analysis of changes in partial recruitment, mean weights, and age structure of the population. Therefore STACFIS recommends that *the currently-used Y/R analysis for American plaice in Div. 3L, 3N and 3O, which indicates $F_{0.1}$ to be 0.26 and F_{max} to be 3.1, be maintained and that the necessary work be carried out so that an analysis of changes in Y/R can be evaluated in 1990.*

Witch Flounder in Divisions 3N and 3O (page 87 re: Future Research)

STACFIS reiterates its recommendation that *countries fishing the witch flounder stock in Div. 3NO should collect catch and effort information as well as length and age data and present them to NAFO to allow for a better evaluation of the status of this resource.*

Greenland Halibut in Subarea 2 and Divisions 3KL (Page 95)

STACFIS recommends that *attempts at an analytical assessment of that portion of the Greenland halibut stock covered by the fishery and the surveys in Subarea 2 and Div. 3K and 3L be considered for review at the June 1990 meeting.*

Greenland Halibut in Subarea 2 and Divisions 3KL (Page 96)

STACFIS recommends that *consideration be given to the biological and practical implications of combining Subareas 0, 1 and 2 and Divisions 3KL for stock assessment purposes when considering Greenland halibut.*

Shrimp in Subareas 0 and 1 (Page 107)

Since no selectivity studies were carried out during 1988, STACFIS recommends that *selectivity studies be conducted for shrimp in Davis Strait to determine optimal mesh size.* Because data are insufficient to answer questions about the existence of separate, self-sustaining stocks, STACFIS recommends that *quantitative information on both abiotic factors and stock features such as temperature, egg mortality, frequency of berried females and survival rate of embryos be obtained in order to evaluate the reproductive potential of shrimp in the different areas.*

Shrimp Stock in Denmark Strait (Page 110)

It was agreed that other recommendations from the June 1988 Meeting (*NAFO Sci. Coun. Rep.*, 1988, page 81), which were not dealt with, should be reiterated. STACFIS therefore recommends that:

i) *the biological samples be obtained from all sectors of the shrimp fishery in Denmark Strait;*

ii) *research vessel surveys for shrimp in the Denmark Strait be continued and intensified.*

In an attempt to increase the usefulness of CPUE data, STACFIS further recommends that *all countries include gear type and size (no. of meshes) in vessel logs.*

Reports on the Otolith Exchanges (Page 114)

STACFIS recommends that *the silver hake otolith exchange between Canada, Cuba and the USSR be continued.*

Review of Current Arrangements for Conducting Stock Assessment (Page 116)

It was recommended that *the Scientific Council at the Annual (September) Meeting should assign, at least laboratories, if not named scientists,* "designated experts" *to stocks for the purpose of preparing preliminary assessments.* The designated expert should then approach, prior to the STACFIS June Meeting, laboratories which may have relevant information and those laboratories should, at their earliest convenience, supply the relevant information to the designated expert.

SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH REPORT

Other Matters (Page 121 re: Environmental Changes)

The NAFO Scientific Council had previously recommended that a 30-year base period (1951-80) for anomalies be used where possible and, if not, to use a 20- or 10-year period. Often this was not possible, or published means were available from sources that do not conform to the above standards. This problem was discussed and the Subcommittee recommends that *an investigation be carried out to compare averages calculated over different base periods.* Where authors had sufficient data to calculate means over those different periods, they should do so and calculate their anomalies relative to them.

STACREC REPORT

Fourteenth Session of CWP, February 1990 (Page 123)

The Committee considered the provisional agenda and proposed that NAFO be represented at the 14th session by the Assistant Executive Secretary, the chairman of STACREC as well as one representative from a Contracting Party. It was recommended that *Cuba provide a representative to the CWP Meeting and USSR be invited to provide a substitute if necessary.*

A handbook on fishery statistics definitions would be published shortly by FAO. STACREC agreed on the usefulness of this document and it was recommended that *relevant sections of the FAO publication should be reproduced by the NAFO Secretariat as SCS documents.*

Survey Design Procedures (Working Group Report) (Page 128)

As this working group's mandate has now been achieved, STACREC recommended that *all survey documentation which were discussed by the Working Group on Survey Design Procedures be made available as an SCS document.*

STACPUB REPORT

Invitational Papers for the Journal (Page 132)

It was agreed by the Committee that such papers be given special status depending upon volume and content. In order to encourage authors of invited papers it was recommended that *they be informed of the possibility of special status with the letter of invitation. The Chairman and the Assistant Executive Secretary should pursue this matter.*

PART B

Scientific Council Annual Meeting - September 1989

SCIENTIFIC COUNCIL REPORT

Plenary Sessions (Page 137)

In order to advise on areal and seasonal concentrations of juvenile American plaice and yellowtail flounder on the Grand Banks (Div. 3LNO), the Scientific Council recommends that:

a) *Member countries provide the Scientific Council with catch statistics for both landings and discards broken down on as fine a scale as possible, preferably by unit areas no larger than 1° latitude and 1° longitude, summarized on a monthly basis.*

b) *Length sampling be enhanced for both nominal landings and discards. The sampling intensity should be on the same scale as given above, i.e. preferably by unit areas no larger than 1° latitude and 1° longitude summarized on a monthly basis.*

c) *Surveys on juvenile flatfish be conducted on a seasonal basis for at least one year throughout the entire stock area.*

The Scientific Council recognizes that the means of collecting these data would be determined on a fleet basis. It is further recognized that to achieve a) and b) above would require increased observer coverage by all countries concerned.

Plenary Sessions (Page 138)

The low biomass and predominance of very young cod on the Flemish Cap led to the adoption by NAFO in 1988 of a moratorium on fishing for cod in Div. 3M. In order to assess the effects of cod by-catches in the redfish and flatfish fisheries, the Scientific Council recommends that:

1. *statistics on discards of cod taken in the redfish and flatfish fisheries on the Flemish Cap be reported to the Scientific Council, in addition to the normal reports of landings.*

2. *length sampling of cod, taken in the redfish and flatfish fisheries on the Flemish Cap, be collected for the two components separately. It is important that depth information accompany each sample.*

STACFIS REPORT

Special Session on Changes in Fish Populations (Page 143)

STACFIS recommended that *more detailed analyses of the changes in* (fish) *growth and its importance in the productivity of these* (marine fish community) *systems be undertaken,* as contained in the report of the Special Session which follows.

STACREC REPORT

Acquisition of STATLANT 21A and 21B Reports (Page 149)

STACREC reiterated the necessity of accurate statistical information for the Scientific Council objectives. STACREC recommended that *since the submission of statistical information was worsening, the Scientific Council bring the matter to the attention of the Fisheries Commission.*

Publication of Statistical Information (page 149)

The Committee observed that the proposed publication date of September for the Statistical Bulletin (No. 36) for 1986 as proposed at the June Meeting,was not realized. STACREC recognized the need to obtain those necessary data and recommended that *the publication should not be delayed any further and every attempt be made to publish as soon as possible.*