Northwest Atlantic Fisheries Organization

Serial No. N1048

NAFO SCS Doc. 85/22

# SCIENTIFIC COUNCIL MEETING - JUNE 1985

## Provisional Report of Scientific Council

Dartmouth, Canada, 5-20 June 1985

CONTENTS

PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

June 1985 Meeting

Chairman: V. A. Rikhter Rapporteur: V. M. Hodder

The Council, with its Standing Committees and associated subcomittees and working groups, met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 5-20 June 1985, to consider and report on various matters listed in its agenda (App. IV). In addition to matters of general scientific interest, the Council considered the requirements of the Fisheries Commission and requests of coastal Contracting Parties (Canada, Denmark on behalf of Greenland, and the European Economic Community (EEC)) for scientific advice on management in 1986 of a number of stocks in Subareas 0 to 4. Prior to adopting the provisional agenda, the Council discussed the format for the provision of advice on managmenet options in response to the EEC proposal (tabled at the start of the meeting, SCS Doc. 85/20), which sought a broader range of options for some stocks than was contained in the official requests that were distributed with the agenda. It was agreed that STACFIS should provide advice in the same format as in recent years, since the Fisheries Commission has not provided any specifications of the format to be used, and that advice on alternative management options could be provided on request. The Executive Committee met briefly prior to the opening session and recommended, for the three Standing Committees and the Environmental Subcommittee, a plan of work which was adopted by the Council.

Representatives attended the various sessions of the Council, committees and working groups from Canada, Cuba, Denmark (Greenland), EEC, Japan, Portugal, Spain, and Union of Soviet Socialists Republics (USSR), and observers were present from the United States of America (USA) (Appendix V).

The reports of the standing comittees, as adopted by the Council on 20 June 1985, are given in Appendix I (STACFIS), Appendix II (STACREC) and Appendix III (STACPUB). Lists of research and summary documents are given in Appendix VI. Brief summaries of the committee reports and other matters considered by the Council are given in Sections I to VI below.

## I. FISHERY SCIENCE (APP. I)

### 1. General Fishery Trends

[This section could not be completed because 1984 catch statistics for some countries were not available.]

### 2. Assessment of Finfish and Invertebrate Stocks

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 EEC (see Appendix IV), and the three stocks in Div. 3M, as required by the Fisheries Commission, and had advised on catch levels corresponding to the reference fishing mortality $F_{0.1}$ or to two-thirds of the fishing effort associated with the maximum sustainable yield. Management advice based on these reference levels could not be provided for some stocks because the data were insufficient to complete such analyses. For the capelin and squid stocks, different management criteria were used. In cases where specific total allowable catches (TACs) were advised, these are lsited in the last column of Table 1. Details of the stock assessments are given in Appendix I. Some general observations are as follows:

a) The cod stock in Subarea 1 has declined drastically in recent years. Management options for various levels of fishing mortality are presented (see relevant section of Appendix I).

Table 1. Summary of recent catches (1979-84) and TACs (1979-85) for stocks reviewed at the June 1985 Meeting of STACFIS, together with the advised TACs for 1986.

| Species | Stock area | Nominal catches (000 tons) 1979 | 1980 | 1981 | 1982 | 1983[1] | 1984[1] | TACs (000 tons) 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cod | 1 | 48 | 47 | 53 | 56 | 63 | 30 | ... | ... | 50 | 62 | 62 | 68 | 28.3 | ( )[2] |
| | 2J+3KL | 167 | 176 | 171 | 230 | 230 | 231 | 180 | 180 | 200 | 237 | 260 | 266 | 266 | (266) |
| | 3M | 30 | 10 | 14 | 13 | 10 | 12 | 40 | 13 | 12.7 | 12.4[3] | 12.4[3] | 13 | 13 | ( 0)[4] |
| | 3NO | 28 | 20 | 24 | 32 | 28 | 27 | 25 | 26 | 26 | 17[3] | 17[3] | 26 | 33 | ( 33)[2] |
| | 3Ps | 33 | 38 | 39 | 34 | 38 | 36 | 25 | 28 | 30 | 33 | 33 | 33[5] | 41 | ( )[2] |
| Redfish | 1 | 9 | 8 | 6 | 8 | 8 | 4 | ... | ... | ... | ... | ... | ... | 9 | ( ) |
| | 3M | 20 | 16 | 14 | 15 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | ( 20) |
| | 3LN | 14 | 16 | 24 | 22 | 20 | 14 | 18 | 25 | 25 | 25 | 25 | 25 | 25 | ( 25) |
| Silver hake | 4VWX | 52 | 45 | 45 | 60 | 36 | 74 | 70 | 90 | 80 | 80 | 80 | 100 | 100 | (100) |
| A. plaice | 3M | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ( 2) |
| | 3LNO | 49 | 49 | 50 | 50 | 38 | 34 | 47 | 47 | 55 | 55 | 55 | 55 | 49 | ( 55) |
| Witch flo. | 3NO | 3 | 2 | 2 | 4 | 4 | 3 | 7 | 7 | 5 | 5 | 5 | 5 | 5 | ( 5) |
| Yellowtail | 3LNO | 18 | 12 | 15 | 12 | 9 | 13 | 18 | 18 | 21 | 23 | 19 | 17 | 15 | ( 15) |
| G. halibut | 0+1 | 19 | 8 | | 9 | 9 | 6 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | ( 25) |
| | 2+3KL | 34 | 33 | 31 | 26 | 28 | 25 | 30[6] | 35[6] | 55[6] | 55[6] | 55[6] | 55[6] | 75 | (100) |
| R. Grenadier | 0+1 | 7 | 2 | + | + | + | + | 8 | 8 | 8 | 8 | 8 | 8 | 8 | ( 8) |
| | 2+3 | 8 | 2 | 7 | 4 | 4 | 4 | 35 | 30 | 27 | 27 | 11 | 11 | 11 | ( 11) |
| Wolffishes | 1 | 17 | 5 | 4 | 4 | 3 | 2 | ... | ... | ... | ... | ... | 5-6 | 5-6 | (5-6) |
| Capelin | 3LNO | 12 | 14 | 24 | 27 | 25 | 333 | 16 | 16 | 30 | 30 | 60 | 38 | 60[7] | (130)[7] |
| Shrimp | 0+1 | 35 | 44 | 46 | 44 | 46 | 45 | 30 | 30 | 35 | 35 | 34.6 | 29.5 | 36 | ( )[8] |
| Squid-Illex | 2-4 | 162 | 70 | 33 | 13 | + | 1 | 120 | 150 | 150 | 150 | 150 | 150 | 150 | (150) |

[1] Provisional statistics.
[2] See relevant section of STACFIS Report (Appendix I).
[3] Excludes expected catches by Spain.
[4] No directed fishery.
[5] TAC established by Canada.
[6] TACs pertain to Div. 2J+3KL.
[7] TAC for Div. 3L only.
[8] Deferred to mid-term meeting in January 1986.

b) For the cod stock in Div. 3M, the 3+ biomass since the late 1970's has been approximately one-half of the reference level which is "one-half of the mean age 3+ equilibrium biomass associated with fishing at $F_{max}$, and assuming long-term average recruitment levels". This target could most speedily be met by cessation of fishing.

c) For cod in Div. 3NO, the current assessment indicates that age 3+ annual mean biomass in 1986 will be approximately 270,000 tons, which is above the reference level of 200,000 tons. The catch in 1986 calculated to correspond to fishing at $F_{0.1}$, is 33,000 tons.

d) For the cod stock in Div. 3Ps, a precise assessment of the status of the stock in 1984 could not be made. However, a catch of 41,000 tons in 1986, the same as the $F_{0.1}$ catch for 1985, falls within a range of catches projected by assuming practical upper and lower values of fishing mortality in 1984.

e) For American plaice in Div. 3LNO, the TAC advised for 1986 is 55,000 tons, an increase of 6,000 tons over that advised for 1985.

f) For Greenland halibut in Subarea 2 and Div. 3KL, the TAC advised for 1986 is 100,000 tons, an increase of 25,000 tons over the advised TAC for 1985.

g) For capelin in Div. 3L, the catch level of 130,000 tons, advised for 1986, corresponds to 10% of the projected biomass in 1986. No catch is advised for capelin in Div. 3NO due to uncertainty about year-class strength and the low level of biomass.

h) No changes in TAC are advised for cod in Div. 2J+3KL, redfish in Div. 3M and Div. 3LN, silver hake in Div. 4VWX, American plaice in Div. 3M, witch flounder in Div. 3NO, Greenland halibut in Subareas 0+1, roundnose grenadier in Subareas 0+1 and 2+3, yellowtail flounder in Div. 3LNO, and squid (Illex) in Subareas 3 and 4.

i) No firm assessments of the stocks of redfish and wolffishes in Subarea 1 were possible due to the lack of biological data. However, it was noted that the redfish yield corresponding to two-thirds of fishing effort associated with the maximum sustainable yield is about 9,000 tons, and that a combined catch in 1986 of 5,000-6,000 tons of spotted and Atlantic wolffishes seems to be reasonable.

j) Advice on management in 1986 of the shrimp stocks in Subareas 0 and 1 and in Denmark Strait could not be provided at that meeting, and it was agreed that a mid-term meeting in January 1986 would be appropriate. At that meeting shrimp experts were requested to review the necessity of future mid-term meetings.

3. Environmental Research

The Council noted that the Environmental Subcommittee had met during 10-11 June 1985, with M. Stein (EEC) as Chairman and had considered about 25 documents which dealt with a variety of environmentally-related topics. The full report of the Subcommittee is at Annex 1 to the Report of STACFIS (Appendix I).

The Council noted that a working group had been established to develop knowledge on the topic of environmentally-induced variations in catchability and the effects of this variation on stock assessments, and to report its findings at the June 1986 Meeting.

4. Ageing Techniques

The Council endorsed the recommendation of STACFIS that participants of the 1981 Shrimp Ageing Workshop be contacted in early 1986 to see if there has been sufficient progress to warrant another shrimp ageing workshop. The Council also noted that the problem of ageing of silver hake was being addressed through joint studies by Canada and the USSR.

5. Review of Scientific Papers

The Council noted that 9 research documents, not reviewed during the stock assessments or in the Environmental Subcommittee, were reviewed by STACFIS. One of these papers had been deferred from the September 1984 Meeting.

6. Other Matters

a) Simultaneous consideration of West and East Greenland cod stocks

The Council noted the recommendation of STACFIS regarding assessments of the cod stocks at West and East Greenland simultaneously and encouraged this approach, because a simultaneous assessment would result in a better understanding and evaluation of the stock interactions and their influence on the state of the stocks.

b) Special session on design and evaluation of biological surveys

The Council noted that 35 papers have been accepted for presentation at the Special Session during 4-6 September 1985 on "Design and Evaluation of Biological Surveys in Relation to Stock Assessments".

c) Topics deferred for consideration in September 1985

i) The Council noted that preliminary discussions had been held by STACFIS on a topic for the 1987 Special Session and looked forward to a final recommendation at the September meeting.

ii) Review of new arrangements for conducting stock assessments.

## II. RESEARCH COORDINATION

### 1. Statistics and Sampling

#### a) CWP activities relevant to NAFO

The Council noted that STACREC had reviewed the Report of the 12th Session of the CWP which was held at Copenhagen, Denmark, in July 1984. The report of that session (SCS Doc. 85/3) was presented by Mr. D. G. Cross (EUROSTAT) who is Deputy Secretary of the CWP. The Council also acknowledged the participation in the STACREC Meeting of Mrs. F. DeLuca from FAO.

The Council was informed that an Inter-agency Consultation on Atlantic Fishery Statistics will be held in London on 5-6 October 1985 and stressed the need of participation by the NAFO Secretariat. A decision on composition of NAFO representation at the 13th Session of the CWP at Rome, Italy, in February 1987 was deferred until the June 1986 Meeting.

#### b) Fishery Statistics

The Council noted that the late submission of STATLANT 21B catch and effort data was again a problem with regard to the publication of 1983 data in the Statistical Bulletin, the outstanding reports being those for France(M), France(SP) and United Kingdom. The Council also noted that many outstanding STATLANT 21A reports for 1984 had prevented STACFIS from preparing the "Fishery Trends" section of its report. The Council agreed that this matter must be brought to the attention of the Fisheries Commission and that representations be made to all Contracting Parties to respect their obligations under Article VI(3) of the NAFO Convention regarding the time submission of fishery statistics.

The Council noted the concern of STACREC relating to possible problems with prorating of effort data and endorsed the proposal that the matter be investigated by the Secretariat.

#### c) Sampling data

The Council welcomed the progress being made by the Secretariat in acquiring summaries of sampling data for 1978-85 period and bringing the data in line with the historical pre-1979 data base, and endorsed the proposal of 30 June as the deadline for the submission of the preceding year's data. The Council further agreed that the early provision of specific sampling data for stock assessments should be arranged by the Chairman of STACFIS.

#### d) Other activities

The Council endorsed the work of the Secretariat in updating the database of fisheries statistics and continuing the production of a summary document containing a time series of catches for selected stocks and a document on tagging activities in the preceding year.

### 2. Biological Surveys

#### a) Survey activities

The Council noted that the introduction of forms for the reporting of survey activities in 1984 and surveys planned for 1985 had met with excellent response, enabling timely compilation of the information (see Tables 1 and 2 of Appendix II). There were no proposals for amending stratification schemes, but it was noted that a provisional scheme for Div. 2GH had been designed and used.

#### b) Time series of survey data

The Council endorsed the proposal time series of survey data to be examined with a view to determining the best way of utilizing such data in the assessments.

3. Other Matters

a) Estimates of discarding

The Council noted that some information on discarding of fish at sea had been provided for some fisheries and agreed that such studies should be continued.

b) Maritime boundary between Canada and USA

The Council noted the decision of the International Court of Justice regarding the Canada-USA boundary in Subareas 4 and 5, and agreed that possible changes to the current boundaries between these subareas should be reviewed at the September 1985 Meeting.

## III. PUBLICATIONS

1. Review of Publications

The Council, in accepting STACPUB's review of the status of publications in the preceding 12 months, was pleased to note that the reissue of Vol. 27-31 of the Statistical Bulletin for 1977-81 (required to correct errors in the original submissions) is scheduled for completion by late 1985, that the List of Fishing Vessels (for 1983) and the NAFO Index of Meeting Documents (1979-84) were published in March 1985, that Scientific Council Studies (No. 7 and 8) were published in August 1984 and April 1985, and that Vol. 5(2) of the Journal was published in December 1984, with Vol. 6(1) being scheduled for production in June 1985.

2. Editorial Policy Concerning Publications

The Council approved the nomination by STACPUB that B. E. Skud (USA) be appointed Editor of the Journal of Northwest Atlantic Fishery Science effective 1 July 1985. The Council also noted the resignation of A. J. Lee (United Kingdom) as Associate Editor for Biological Oceanography effective 31 May 1985 and approved the nomination by STACPUB that G. A. Robinson (United Kingdom) be appointed Associate Editor of the Journal for contributions relating to Biological Oceanography.

3. Production of Microfiche Copies of Meeting Documents

The Council was pleased to note that contract arrangements for the production of microfiche copies of all research-related ICNAF meeting documents have been completed and that costs are projected to be under the budgeted amount.

4. Papers for Possible Publication

The Council noted that STACPUB had reviewed 2 outstanding research documents from the September 1984 Meeting and 78 from the January and June 1985 Meetings and had nominated 10 of these for possible publication in the Journal or Studies.

## IV. COLLABORATION WITH OTHER ORGANIZATIONS

1. NAFO/ICES Study Group on West Greenland and Irminger Sea Redfish Stocks

The Council was informed that the Study Group did not meet in early 1985.

2. Twelfth Session of the CWP (Coordinating Working Party on Atlantic Fishery Statistics)

The Council noted that the CWP had met during 25 July-1 August 1984 at ICES Headquarters in Copenhagen, Denmark, and that NAFO was represented by the Assistant Executive Secretary (V. M. Hodder), and the Chairman of STACREC (J. M. Jensen) who was elected Vice-chairman for the session. Matters of relevance to NAFO from the Report of the 12th Session (SCS Doc. 85/3) were dealt with by STACREC.

3. Thirteenth Session of the CWP

The 13th Session of the CWP will be held in Rome, Italy, during 11-18 February 1987, and the designation of NAFO representatives will be made at the June 1986 Meeting of the Council. Meanwhile, an ad hoc Inter-agency Consultation on Atlantic Fishery Statistics will be held in London, England, during 5-6 October 1985, to consider several matters, including the agenda and plans for the 13th Session of the CWP.

## V. FUTURE SCIENTIFIC MEETINGS

1. Special Session in Advance of the September 1985 Meeting

The Special Session on "Design and Evaluation of Biological Surveys in Relation to Stock Assessments" will take place at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 4-6 September 1985. The Convener (Dr. J. Messtorff) reported that, on the basis of titles and abstracts in hand, 35 contributions were expected.

2. Annual Meeting, September 1985

The Scientific Council will meet in conjunction with the Seventh Annual Meeting during 9-13 September 1985 in Havana, Cuba.

3. Mid-term Meeting for Shrimp

The Council concurred with the view of STACFIS that the best time for a meeting to assess the shrimp stocks would be in early 1986, and tentatively agreed that the meeting of 5-6 days should start on 14 January 1986 at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada.

4. Scientific Council Meeting, June 1986

*It was tentatively agreed that* the Scientific Council and its Standing Committees, including the Environmental Subcommittee, will met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 4-19 June 1986.

5. Special Session in September 1986

The Council unanimously nominated Dr. M. D. Grosslein (USA) as Convener of the Special Session on "Recent Advances in Understanding Recruitment in Marine Fishes of the Northwest Atlantic, with Particular Emphasis on Georges Bank and Flemish Cap", which will be held in advance of the Annual Meeting in September 1986. A preliminary outline of topics was reviewed, and the Convener was requested to organize these in the form of an agenda for final consideration at the September 1985 Meeting and for subsequent distribution in the form of a poster before the end of 1985.

## VI. NOMINATION OF OFFICERS FOR 1986-87

1. Election of Officers

The Chairman appointed a small nominating committee to solicit the views of the representatives of the Contracting Parties at this meeting regarding potential candidates for the various offices open for election. *The Council unanimously* accepted the proposal of the nominating committee that the following slate of candidates be put forward for election to the respective offices:

| | |
|---|---|
| Chairman of Scientific Council | : Dr. J. Messtorff (EEC) |
| Vice-Chairman of Scientific Council | : Mr. J. Beckett (Canada) |
| Chairman of STACFIS | : Mr. W. R. Bowering (Canada) |
| Chairman of STACREC | : Mr. R. Dominguez (Cuba) |
| Chairman of STACPUB | : (The Vice-Chairman of the Scientific Council becomes ex officio Chairman of this Committee. |

There being no further nominations and in the absence of the necessary quorum, the Executive Secretary was requested to conduct a postal vote and report the results at the beginning of the September 1985 Meeting of the Scientific Council.

## VII. OTHER MATTERS

1. Discussion and Revision of Proposed Rule of Procedure 3.7

The Executive Secretary explained the difficulties surrounding the election of an interim Chairman of the Scientific Council when both the Chairman and Vice-Chairman are absent. The main difficulty was that very often there was no quorum. After general discussion, it was proposed that, instead of applying the procedure only to the election in question, the method should be part of a more general Rule of Procedure which then could be used when any urgent decision could not be taken for lack of a quorum. This was agreed and the Executive Secretary was given the task of elaborating such a Rule for discussion and adoption by the Scientific Council at the September 1985 Meeting.

2. Theme for Annual Meeting in September 1987

The Council noted that, although STACFIS had discussed a possible topic for the Special Session in September 1987, it was agreed to defer this matter to the September 1985 Meeting.

3. Provisional Report of January 1985 Meeting

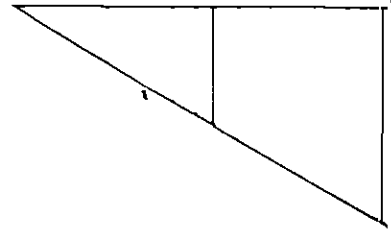
The Council formally approved, with minor amendments, the report of its meeting in Copenhagen, Denmark, 16-22 January 1985 (SCS Doc. 85/2).

## VIII. ADJOURNMENT

There being no further business, the Chairman noted that the changes in the operation of STACFIS, which were proposed in September 1984 and introduced at this meeting, were effectively demonstrated, in that many fewer items were deferred for consideration at later meetings than was the case at the June 1985 Meeting. Further improvement in working arrangements could be achieved if an effort was made not to repeat in STACFIS the detailed discussions within the working groups.

The Chairman expressed his appreciation to the chairmen of the various committees (J. E. Carscadden, J. Messtorff, B. Atkinson and M. Stein) and the conveners of the ad hoc working groups (S. Gavaris and W. Bowering), to the rapporteurs who worked hard to prepare initial drafts of the material which constitute this report, and to all other participants for their cooperation and contributions to the success of this meeting. Not to be forgotten are the staff members of the Secretariat for arranging the meeting facilities and servicing the meeting in a very efficient manner.

The final session was adjourned at 1500 hours on 20 June 1985.



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

Chairman: J. E. Carscadden Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 5-20 June 1985 to consider and report on various matters referred to it by the Scientific Council, particularly with regard to the provision of advice on management measures for certain finfish and invertebrate stocks in Subareas 0 to 4 (see Appendix IV for agenda). Scientists attended from Canada, Cuba, Denmark (Greenland), EEC (Federal Republic of Germany, France and Commission of the European Communities), Japan, Portugal, Spain, USSR and USA.

Meetings of the ad hoc Working Group on Cod (convened by S. Gavaris) and the ad hoc Working Group on Species except Cod (convened by W. R. Bowering) were held concurrently. Various scientists, designated by the Chairman, assisted in the initial preparation of the draft reports on the various topics considered by the Committee (Section II). The report of the Subcommittee on Environmental Research (Chairman: M. Stein) is introduced in Section III of this report and given in detail in Annex 1. The remaining sections dealt with other matters that were considered by the Committee.

## I. FISHERY TRENDS

[This section, which includes Table 1, could not be completed during this meeting because of lack of catch statistics from several countries.]

## II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 85/17, 29, 30, 31, 61, 62, 63; SCS Doc. 85/7, 17)

a) Introduction

The fishery for cod in Subarea 1 is partly an offshore fishery, mainly by large trawlers using bottom otter trawls, and partly a coastal and fjord fishery in which the major part of the catch is taken by pound-nets. The pound-net season is generally from May-June to September, but pound-nets seem to have been used as late as October in 1984. Offshore fishing was conducted by some vessels fishing with longlines and bottom gillnets in 1984. Offshore catches by these gears accounted for approximately 7% of the total offshore catch, the remaining 93% being taken by trawl. The trawler catch accounted for 59% of the total Subarea 1 catch of cod in 1984, compared to about 67% in 1983 and 50% in 1982 (Table 2).

Division 1E was the most important division for the offshore fishery in 1984, closely followed by Div. 1D, whereas Div. 1D was the most important for the inshore fishery, followed by Div. 1C. The three northern divisions supplied about one-third of the inshore catch, whereas virtually no offshore fishing for cod took place in these divisions.

Fishing effort has been reported by some of the trawlers only. Their overall catch-per-unit-effort (CPUE) decreased from 3.3 t/hr in 1981 to 1.0 t/hr in 1984, the lowest since 1976 (Table 2). In the past, CPUE was generally high in the first half of the year and decreased from June-July to September-October. However, after the usual decrease from June to September, CPUE in 1983 did not increase but fluctuated at the low level from September 1983 through 1984, the only exception being August 1984. Information for the first months of 1985 indicates that catches are below the level of earlier years in the corresponding months.

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.

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawlers | 28 | 19 | 46 | 53 | 57 | 16 | 14 | 29 | 42 | 18[1] | |
| Other vessels | 20 | 14 | 27 | 20 | 42 | 38 | 39 | 27 | 21 | 12[1] | |
| Total (000 tons) | 48 | 33 | 73[2] | 73[2] | 99[2] | 54[2] | 53 | 56 | 63 | 30[1] | |
| TAC (000 tons) | 51[3] | 45[3] | 31[3] | -[4] | -[4] | 20[3] | 50 | 62 | 62 | 68 | 28.3 |
| CPUE (tons/hr) | 0.79 | 0.63 | 1.29 | 3.33 | 2.38 | 1.24 | 3.26 | 2.21 | 1.36 | 0.99 | |

[1] Provisional data.
[2] Estimates used for stock assessments.
[3] Quota for offshore fishery only.
[4] Catches limited to Greenlandic fishery and to bycatches.

During the 1955-68 period, catches fluctuated between 234,000 and 451,000 tons, with the highest catch in 1962. Catches declined gradually after 1968 to a low of 33,000 tons in 1976, after a number of years with recruitment failure. The relatively good 1973 year-class, which recruited during 1976 and 1977, resulted in increased catches up to 1979. During 1980-83, catches fluctuated between 53,000 and 63,000 tons, close to the TAC level, but decreased sharply in 1984 to about 30,000 tons, the lowest on record since 1952. The TAC for 1985 is 28,300 tons (including a special allowance of 3,300 tons to be taken in the first quarter by trawlers of the Federal Republic of Germany), but it appears unlikely that this catch will be taken.

b) Commercial fishery data

i) Age composition

Catches in 1983 were dominated by the 1977 (age 6) and 1979 (age 4) year-classes (49% and 35% by numbers respectively). The same two year-classes dominated the 1984 catches but in reverse order of magnitude (20% by number for 1977 and 58% for 1979). The overall mean weight of fish thereby decreased slightly from 1.80 kg to 1.66 kg. The 1985 catches are expected to be heavily dominated by the 1979 and younger year-classes.

ii) Weight-at-age data

The mean weight-at-age values for the trawl catches of the Federal Republic of Germany are higher than for the various Greenland components, as would be expected, because the German figures are based on data for Div. 1E-1F in the fourth quarter of the year. The mean weight-at-age values that were used in the projections (Table 3) are based on the mean weights from both the German trawl survey and from the Greenlandic trawl fishery. These figures are slightly lower than those used in last year's assessment (*NAFO Sci. Coun. Rep.*, 1984, page 32).

c) Data from research surveys

i) Stock size and distribution

Stratified-random bottom-trawl surveys off West Greenland were conducted in November-December 1982 and 1983 by R/V Walther Herwig and in October-November 1984 by R/V Anton Dohrn. The survey area consists of 7 main strata extending from the southern part of Div. 1B to and including Div. 1F. Stratum 4 (west of 55°), mainly containing depths exceeding 600 m was for the first time covered to a depth of 600 m by the 1984 survey. The 1982-84 survey results were based on 98, 142 and 158 valid sets. The sampling intensity accordingly improved from 203 nm² per set in 1982 to 140 nm² in 1983 and 127 nm² in 1984. Cod biomass and abundance estimates for the total survey area off West Greenland of 19,864 nm² in 1982 and 1983 and of 20,133 nm² in 1984 (including stratum 4) amounted to:

| Year | Biomass (tons) | Number (000) |
|---|---|---|
| 1982 | 179,934 ± 37.0% | 109,039 ± 36.1% |
| 1983 | 98,843 ± 28.5% | 59,375 ± 26.5% |
| 1984 | 24,945 ± 39.7% | 16,100 ± 39.1% |

Confidence intervals are given at the 95% level of significance.

Since 1982, the survey results reveal a drastic decline in cod biomass and abundance which was observed not only for the total survey area but for all divisions. Reduced stock sizes in 1983 and 1984 were also confirmed by examination of continous echo-sounder recordings between stations.

ii) Age composition

The age compositions of the West Greenland cod stock since 1982, as obtained from survey data, show predominance of the younger ages of which the 1977 and 1979 year-classes are clearly outstanding although drastically declining in numbers over the 3-year period. Age 8 and older cod amount to only 2-3% in numbers. The good 1973 year-class was already reduced to 2% of the total stock abundance in 1982 and practically absent in 1984. The consequence of this development is a drastically reduced stock size in 1984 with the 1979 year-class (age 5) predominating (51% by numbers). Age 6 and older cod made up only 20%, including the 1977 year-class (13%).

It is noteworthy that for the first time in the 3-year series of bottom-trawl surveys off West Greenland, a few 0-group cod (1984 year-class) were obtained in all divisions. The results from an extension of the survey, to include stratum 4 in the area surveyed in 1984, did not show any substantial number of cod on the deeper parts of the continental slope.

iii) Comparison between survey results and catch rates (Fig. 1) .

The catch rates for the Greenlandic trawl fishery in Div. 1D and 1E show a declining trend which is very similar to that in the biomass estimates from the German research vessel surveys. Data on catch rates in the inshore fishery are not available (effort presently not recorded), but there was no substantial change in effort in the fourth quarter of recent years, when catches mainly came from the hook and gillnet fishery. The trend in catches in this fishery also showed a significant decline.

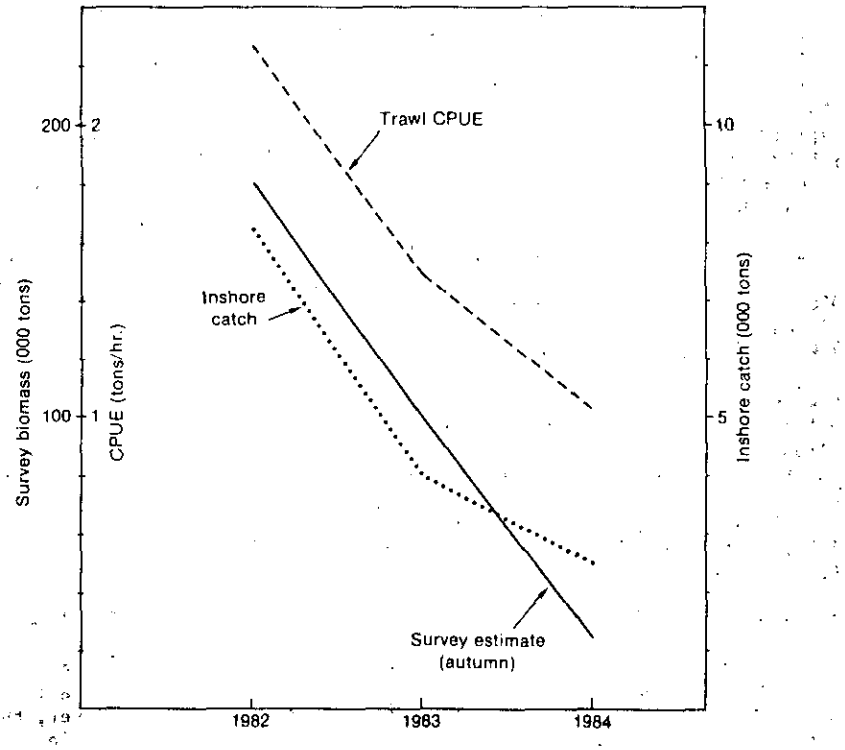



Fig. 1. Cod in Subarea 1: trends in survey biomass estimates, CPUE of Greenland trawlers in Div. 1DE, and fourth quarter inshore catches, 1982-84.

iv) Maturity-at-age

Data on maturity-at-age were obtained from the trawl-survey catches, mentioned above. Since the results were not significantly different from those of the 1983 survey, as used in last year's assessment, the previous maturity ogive was used (NAFO Sci. Coun. Rep., 1984, page 34).

v) Environmental data

The winters of 1982/83 and 1983/84 over Davis Strait and West Greenland were both record cold seasons, and two consecutive winters as cold as those have not been observed during the more than 100-year period for which meteorological data have been collected there. Great amounts of ice were formed between Greenland and Baffin Island-Labrador, and ice was a physical hindrance to fishing in the first half of 1984.

These cold winters led to some cooling of the water masses, but the ice coverage, to some extent, prevented winter cooling to spread to the deeper water layers. Surface temperatures along the West Greenland coast were below normal throughout the year. In the deep layers, which usually are highly influenced by the inflow of Irminger Sea water, the temperatures were markedly below normal at the end of 1983 and during the first 9 months of 1984.

Although no direct mortality of fish as a consequence of the cold water has been observed, the climatic events may have influenced the occurrence, distribution and recruitment of cod.

d) Assessment results (SCR Doc. 85/63)

The stock size in number-at-age at the end of 1984 was calculated from the abundance estimate

of the October-November 1984 survey. Total mortality (Z) for 1984 was calculated, from this estimate and the corresponding one from the 1983 survey, to be 1.6 on age 5 and older cod. The difference between age 5+ in the 1983 survey stock and age 6+ in the 1984 survey stock was taken to be the total deaths. Fishing mortality was estimated as the total mortality rate multiplied by the ratio of total catch to the total deaths. The estimated value of 0.57 was about the same level of that for 1983. The difference (0.83) between the total mortality rate and the sum of the fishing mortality rate and the assumed natural mortality rate (0.2) was attributed to emigration.

The report of the ICES Working Group on Cod Stocks off East Greenland (ICES C.M. 1985/Assess:6) contained an estimate of immigrants from West Greenland of about 4 million cod (age 5+) in 1984, based on trawl surveys in that area. Of the possible total loss due to emigration of about 23 million fish, as estimated from the present West Greenland assessment and deducting the 4 million migrants accounted for at East Greenland, about 19 million are thus still unexplained, compared to 13 million in 1983. This lends some support to the hypothesis that the present reduction in the West Greenland cod stock is due to vast migrations. Earlier tagging experiments showed considerable migration of West Greenland cod to Iceland, and this may account for the rest of the estimated losses.

Previous estimates of emigration rates were much lower than the present ones. The ICES North-Western Working Group found an emigration coefficient of 0.29, after combining the migration from Div. 1E-F and East Greenland to Iceland. With only little migration from the northern divisions, this led to an emigration coefficient of 0.05 for the total West Greenland stock when weighted by the catch distribution among divisions during that time.

Much of the variation in the stock size and distribution of cod at West Greenland can be attributed to the overall tempeature regime (Hermann et al., 1965)[1]. The water temperature in both 1983 and 1984 showed significant negative anomalies, and the recent mass migrations may be related to the below-average temperature conditions. If migration is temperature dependent, estimation of a reliable emigration coefficient for the projection period is very difficult, because mean temperatures show great and unpredictable variations (Stein and Buch, 1985)[2]. An emigration coefficient of 0.3, which lies between the historical average and the high values for the last years, was used for the projection.

An illustrative VPA, with fishing mortality (F) of 0.5 in 1984 and emigration coefficient (E) of 0.3 for age 6 and older cod, resulted in stock abundance estimates for the beginning of 1983 and 1984 which were considerably below the survey estimates for these years. A regression of the biomass (age 4+) against CPUE of Greenlandic trawlers indicated that, prior to 1983, a VPA could be used in assessing the stock. However, the value for the beginning of 1984, reflecting changes in the stock during 1983, lies far below the regression line. To bring the 1984 value closer to the regression line would require either a fishing mortality in 1984 considerably below the level used or a higher emigration rate in that year. Also, lack of comparability of the 1983 and 1984 CPUE data with the rest of the time series due to diversion of effort in these recent years adds a further element of uncertainty to the calibration of the VPA. It was therefore concluded that, in the present situation, a VPA would not give more reliable results than the estimate of minimum trawlable biomass from groundfish surveys.

e) Recruitment prospects

The 1981 year-class. The strength of this year-class was estimated as rather poor on the basis of favourable hydrographic conditions and very low larval abundance. Therefore, recruitment of 20 million at age 3 fish was used. The relatively low abundance of that year-class at ages 1 to 3 in the subsequent German trawl surveys gives no reason to change the initial estimate.

The 1982 year-class. Based mainly on the high abundance of cod larvae in plankton catches, the 1982 year-class was considered to be relatively good and was estimated as 200 million recruits at age 3. However, in the German trawl surveys, the 1982 year-class was observed for the first time at age 2 in only very small numbers. Also, Danish research-vessel catches with small-meshed gear (shrimp trawl), conducted on standard stations during 1983 and 1984, did not contain cod of that year-class. If that year-class had been of the initially-estimated size, some catches would have been expected in the Danish surveys. The recruitment estimate has therefore been reduced to 20 million fish, the conventional level of poor year-classes.

The 1983 year-class. The strength of the 1983 year-class was initially estimated as poor (20 million fish at age 3) based mainly on observations of relatively cold water over the banks during 1983. There is no reason to change the previous assumption since that year-class was virtually absent in subsequent surveys.

---

[1] HERMANN, F., P. M. HANSEN, and Sv. Aa. HORSTED. 1965. The effect of temperature and current on the distribution and survival of cod larvae at West Greenland. ICNAF Spec. Publ., 6: 389-395.

[2] STEIN, M., and E. BUCH. 1985. 1983: an unusual year off West Greenland? Arch. Fischwiss. 36: 81-85.

The 1984 year-class. It is known that 0-group fish drift with the current from East Greenland waters to West Greenland. It is therefore interesting to note that the Icelandic 0-group survey in 1984 (ICES C.M. 1985/Assess:6) in East Greenland waters gave a very high abundance index of 0-group cod, about 3 times higher than that for the strong 1973 year-class. Cod of this age-group were caught at West Greenland in the R/V Anton Dohrn trawl survey in late October-November 1984. This is the first time that these surveys (carried out since 1982) showed occurrence of 0-group fish. However, the extremely cold winters of 1982/83 and 1983/84 cooled the upper water masses in Davis Strait, resulting in negative temperature anomalies of 1° to 2°C throughout the following year (Stein and Buch, 1985). This low temperature may already have influenced the survival of the 1984 year-class. It will be necessary to follow the 1984 year-class closely in the following year to see whether it is more abundant than is to be expected from temperature observations.

Bearing in mind the revision of the first estimate of the 1982 year-class, a figure of 20 million fish was used in the projection for 1986, which is only marginally affected by the assumption about the 1984 year-class.

f) Projections of catch and stock size for 1986-1987

The parameters used to project catch and biomass of the cod stock at age 3 and older, as well as the spawning stock biomass, are given in Table 3. The numbers by age-group at the

Table 3. Cod in Subarea 1: parameters used in catch projections, with M = 0.2 (0.3 for age 3 to account for discarding) and recruitment at age 3 of 20 million for the 1981-84 year-classes. (Emmigration coefficient of 0.3 is added to M for age 6 and older cod.)

| Age (yr) | Stock size 1 Jan 1985 (000) | Relative M | Mean weight (kg) | Percent maturity | Relative F |
|---|---|---|---|---|---|
| 3 | 20,000 | 1.5 | 0.78 | 1 | 0.039 |
| 4 | 14,307 | 1.0 | 0.91 | 3 | 0.52 |
| 5 | 1,286 | 1.0 | 1.37 | 15 | 1.0 |
| 6 | 7,994 | 2.5 | 2.00 | 48 | 1.0 |
| 7 | 716 | 2.5 | 2.75 | 83 | 1.0 |
| 8 | 1,901 | 2.5 | 3.50 | 96 | 1.0 |
| 9 | 80 | 2.5 | 3.94 | 99 | 1.0 |
| 10 | 224 | 2.5 | 4.92 | 100 | 1.0 |
| 11 | 14 | 2.5 | 5.80 | 100 | 1.0 |
| 12+ | 4 | 2.5 | 6.50 | 100 | 1.0 |

beginning of 1985 are derived from the 1984 groundfish survey results. The relative fishing mortalities at ages 3 and 4 were derived from catch curve analysis (NAFO SCR Doc. 83/60). Projections were carried out for two different levels of catch in 1985: (i) a catch of 28,300 tons which is equal to the TAC, (ii) a catch of 13,100 tons, which is associated with the estimated fishing mortality of 0.568 in 1984. The results of the calculations are given in Tables 4 and 5 covering various management options. Catches in 1986 and resulting stock sizes at the beginning of 1987 are shown in Fig. 2 for the range of fishing mortality between F = 0 and $F_{max}$.

Table 4. Cod in Subarea 1: projections of age 3+ biomass and spawning stock biomass at the beginning of each year and catch during the year for different management strategies. (The assumed catch of 28,300 tons in 1985 corresponds to the TAC. All weights are in thousands of tons.)

| Year | Parameter | F(86)= $F_{0.1}$ | F(86)= $F_{max}$ | F(86)= F(84) | Catch= 25000 t | Catch= 15000 t | Catch = 0 | F(85-86)[1] = $F_{0.1}$ | F(85-86)[1] = $F_{max}$ | C(85-86)[1] =15000 t |
|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | Age 3+ biomass | 56.5 | 56.5 | 56.5 | 56.5 | 56.5 | 56.5 | 56.5 | 56.5 | 56.5 |
| | Spawning biomass | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 |
| | Mortality (F) | 1.844 | 1.844 | 1.844 | 1.844 | 1.844 | 1.844 | 0.392 | 1.000 | 0.674 |
| | Catch | 28.3 | 28.3 | 28.3 | 28.3 | 28.3 | 28.3 | 9.7 | 19.9 | 15.0 |
| 1986 | Age 3+ biomass | 37.9 | 37.9 | 37.9 | 37.9 | 37.9 | 37.9 | 57.2 | 46.4 | 51.6 |
| | Spawning biomass | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 15.4 | 9.0 | 12.0 |
| | Mortality (F) | 0.392 | 1.000 | 0.568 | 8.300 | 1.750 | 0 | 0.392 | 1.000 | 0.775 |
| | Catch | 5.1 | 10.6 | 6.9 | 25.0 | 15.0 | 0 | 10.3 | 15.2 | 15.0 |
| 1987 | Age 3+ biomass | 48.3 | 41.5 | 46.0 | 25.6 | 36.2 | 54.6 | 60.7 | 44.6 | 51.6 |
| | Spawning biomass | 6.6 | 4.2 | 5.8 | 0.5 | 2.5 | 9.0 | 15.2 | 6.2 | 9.0 |

[1] Management strategies from 1985 onward were applied

Table 5. Cod in Subarea 1: projections of age 3+ biomass and spawning stock at the beginning of each year and catch during the year for different management strategies. (The assumed catch of 13,100 tons in 1985 corresponds to a fishing mortality of 0.568, the same as in 1984. All weights are in thousands of tons.)

| Year | Parameter | F(86)= $F_{0.1}$ | F(86)= $F_{max}$ | F(86)= F(84) | C(86)= 15000 t | C(86) = 0 |
|---|---|---|---|---|---|---|
| 1985 | Age 3+ biomass | 56.5 | 56.5 | 56.5 | 56.5 | 56.5 |
| | Spawning biomass | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 |
| | Mortality (F) | 0.568 | 0.568 | 0.568 | 0.568 | 0.568 |
| | Catch | 13.1 | 13.1 | 13.1 | 13.1 | 13.1 |
| 1986 | Age 3+ biomass | 53.5 | 53.5 | 53.5 | 53.5 | 53.5 |
| | Spawning biomass | 13.2 | 13.2 | 13.2 | 13.2 | 13.2 |
| | Mortality (F) | 0.392 | 1.000 | 0.568 | 0.715 | 0 |
| | Catch | 9.3 | 19.0 | 12.6 | 15.0 | 0 |
| 1987 | Age 3+ biomass | 58.4 | 47.1 | 54.5 | 51.7 | 69.4 |
| | Spawning biomass | 13.5 | 8.0 | 11.6 | 10.2 | 19.2 |

g) Management considerations

Catch and estimated biomass declined by 50% and about 75% respectively between 1983 and 1984, and STACFIS is concerned about this catastrophic decline in stock size. It is unlikely that the TAC of 28,300 tons set for 1985 will be taken. A total catch in the range of 10,000-15,000 tons seems to be more realistic. Although detailed catch projections do not seem necessary, projections are presented in accordance with the request to NAFO by Denmark on behalf of Greenland (Tables 4 and 5, Fig. 2). However, present knowledge on future recruitment does not allow for catch and stock projections beyond 1986 and 1987, because 51% of the stock biomass (age 3+) by the beginning of 1985 and about 29% of the expected catch for the year are based on estimates of the recruiting year-classes 1981 and 1982, which were set at the conventional level (20 million cod at age 3) of poor year-classes.

The calculations show that the fishing mortality coefficient (F), corresponding to the catch of 30,000 tons in 1984, was about 0.57, which is between the $F_{0.1}$ and $F_{max}$ estimates from last year. However, F would have to be more than three times as high in order to maintain that catch in 1985, and it would increase to the very unrealistic level of 8.0 or higher to maintain such a catch in 1986. In other words, not even catches of the 1984-level are likely to occur until such a time that recruitment improves considerably. The spawning stock bimass remaining after the 1984 fishery was about 18,000 tons, which is the lowest estimate for more than 25 years. Estimates of the spawning biomass for the 1962-83 period (NAFO Sci. Coun. Rep., 1983, page 32) show that the present low level was approached only in the 1975-78 period (about 25,000 tons). For the remainder of the period, the estimates were considerably higher, although decreasing from the high level of 700,000 tons by 1962. Under such conditions, catch rates may well be so low that fishing effort might be reduced. In evaluating the options in Tables 4 and 5, it should be noted that, even without fishing, the spawning stock biomass by 1987 will only marginally be above the level estimated for 1985, and any exploitation in 1986 would reduce the spawning stock below that level.

Unless the now 65-year-long cod period at West Greenland really has come to an end, the occurrence of a relatively good year-class is to be expected at some time. A situation somewhat similar to that in 1976, when the good 1973 year-class suddenly recruited to the fishery at age 3 after a series of years with poor recruitment, would then occur. However, since the present stock level is well below that before the 1973 year-class recruited, future improvement is likely to be relatively much more marked. In such a situation the major part of the fishable stock would consist of 3 year-old fish. Substantial discarding would then occur and landings would consist almost entirely of fish just above the minimum marketable size of 40 cm. Although the amount of fish below 40 cm would have decreased in the following year (unless two consecutive good year-classes were recruiting), there could still be a considerable proportion of discards. Both from the viewpoint of harvesting a year-class to give maximum yield-per-recruit and from the viewpoint of rebuilding the spawning stock, such a situation would call for strict measures with great potential benefit some years later. STACFIS therefore advises that managers should be prepared to introduce management measures to protect young fish (such as a temporary ban on directed cod fishing) in the event that an abundant year-class enters the exploitable stock, because even a low catch of fish of marketable size can be taken only by sacrificing a large number of small fish in such a situation.

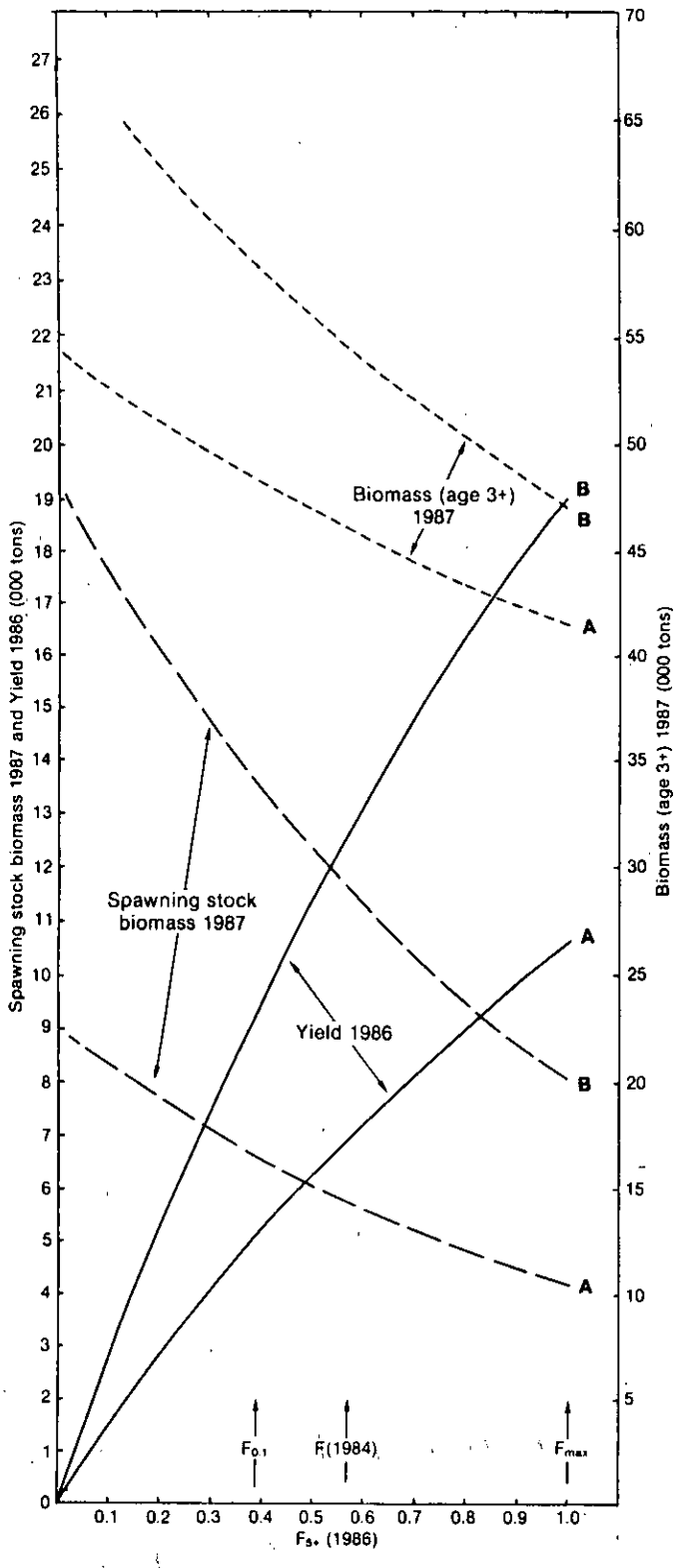



Fig. 2. Cod in Subarea 1: calculated yield in 1986, biomass (age 3+) and spawning stock biomass in January 1987 for various levels of fishing mortality in 1986, assuming (A) the 1985 catch to be 28,300 tons, and (B) the 1985 catch to be 13,200 tons.

2. Cod in Divisions 2J, 3K and 3L (SCR Doc. 85/28, 37, 40; SCS Doc. 85/12, 14, 15)

a) Introduction

Nominal catches declined from a peak of about 800,000 tons in 1968 to a low of about 139,000 tons in 1978. The catches in 1982, 1983 and 1984 have each been about 230,000 tons, the highest since 1975. Although the catch by inshore gears (trap, longline, handline and gillnet) declined slightly in 1984, it was still at a level similar to the late 1960's. About 50% of the 1984 nominal catch was taken by inshore gears. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inshore catch | 41 | 60 | 73 | 81 | 86 | 97 | 77 | 116 | 106[1] | 97[1] | |
| Offshore catch | 246 | 154 | 100 | 57 | 81 | 79 | 94 | 114 | 124[1] | 134[1] | |
| Total catch | 288 | 214 | 173 | 139 | 167 | 176 | 171 | 230 | 230[1] | 231[1] | |
| TAC | 554 | 300 | 160 | 135 | 180 | 180 | 200 | 237 | 260 | 266 | 266 |

[1] Provisional data.

b) Input data

i) Commercial fishery

Approximately 11% of the nominal catch in 1984 came from Div. 2J, 40% from Div. 3K, and 49% from Div. 3L. The most dominant year-classes in the catch were those of 1978 and 1979. The proportions of age 8 and older cod in the total catches during the 1977-80 period ranged between 7 and 8%. The progression through the catches of the 1973 and older year-classes was apparent during 1981-84 as the proportion of cod of the same ages then ranged from 19 to 27%. Mean weight-at-age values were similar to those in 1983.

Catch rates for 1959-84, standardized with respect to gear type by country, division and month, were derived from catch and effort data using the multiplicative model. The catch-rate series was analyzyed by two time-periods (1962-79 and 1978-84). To determine if seasonal and divisional patterns were similar throughout the 1962-79 time-period, data for the 1962-70 and 1971-79 periods were analyzed separately. It was determined that the patterns in question were reasonably similar to both periods, and the trend in the annual catch-rate indices compared well with those from the 1962-79 period. Therefore, the 1962-79 series was accepted. In past assessments, the earlier period up to 1979 and the latter period were scaled by using 1979 as a reference in both periods. Because the choice of reference period is critical to the resultant catch-rate series, it was determined to use two years (1978 and 1979), as only for these years was there enough overlap in the country-gear components of the fishery. The catch-rate indices in the 1979-84 period were lower relative to pre-1979 indices, using two years as a reference as opposed to one year. In general, the catch-rate series showed a decline through the late 1960's to the mid-1970's, with an increase in subsequent years. The 1984 value was about the same as that for 1969.

ii) Research data

Time series of research-vessel surveys to provide abundance estimates are as follows:

| Country | Division 2J | 3K | 3L |
|---|---|---|---|
| Canada (N) autumn | 1977-84 | 1978-84 | 1981-84 |
| Canada (N) spring | - | - | 1971-82 |
| Federal Republic of Germany | 1972-83 | - | - |
| USSR | - | 1972-84 | 1972-84 |

An overall biomass index for Div. 2J, 3K and 3L from Canadian surveys showed an increase from 1977 to 1978 and relative stability from 1979 to the present. The Federal Republic of Germany surveys showed a decline in biomass from the early to mid-1970's with a subsequent increase. Surveys conducted by the USSR showed a decline in biomass from the early to mid-1970's, an increase during 1977-78, relative stability during 1979-83, and a considerable increase in 1984.

The results of tagging experiments have shown that cod migrate between the inshore and offshore areas, including areas outside the Canadian 200-mile limit. The amount of this migration has not been quantified. On the basis of vertebral averages of cod sampled on the eastern and southern Grand Bank, it is concluded that there may be a mixture of cod from the northern and southern Grand Bank in the area around the eastward projection of the bank. On the basis of infestation rates of cod with an adult copepod (Lernaeocera branchialis), it was concluded that a portion of the offshore cod in Div. 3L west of 50°W (mainly northwestern Grand Bank and Avalon Channel) apparently migrate from areas where little or no direct infestation occurs such as the eastern and southern parts of the bank (Div. 3N and 3O).

c) Estimation of assessment parameters

i) Catch composition, weight-at-age and partial recruitment

Catch-at-age and average weight-at-age data from the commercial fishery were used in cohort analyses for the 1962-84 period. Average weight-at-age values were determined for each year separately for 1977-84, but mean values were used for all preceding years. It was suggested that the abrupt change in average weight-at-age between 1976 and 1977 should be investigated. Natural mortality was assumed to be 0.20. It was assumed that ages 8-13 were fully recruited. Values for ages 4-7 were obtained by taking averages of the partial recruitment derived from cohort analysis for 1977 to 1982 after replacing values greater than 1.0 by 1.0. The results of cohort analyses using these parameters were used in the estimation of fully-recruited fishing mortality in 1984.

ii) Fishing mortality in 1984

A significant geometric mean regression ($r^2 = 0.74$) between Canadian (Div. 2J and 3K) and Federal Republic of Germany (Div. 2J) survey indices of biomass for the 1977-83 period was used to estimate a value for the Federal Republic of Germany series in 1984 when no survey was conducted. The same geometric mean regression was also used to estimate values for the Canadian series for the 1972-76 period during which only Federal Republic of Germany surveys were conducted. Averaging values obtained by estimation with empirical values thus produced a biomass index for the entire 1972-84 period. Calibration by using this survey biomass index and age 4+ population biomass from the cohort in the following year implied a high F-value in 1984 (0.4-0.5). Concern was expressed about the procedure used to estimate the 1972-76 Canadian values and the 1984 Federal Republic of Germany value with a relationship based on such a short period (1977-83) and with a large intercept.

A survey abundance index was constructed in a manner similar to the survey biomass index above. Calibrations of the cohort analysis with this index of abundance using age 6+ survey abundance in one year with cohort age 7+ population numbers in the following year were attempted for various time periods (1972-83, 1977-83 and 1977-84). The 1984 survey point was suspect because of inconsistencies with other stock size indices such as commercial catch rates. These calibrations implied F-values in 1984 of 0.25, 0.35 and 0.45 respectively. Because of the uncertainties, precise calibration could not be achieved by using survey results. Nonetheless, the survey results indicated that fully-recruited fishing mortality in 1984 was 0.25 or higher.

An index based on commercial catch rates, as derived in section 2b(i) above for the 1962-84 period, was regressed against exploitable biomass for the same period. Calibrations of the cohort analysis with this relationship implied a F-value of 0.175 in 1984. Concern was expressed however, about using the entire time series of catch rates which overlapped the time of extension of fisheries jurisdication in 1977, since changes in fleet structure and season may have influenced the comparability of the series in the pre-1977 and post-1977 period. Therefore, a relationship between catch rate and exploitable biomass for the 1977-84 period only was used to calibrate the cohort analysis. This resulted in a best fit with a F-value between 0.175 and 0.25, probably in the vicinity of 0.20.

In view of the uncertainties associated with each of the indexes of stock size used to calibrate the cohort analysis and because terminal fishing mortalities have been consistently underestimated for this stock, STACFIS considered that the likely range of fully recruited fishing mortality in 1984 was 0.20 to 0.25 and agreed upon 0.23 as the value for F in 1984.

iii) Recruitment

Abundance estimates at ages 3 and 4 from Canadian surveys in Div. 2J+3KL and from Federal Republic of Germany surveys in Div. 2J and at age 3 from USSR surveys in Div.

3KL were examined as potential indicators of year-class strength. The Canadian, Federal Republic of Germany and USSR indices, and an overall combined index for strengths of the 1968-77 year-classes, were, in some cases, significantly correlated with estimated numbers at age 4 from cohort analysis. However, the relationships were strongly influenced by the 1968 year-class estimates and Canadian data were scanty for year-classes prior to that of 1973. To circumvent these problems, the data series used was restricted to that for the 1973-77 year-classes for which Canadian survey coverage was more complete. With the small number of observations involved, only the Canadian index gave a significant correlation at the 95% level ($r^2 = 0.81$) with estimated numbers at age 4 from cohort analysis. However, predictions from unweighted least squares regressions of the size of the 1978-80 year-classes did not vary greatly irrespective of which of the 1973-77 year-class index series was used. Based on the Canadian series, which gave the best statistical relationship, year-class strength estimates of 250, 300 and 350 million fish at age 4 were obtained for the 1978-80 year-classes respectively. This relationship also gave an estimate, based on observation at age 3 only, of 400 million for the 1981 year-class. The 1982 year-class was assumed to be 250 million, which is the geometric mean recruitment at age 4 for the 1973-82 period.

In trial cohort analysis, using the predicted strengths for 1978-80 year-classes and the estimated fully-recruited fishing mortality of 0.23 in 1984, the partial recruitment pattern was different from that initially calculated based on historical average values and indicated an unrealistically high value of 2.1 for age 6. On this basis, it was concluded that the size of the 1978 year-class had been underestimated, and it was adjusted to 400 million fish at age 4, which made it consistent with a partial recruitment value of 1.0 at age 6 in 1984.

Despite the deficiencies in the relationships used to determine year-class strength estimates, this approach was considered superior to that used last year which depended on number-per-tow of age 3 fish for 1959-78 year-classes from USSR surveys. The previous relationship, although statistically significant, did not have a high correlation coefficient but had a high intercept. The present approach more fully utilizes recent data and does not depend on the accuracy of cohort analysis for the period prior to 1977.

d) Catch projections

The parameters used to project stock sizes and catches are given in Table 6. Subsequent to determination of recruiting year-class strengths, it was necessary to increase partial recruitment values in 1984 to obtain consistency between estimated year-class strengths and estimated fully-recruited fishing mortality in 1984. As a result, partial recruitment of ages 6 and 7 was set to 1.0 and that for age 5 was increased from 0.46 to 0.70. The value for age 4, estimated at 0.21, did not change significantly. These modified partial recruitments were used for the projections. The weight-at-age values used for projections are averages of the values derived for 1983 and 1984. The TAC of 266,000 tons was used as the expected catch in 1985. The projections (Table 7) indicate that spawning stock biomass values (age 7+) are substantially below (about 30-40%) those that were calculated last year.

The calculated catch that would result from fishing at $F_{0.1}$ (0.20) differs from the 1985 TAC by 8%. Due to the variation in the data and relationships used to estimate parameters, STACFIS was unable to discriminate between the calculated catch at $F_{0.1}$ and the 1984-85 TAC of 266,000 tons. Therefore STACFIS advises that the 1985 TAC (266,000 tons) would approximate exploitation at the $F_{0.1}$ reference level in 1986.

Table 6. Cod in Div. 2J, 3K and 3L: parameters used in the projections of stock biomass and catch.

| Age (yr) | 1984 population (millions) | 1984 catch (millions) | Mean weight (kg) Annual mean | Mean weight (kg) Initial mean | Partial recruitment |
|---|---|---|---|---|---|
| 4 | 350.0 | 14.8 | 0.88 | 0.74 | 0.21 |
| 5 | 233.8 | 31.6 | 1.26 | 1.05 | 0.70 |
| 6 | 206.0 | 38.5 | 1.77 | 1.49 | 1.00 |
| 7 | 66.9 | 12.5 | 2.28 | 2.01 | 1.00 |
| 8 | 38.5 | 7.2 | 2.65 | 2.46 | 1.00 |
| 9 | 47.1 | 8.8 | 3.07 | 2.85 | 1.00 |
| 10 | 22.5 | 4.2 | 3.57 | 3.31 | 1.00 |
| 11 | 13.4 | 2.5 | 4.53 | 4.02 | 1.00 |
| 12 | 2.1 | 0.4 | 6.97 | 5.62 | 1.00 |
| 13 | 0.6 | 0.1 | 8.73 | 7.80 | 1.00 |

Table 7. Cod in Div. 2J, 3K and 3L: projections of spawning stock biomass (age 7+) at beginning of the year and catch during the year at fishing mortality on fully-recruited age-groups.

| Parameter | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|
| Spawning biomass (000 tons) | 508 | 668 | 732 | 821 |
| Fishing mortality (F) | 0.23 | 0.23 | 0.20 | |
| Catch (000 tons) | 226 | 266 | 244 | |

Projected levels to the beginning of 1987 are below the range of target spawning biomass (1.2-1.8 million tons) that was established by ICNAF's Standing Committee on Research and Statistics. The lower estimates of projected spawning biomass from the present calculations (Table 7) result from revised estimates of fishing mortality for 1983, which are higher than those used in last years's calculations, from lower estimates of the strength of recruiting year-classes, and from a decrease in weight-at-age values since 1980. Nevertheless, the trend in stock size remains unchanged from the minimum values in 1977-78 to the current level which is several times larger.

3. Cod in Division 3M (SCR Doc. 84/95; 85/28, 65, 72; SCS Doc. 85/12, 14, 15)

a) Introduction

The average catch in the 1963-72 period (41,000 tons) was almost double that in the 1973-83 period (23,000 tons). Catches in 1976-79 ranged from 22,000 to 33,000 tons. In 1980-83, TACs were lower and probably restrictive to some fleets and catches ranged from 10,000 to 14,000 tons. Large portions of the catches since 1980 have been taken by vessels from Spain, Faroe Islands, Norway, Portugal and USSR. Recent catches and TACs (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 40 | 40 | 25 | 40 | 40 | 13 | 12.7 | 12.4[1] | 12.4[1] | 13 | 13 |
| Catch | 22 | 22 | 27 | 33 | 30 | 10 | 14 | 13 | 10[2] | 12[2] | |

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

b) Input data

i) Commercial fishery data

The catch-rate series, presented in 1981 for the 1960-80 period, was not extended due to the scarcity of effort information. Catch-rate indices, derived from Spanish pair-trawler data as reported by Spanish observers, were about 0.8 and 1.3 in 1983 and 1984 respectively. These values are on a different scale from the catch rates used previously and cannot readily be compared. Catch rates from the fleet as a whole for 1982-84 were 0.52, 0.55 and 0.75 tons per hour respectively. Age and length compositions from the 1984 fishery were available for the Spanish, Portuguese, Norwegian and Faroese fleets. The estimated portion in the catch of age 4 and younger cod for these fleets were 91, 97, 96 and 81% respectively. The dominant age-group in each case was the 1981 year-class at age 3. Although only a small portion of age 2 cod were evident in the sampled catches, there were indications that there may have been substantial discarding of this group (1982 year-class) and of the 1981 year-class as well.

ii) Research data

Research-vessel groundfish surveys have been conducted in the area by the USSR since 1971 and by Canada since 1977. A comparison of length compositions of the catches by the Suloy and Gadus Atlantica in 1984 were remarkedly similar. Estimates of total mortality in 1983, calculated from either series, were in excess of 1.0. Abundance estimates from the Canadian surveys were consistent with F-values in the order of 1.0 since the late 1970's.

Both USSR and Canadian survey results indicated a strong increase in population size (number) from 1982 to 1983, with a much smaller increase in biomass (NAFO Sci. Coun. Rep., 1984, page 41). This increase in number was due to the entrance of the strong 1981 year-class at age 2. In 1984, the 1981 year-class was predominant in both the

USSR and Canadian surveys, while age 4 and younger cod accounted for 86 and 93% respectively of the estimated population numbers from these surveys. The 1981 and 1982 year-classes (ages 3 and 4) made up 23 and 68% of the population numbers in the preliminary estimates from the Canadian survey in February 1985. From survey results, the 1981 year-class at age 3 may have been about twice the size of each of the 1980 and 1982 year-classes at the same age.

An analysis of stomach contents of cod from 3 years of observations showed that the prey spectrum was relatively narrow and the importance of major prey (redfish, cod, myctophids, hyperiids and shrimp) varied annually. The results of USSR ichthyoplankton investigations on the Flemish Cap in 1978-83 showed that cod eggs and larvae had been extremely scarce compared to the abundance of redfish larvae. The possible importance of the anticyclonic gyre in the central part of the bank in determining transport and survival of young fish stages was noted.

c) Estimation of parameters

Because of inadequate sampling of the commercial fishery in 1981-82, STACFIS considered it inappropriate to do a cohort anlaysis, because little confidence could be placed in the results for the most recent years.

d) Assessment results

In 1978-80, the average mid-year biomass (age 3+) was in the range of 30,000-35,000 tons (NAFO Sci. Coun. Rep., 1984, page 41). Catch rates from the Canadian and USSR surveys in 1978-85 were as follows:

| | Survey catch rates (kg/tow) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| Canada | 105 | 39 | 45 | 32 | 13 | 37 | 25 | 32 |
| USSR | 79 | 108 | 35 | 61 | 34 | 69 | 93[1] | |

[1] Preliminary estimate.

The USSR survey results imply that the average biomass in 1983-84 was slightly larger than that in 1978-80, while the Canadian results for 1983-84 show a decline from the earlier periods. STACFIS concluded that the biomass (age 3+) currently is in the order of 30,000-35,000 tons and has been at about that level since the late 1970's. In the 1960-65 period, the average biomass was about 200,000 tons.

e) Prognosis

The 1980 year-class has already been extensively fished in 1983 and 1984 at ages 3 and 4. In the 1984 fishery, the 1981 year-class at age 3 was predominant in the catches of all fleets, including the longline fleet, and it is expected that this year-class will dominate the catches in 1985. Too early exploitation of the 1980 and 1981 year-clasaes will already have reduced considerably their potential contribution to the fishable biomass and subsequently to the spawning stock by the end of 1985.

STACFIS noted the decision of the Fisheries Commission not to increase the TAC beyond 12,965 tons until a target biomass (age 3+) has been reached, and considered the target biomass, as defined by the Fisheries Commission, to be in the order of 85,000 tons. It is clear that the target biomass will not be reached in 1986. It can most speedily be met by a cessation of fishing in order to allow young fish, including the 1982 year-class, to contribute fully to the fishable biomass and to the spawning stock. STACFIS encourages a further examination of the commercial catch and effort data by its members with a view to establishing a continuous historical abundance index from these sources.

4. Cod in Divisions 3N and 3O (SCR Doc. 85/28, 39; SCS Doc. 85/12, 14, 15)

a) Introduction

Nominal catches declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Catches have been in the range of 20,000-30,000 tons since 1979. The Spanish pair-trawl fishery, which has traditionally accounted for the highest proportion of the catch in this area, has been conducted in a restricted area in the southernmost part of the zone since 1981. Catches of cod in the Canadian otter-trawl fishery increased in recent years to the level of those taken in the 1950's, a significant proportion of the cod catch being taken as by-catch in the flounder fisheries. Catches by Portugal are mainly from a gillnet fishery. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 88 | 43 | 30 | 15 | 25 | 26 | 26 | 17[1] | 17[1] | 26 | 33 |
| Catch | 44 | 24 | 18 | 15 | 28 | 20 | 24 | 32 | 28[2] | 27[2] | |

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

b) Input data

i) Commercial fishery catch-effort data

Catch and effort data were available from ICNAF and NAFO Statistical Bulletins for the 1959-82 period. Preliminary data for 1983 were available from reports to the NAFO Secretariat. Catch and effort data for the Canadian fishery in 1984 were obtained from the Department of Fisheries and Oceans, Canada. Because of differences in seasonal catch-rate patterns, otter trawl (1959-84) and pair trawl (1959-83) data were analysed separately, using a multiplicative model to standardize for country-gear-tonnage class type, month and division. For the 1976-84 period, only Canadian otter trawl data were used. The otter-trawl catch-rate index showed an increasing trend in recent years but declined slightly in 1984. The pair-trawl index showed no trend in recent years.

A third catch-rate index was derived by combining the otter-trawl and pair-trawl series. Each series was scaled to its respective mean for the 1959-75 period. The combined index was then calculated, for the 1959-75 period, by taking the average of the two scaled series. Only the scaled otter-trawl series was used for the 1976-84 time period. This procedure for arriving at a catch-rate series is the same as was used in last year's assessment and was considered then to be most reflective of information on the fishery.

Previously-stated uncertainties about the catch-rate data for this stock continue to exist and are as follows: (1) large fluctuations in the catch rates of Spanish pair trawlers in recent years, together with fishing being limited to a much smaller area in 1981-84 than in previous years; (2) use of catch-rate data for otter trawlers which took a relatively small proportion of the total catch prior to 1976; and (3) use in recent years of catch-rate data for Canadian otter trawlers which take a considerable portion of cod as by-catch in the flounder fisheries.

Catch rate indices derived from Spanish pair trawler data as reported by Spanish observers have indicated increases each year over the period 1982-84.

ii) Research surveys

Stratified-random research surveys were conducted in the area by Canada during 1971-82, 1984 and 1985. Div. 3O was not surveyed in 1971, 1972 and 1974, and strata coverage was incomplete and inconsistent in the earlier years in both Div. 3N and 3O. Estimates of mean number-per-tow and mean weight-per-tow for 1972 and 1974 in Div. 3O were derived from the ratio of Div. 3O and Div. 3N values from the 1977-85 surveys (excluding 1979 and 1981). No trends were evident in biomass or abundance from 1972 to 1985 except that the biomass index values for 1984 and 1985 were much higher than previous values. Surveys in 1984 and 1985 were conducted by a different research vessel than that used previously, but comparative fishing experiments, although not extensive, imply that there was no substantive difference between the vessels in catching cod.

Surveys conducted by the USSR over the same period showed considerable fluctuation and no consistent trend. However, there was a substantial increase in biomass and abundance from 1983 to 1984.

The Canadian survey in 1984 indicated that the 1978, 1980 and 1981 year-classes were dominant. Year-classes that were dominant in the USSR survey were those of 1979-82, with the 1981 year-class being the most abundant. Surveys by both countries indicated that the 1982 year-class may be at or above average.

iii) Catch-at-age

Biological sampling data from the Canadian otter-trawl, Portuguese gillnet and Spanish pair-trawl fisheries were used to estimate the age composition and mean weight-at-age of the commercial catches in 1984. Sampling obtained by Spanish observers indicated that the processed catch was distributed somewhat evenly over a wide range of ages (4-9) and that the most abundant was the 1978 year-class. Cod of ages 2 and 3 accounted for 38% of the catch in numbers and 7% of the biomass in the Spanish catch in 1984. The 1978 year-class was most abundant in the landings by the Canadian otter-trawl fleet.

c) Estimation of parameters

i) Cohort analysis

Catch compositions from the commercial fishery for each year over the 1959-84 period were used in cohort analysis. For each period (1959-65 and 1966-75) average weight-at-age values were used, whereas for each year of the 1977-84 period weight-at-age data were obtained from commercial sampling data. A partial recruitment vector for 1984 was estimated from the ratio of commercial catch-at-age to survey number-per-tow in 1984 (normalized to maximum value). The estimated value at age 3 was considered to be low (0.01) and was adjusted to a level comparable to that observed in the fishing mortality matrix in recent years for projection purposes. These partial recruitment and average weight-at-age values in 1984 are as follows:

| Age (years) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| Partial recruitment | .05 | 0.16 | 0.44 | 0.69 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Average weight (kg) | 0.75 | 1.09 | 1.49 | 2.49 | 3.67 | 5.67 | 7.23 | 8.40 | 9.30 | 12.83 |

A natural mortality rate of 0.20 was used and the fishing mortality for the oldest age (12) was set at the level for fully-recruited ages (6-10).

ii) Fishing mortality in 1984

In last year's assessment of this stock, fishing mortality was estimated from the relationship between average exploitable biomass and catch-rate index from the combined otter-trawl and pair-trawl index and from the pair-trawl index. The analysis indicated F-values for fully-recruited age-groups of 0.15 and 0.40 respectively. In the present assessment, similar relationships of exploitable biomass with equivalent catch-rate indices provided estimates of fully-recruited F-values in 1984 of 0.10 and 0.30 respectively. Problems, previously mentioned, with both catch-rate series were considered, and concern was expressed as to the quality of some of the data from earlier years in terms of catch rate as well as the accuracy of catch estimates and the adequacy of biological sampling. The relationship of cohort exploitable biomass to catch rates from a recent time period (1977-84), when catches and catch-rate information were thought to be more reliable, indicated a fishing mortality of approximately 0.20. However, due to the small number of data points, it was not possible to reliably estimate fishing mortality for fully-recruited age-groups. A comparison of the ratios of cohort exploitable biomass and commercial catch rate over the 1977-80 and 1981-84 periods also indicated that F was approximately 0.20.

Estimates of average fishing mortality (age 6+) from the research survey data (1977-82) and commercial catch and effort data (1977-83) were 0.21 and 0.42, compared to an average F of 0.23 from a cohort fishing mortality matrix at $F_t = 0.10$. A comparison of the ratio of Canadian survey biomass with cohort biomass over the 1981-84 period indicated that F in 1984 may be lower than 0.20, but suspected differences in availability, noted when comparing 1982 and 1984 survey results, might result in inflated survey estimates.

Although it was not possible to calibrate the cohort analysis precisely, it was agreed that F = 0.20 for fully-recruited age-groups would be appropriate to the fishery in 1984. It was noted that this estimate may be close to an upper estimate of F in 1984, because analyses, using ratios of Canadian survey biomass for 1981-84 and the catch-rate series for 1959-84, indicate a somewhat lower value.

iii) Recruitment

From an index of recruitment which was derived by combining indices for ages 2 and 3 from Canadian and USSR surveys in Div. 3N and 3O, the 1980-82 year-classes were considered to be about three times the geometric mean of the 1968-82 year-classes. This geometric mean was considered to be 35 million fish at age 3 in the 1984 assessment (NAFO Sci. Coun. Rep., 1984, page 43), and thus the survey indices imply about 100 million fish as the size of the 1980 year-class. However, this is larger than any year-class since the 1966 year-class. The strength of the 1980 year-class was considered to be 70 million fish at age 3 based on the ratio of recruitment indices for the 1978 and 1980 year-classes. The indices of recruitment for the 1981 and 1982 year-classes imply that these year-classes are similar in abundance to the 1980 year-class. However, suspected differences in availability, from the 1984 survey, would likely result in overestimating the strength of these year-classes relative to the 1980 year-class. The USSR surveys imply that these year-classes are somewhat weaker than the 1980 year-class, and it was therefore agreed to set the size of the 1981 and 1982 year-classes at the geometric mean level of 35 million fish. Even if this is a conservative estimate,

these year-classes will only be ages 4 and 5 in 1986, and a gain in yield-per-recruit would accrue from fishing them less heavily. The 1983 year-class was also set at the geometric mean of 35 million fish.

d) Catch projections

Population numbers at age from cohort analysis at F = 0.20 in 1984, together with a recruitment estimate of 35 million for each of the 1981-83 year-classes and the parameters shown in Table 8, were used in projections of biomass (age 3+) to 1986. The catch in 1985 was assumed to be equal to the TAC of 33,00 tons, and $F_{0.1}$ = 0.18 was used as the fishing mortality in 1986. Estimation of recruitment levels of the 1980 and 1981 year-classes produced a change in partial recruitment at ages 3 and 4 in 1984 to 0.01 and 0.08 respectively. Average weights used in the 1985-86 projections were derived from commercial sampling in the 1982-84 period.

Table 8. Cod in Div. 3N and 3O: parameters used in the projections of stock biomass and catch.

| Age (yr) | 1984 population (000) | 1984 catch (000) | (1985-86) Mean weight (kg) | (1985-86) Partial recruitment |
|---|---|---|---|---|
| 3 | 35,000 | 49 | 0.85 | 0.05 |
| 4 | 56,901 | 768 | 1.14 | 0.16 |
| 5 | 14,739 | 1,127 | 1.62 | 0.44 |
| 6 | 16,943 | 1,984 | 2.44 | 0.69 |
| 7 | 6,091 | 1,004 | 3.77 | 1.00 |
| 8 | 3,385 | 558 | 5.38 | 1.00 |
| 9 | 4,271 | 704 | 7.00 | 1.00 |
| 10 | 2,609 | 430 | 8.43 | 1.00 |
| 11 | 522 | 86 | 9.37 | 1.00 |
| 12 | 316 | 40 | 12.04 | 1.00 |

The status of this stock has been considered to be in a depressed state in recent years and a cautious approach to management has been recommended. Recent assessments have indicated that the stock has shown signs of improvement, and the present assessment also indicates continued improvement in terms of biomass and abundance.

In 1982, the Fisheries Commission decided that the TAC for this stock would not be increased above the level of 26,000 tons until the annual mean biomass (age 3+ fish) reached 200,000 tons. The 1985 mean biomass (age 3+) was projected to be over 200,000 tons (NAFO Sci. Coun. Rep., 1984), and the current assessment indicates that the annual mean biomass (age 3+) in 1986 will be approximately 271,000 tons. The Committee points out, however, that the 1980-83 year-classes, for which recruitment indices are imprecise, will account for almost 60% of age 3+ biomass in 1986. STACFIS advises that the yield in 1986, calculated to correspond to fishing at $F_{0.1}$, is 33,000 tons.

5. Cod in Subdivision 3Ps (SCR Doc. 85/32, 38; SCS Doc. 85/16)

a) Introduction

Catches from this stock have ranged from a high of 84,000 tons in 1961 to a low of 27,000 tons in 1978. Since 1977, only Canada and France have prosecuted the fishery, and, because of restrictions on Canadian offshore allocations in recent years, inshore gears (gillnet, cod-trap, line-trawl and handline) have taken the larger portion of the total catch. In the Canadian inshore fishery, the line-trawl component has taken the largest proportion of the catches since the late 1970's. Line-trawl catches showed an increasing trend from 1975 to 1980 but have declined since that time. Catches by France are mainly from the offshore otter-trawl fishery. Cod catches (000 tons) in Subdiv. 3Ps since 1975 and the corresponding TACs set by Canada since 1977 are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 62.4 | 47.5 | 32.5 | 25 | 25 | 28 | 30 | 33 | 33 | 33 | 41 |
| Catch | 35 | 37 | 32 | 27 | 33 | 38 | 39 | 34 | 38[1] | 36[1] | |

[1] Provisional data.

Management regulations were also established by EEC for 1983, 1984 and 1985 (Reference: Regulation No. 3624 of 20-12-1983-OJ L365, Regulation No. 320 of 8-2-1984-OJ L37, and Regulation No. 97 of 14-1-1985-OJ L13).

b) Input data

i) Commercial fishery catch-effort data

Catch and effort data for the commercial fishery during 1959-84 were analyzed to obtain a catch-rate index by using the multiplicative model. Since 1977, catch-rate data were available from the Canadian otter-trawl fishery, and data from France (SP) otter-trawl fishery were available only for 1978-79 and 1981-82. The catch-rate index indicated lowest values in the mid-1970's, some fluctuations during 1978-82, and a substantial increase since 1982.

ii) Research surveys

Stratified-random research vessel surveys have been conducted in this area by Canada since 1972 and by France since 1977.

Because of inconsistent sampling of strata and consequent incomplete survey coverage, estimates of missing data for the non-sampled strata in the Canadian surveys were obtained by using the multiplicative model. The Canadian surveys were conducted at different times (February-June) in different years. The abundance estimates were adjusted for seasonality by using parameters from the commercial catch-rate standardization. Abundance estimates from the Canadian surveys showed considerable fluctuation but were in general lowest in the mid-1970's, after which there was an increasing trend until 1981. With the exception of a low value in 1984, abundance estimates showed some stability from 1982 to 1985. The surveys in 1983-85 were conducted by a different research vessel than that used previously, but comparative fishing experiments, although not extensive, imply that there was no substantial difference between the vessels.

French surveys have been conducted in February and/or March of each year and the data needed no adjustment for seasonality. The results from the 1977 survey were not considered, due to inadequate sampling of strata. Abundance and biomass estimates showed an increasing trend from 1978 to 1984 but declined substantially in 1985.

The 1980 and 1981 year-classes were the most abundant ones in the 1985 Canadian survey, whereas the 1981 and 1982 year-classes were dominant in the 1985 French survey. Considerable numbers of the 1983 year-class were also taken during the French survey.

iii) Catch-at-age data

Catch-at-age and average weight-at-age data for the commercial fishery in 1984 were derived from sampling data obtained by Canada and France. The 1978, 1979 and 1980 year-classes were dominant in the catches from both the French and Canadian fisheries.

c) Estimation of parameters

i) Partial recruitment

In the 1984 assessment of this stock, estimates of partial recruitment were those which had been adjusted so that the ratio between cohort and survey numbers at age 3, for year-classes which were partially recruited in 1983, showed some correspondence. Using the same method, partial recruitment appropriate to the 1984 fishery was determined. The resultant values showed a close correspondence with values obtained by averaging cohort fishing mortalities over a recent time period. The partial recruitment values (see Table 9) were estimated from the relationships of age 3 abundance in surveys and cohort analyses for 1984.

ii) Cohort analysis

Catch-at-age and average weight-at-age data for the commercial fishery in the 1959-84 period were used in cohort analyses. Natural mortality was assumed to be 0.20, and the fishing mortality on the oldest age group (14) was set equal to the fishing mortality for fully-recruited age groups (7-11).

iii) Fishing mortality in 1984

The relationship between catch-rate index and exploitable biomass gave an estimate of F in 1984 of 0.20, based on the residual pattern in 1982-84 data. Catch rates for 1983 and 1984 were the major determining factor in this relationship. As stated previously, these catch rates were for Canadian otter trawlers because data from the

French fishery were not available for 1983 and 1984. The Canadian otter-trawl fishery has had a reduced allocation in recent years, and the catch in the directed fishery represents a small portion (5-10%) of the total catch from the stock. The catch and catch rates in 1983 and 1984 also imply a decrease in effort (approximately 60%) over this time period, although there is no supporting evidence from the fishery. Canadian otter-trawl catches in 1983 and 1984 were almost entirely from months when catch rates have been traditionally highest. As such, it was decided that the 1983 and 1984 catch rates were not representative for their respective years and could not be used for tuning the cohort analysis.

Abundance estimates from Canadian and French surveys showed some inconsistencies mainly in recent years. Abundance estimates (age 3+) from French surveys showed an increasing trend while those from Canadian surveys indicated some stability in recent years. The relationships of cohort to survey abundance from both survey series, at ages 3+ and 6+, from unweighted least squares regression analysis, indicated a significant relationship only for the age 3+ data from the French survey. The correlation coefficient (r) continued to increase for values less than 0.20. Using the criteria of best 'fit' on the basis of the balance of residuals from 1983 to 1985 implies a $F_t$-value of approximately 0.50 (non-significant regression).

The use of fishing mortalities between 0.2 and 0.4 in 1984 resulted in average fishing mortalities between 0.4 and 0.5 during the 1979-83 period when catches averaged 36,000 tons. There was no supporting evidence from either the French offshore fishery or the Canadian inshore fishery to suggest that effort has changed significantly in recent years. Thus, it was considered likely that fishing mortality in 1984 was similar to that of the recent period. STACFIS concluded that F in 1984 fell between 0.20 and 0.40 which were considered as practical lower and upper limits, but discrimination between the two was not possible.

d) Projections

Projections were considered by assuming F-values in 1984 of both 0.20 and 0.40, with input values as in Table 9. Recruitment in 1985 and 1986 was assumed to be equal to the geometric mean values of 55 million fish, as used in previous assessments. These projections imply catches at $F_{0.1}$ in 1986 of 26,000 tons and 61,000 tons. This range encompasses the catches at $F_{0.1}$ for 1985, as calculated in last year's assessment. STACFIS notes that the requested advice could not be provided because of difficulty in estimating fishing mortality in 1984.

Table 9. Cod in Subdiv. 3Ps: parameters used in the projections of stock biomass and catch.

| Age (yr) | 1984 population (000) F(84)=0.2 | 1984 population (000) F(84)=0.4 | 1984 catch (000) | Mean weight (kg) | Partial recruitment |
|---|---|---|---|---|---|
| 3 | 112,649 | 56,379 | 204 | 0.56 | 0.01 |
| 4 | 120,550 | 61,439 | 4,287 | 0.88 | 0.20 |
| 5 | 47,526 | 24,909 | 4,106 | 1.30 | 0.50 |
| 6 | 57,683 | 30,786 | 6,846 | 1.91 | 0.70 |
| 7 | 12,539 | 6,872 | 2,067 | 2.53 | 1.00 |
| 8 | 3,616 | 1,981 | 596 | 3.30 | 1.00 |
| 9 | 3,246 | 1,779 | 535 | 4.14 | 1.00 |
| 10 | 2,141 | 1,174 | 353 | 5.29 | 1.00 |
| 11 | 764 | 419 | 126 | 6.25 | 1.00 |
| 12 | 200 | 110 | 33 | 8.70 | 1.00 |
| 13 | 55 | 30 | 9 | 9.97 | 1.00 |
| 14 | 40 | 40 | 8 | 11.21 | 1.00 |

e) Recommendations for data base improvement

Difficulties associated with the assessment of this stock in recent years have resulted mainly from problems with catch-rate indices. Catches have been mainly from the Canadian inshore fishery, for which no catch-rate data have been collected. This problem was addressed in the past and recommendations were made regarding action to overcome the difficulty, apparently to no avail. STACFIS again

recommends

*that action be taken to correct the deficiency in the Canadian statistics for this stock as soon as possible by collecting the necessary catch-rate data.*

Catch-rate data from the French otter-trawl fishery are available only for vessels based in St. Pierre and for the years 1978-79 and 1981-82. In contrast with Canadian otter trawlers, these vessels fish over a more extended time period during the year and, as such, might give a better overall picture of stock status. Catch-rate data for 1983 and 1984 might have provided a firmer basis for advice on current stock status, if these had been available for assessment purposes. Other data, such as effort (hours fished and days fished), for the France (M) distant-water fleet were also unavailable for 1983 and 1984. STACFIS therefore

recommends

*that French catch and effort data for the cod stock in Subdiv. 3Ps be made available on a timely basis for assessments purposes.*

6. Redfish in Subarea 1

a) Introduction

Nominal catches have fluctuated greatly since 1951, increasing from 150 tons in that year to a maximum of 61,000 tons in 1962, decreasing to a low level of 3,000 tons in 1971-74, increasing thereafter to a level of about 6,000-8,000 tons in 1980-83, and decreasing to about 4,000 tons in 1984. There is indication that catches in 1977 to 1979 were overestimated in the offical statistics. These catches are almost entirely Sebastes marinus. Preliminary observations are that Sebastes mentella occurs in deeper water than S. marinus and is currently not taken in the commercial fishery. Small S. mentella are quite abundant as by-catch in the shrimp fishery. Redfish are taken in a directed trawl fishery or as by-catch in a trawl fishery directed for cod. The decrease in the 1984 catch was due mainly to very limited effort in the trawl fishery for cod. Sampling data for redfish (mainly S. marinus) obtained from comercial catches and research vessel surveys by the Federal Republic of Germany in recent years will be presented next year. Recent catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|---|---|---|
| Catch | 9 | 14 | 31 | 8 | 9 | 8 | 6 | 8 | 8[1] | 4[1] |

[1] Provisional data.

b) Catch projections

The Sebastes marinus stock was assessed at the ICNAF Meeting in June 1979 (ICNAF Redbook, 1979, page 74). Further assessment has not been possible due to the lack of sufficiently good fishing effort data for recent years. The 1979 assessment, based on a general production model analysis, indicated a MSY (maximum sustainable yield) level of about 10,000 tons and an equilibrium catch at 2/3 MSY effort of about 9,000 tons. However, the correlation coefficient for the regression of CPUE on fishing effort ($r = 0.63$) indicated that catch levels derived from the model have farily large variances. STACFIS, however, has no basis on which to advise whether a catch at 9,000 tons in 1986 will correspond to 2/3 MSY effort.

7. Redfish in Division 3M (SCR Doc. 85/48, 53; SCS Doc. 85/14 (part I), 15)

a) Introduction

Although the TAC was not achieved in 1980-82, it was fully utilized in 1983 and 1984. The USSR continues to dominate in the fishing , catching 16,500 tons in 1984. Recent TACs and catches (000) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 16 | 16 | 16 | 16 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Catch | 16 | 17 | 20 | 17 | 20 | 16 | 14 | 15 | 20[1] | 20[1] | |

[1] Provisional data.

b) Input data

Catch and effort data were extracted from ICNAF and NAFO Statistical Bulletins for the 1959-83 period. Revision of the country-gear-tonnage class combinations enabled the incorporation of data for the entire period to be utilized in a multiplicative model to derive a standardized catch-rate series. Previously, only data from 1971 onward were used.

The revised catch-rate data show a gradual decline during 1960-67, followed by an increase to the highest level recorded in 1970. Catch rates declined until 1979, showed a moderate increase through 1981 and then declined slightly thereafter.

Commercial length frequencies were available from the Cuban and Portuguese fisheries in 1984. Research frequencies from Canadian surveys in 1978-85 and from USSR surveys in 1980-84 were available, as were biomass estimates for the 1978-85 (Canada) and 1983-84 (USSR) periods. Also available were the estimated numbers caught at age (determined from scales) in the USSR fishery for the 1968-84 period.

c) Estimation of parameters

The derived catch-at-age matrix (SCR Doc. 85/53) was used in the VPA. Input natural mortality varied with age. The analysis indicated a catch in 1986 of 22,000 tons at $F_{max} = 0.15$.

The revised catch-rate series was regressed (least square) on effort (unlagged and lagged 6, 8 and 10 years). The regression, using unlagged data, was not significant but significant correlations were obtained for those with the 6, 8 and 10 year lags ($r = -0.61$, $-0.58$ and $-0.59$ respectively). The general production analyses indicated a yield at 2/3 MSY effort of about 15,000 tons and a yield at MSY of about 17,000 tons.

d) Catch projections

It was noted that the VPA employed a new technique with variable M, and it was also unclear how the VPA was tuned. STACFIS therefore agreed that further documentation was required for review before acceptance of such a procedure. Such documentation will be forthcoming for review at the meeting in June 1986.

The few available length frequencies from the commercial catches indicated that the 1984 fishery was again concentrated on the relatively strong year-classes of the early 1970's. These fish had a model length of about 30 cm. Research data from both Canadian and the USSR surveys indicated a slight decline in biomass from 1983 to 1984. The Canadian data indicated a further decline from 1984 to 1985. These declines, which had been predicted previously, are reflected in the slight decrease in catch rates since 1981. They are related to the concentration of the fishery on the year-classes of the early 1970's and their resultant decline in numbers. Stratified number-per-tow-at-length also reveals the decline in abundance of these year-classes.

Both sets of research data indicate the occurrence of two more strong year-classes, probably from the early 1980's. The first appeared in both surveys in 1981 and the second in 1982. There was a considerable decline in abundance of these year-classes from 1983 to 1984, according to the Canadian data. This lower level persisted in 1985, and so is not considered to be an artifact of the 1984 survey. A similar decline was not seen from the USSR survey data, but these year-classes were not caught in as large numbers in 1982 and 1983. The research length frequencies from surveys by both countries indicate the presence of a high proportion of older fish that are not being caught commercially.

STACFIS noted that its predictions concerning a gradual decline in biomass and catch rate, due to depletion of the year-classes of the early 1970's, are holding true. This is expected to continue until the strong year-classes of the early 1980's enter the fishery, at which time catch rates should stabilize or increase once again. The increase may not be as great as previously thought on the basis of Canadian research data. The general production analyses, using lagged data to approximate equilibrium conditions, indicated an equilibrium yield at 2/3 MSY effort of only 15,000 tons, well below the present TAC of 20,000 tons. It was felt that with the relatively good recruitment of the year-classes of the early 1970's followed by those of the early 1980's, an equilibrium condition does not exist. In addition, there is evidently a good reserve of older fish, and an unnecessary loss of yield could result from lowering the TAC. STACFIS therefore advises that the TAC for 1986 should remain at 20,000 tons.

8. Redfish in Divisions 3L and 3N (SCR Doc. 85/49, 53; SCS Doc. 85/14 (part I))

a) Introduction

Only about 56% of the TAC was taken in 1984. As in previous years, USSR vessels took most of the catch in Div. 3N while Canadian vessels accounted for the greatest proportion in Div. 3L. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 20 | 20 | 16 | 16 | 18 | 25 | 25 | 25 | 25 | 25 | 25 |
| Catch | 18 | 21 | 17 | 12 | 14 | 16 | 24 | 22 | 20[1] | 14[1] | |

[1] Provisional data.

b) Input data

Catch and effort data extracted from ICNAF and NAFO Statistical Bulletins for the 1959-83 period, and provisional Canadian statistics for 1984 were combined and incorporated in a multiplicative model to derive a standardized catch-rate series. The country-gear-tonnage class combinations were modified from those used previously in order to make the catch-rate series more representative of the fishery. Commercial length frequencies for 1984 were available from the Canadian and German Democratic Republic fisheries in Div. 3L and the Japanese fishery in Div. 3N. The estimated age compositions of catches in 1968-84 were available for input into VPA (SCR Doc. 85/53).

No recent Canadian research survey data were available. Length frequencies from USSR research surveys in Div. 3L and 3N were available for the 1980-84 period. Abundance indices were available from these surveys for 1983 and 1984.

c) Estimation of parameters

The available catch-at-age data (SCR Doc. 85/53) and natural mortality that varied with age were utilized in a VPA. Tuning was done by regressing fishery mortality on fishing effort (USSR data only). The analysis indicated a catch of 25,000 tons in 1986 when fishing at $F_{max}$ = 0.15. The revised catch-rate series (SCR Doc. 85/49) indicated considerable year-to-year fluctuation, but the 1968 and 1974 points were not longer anomalously low (NAFO Sci. Coun. Rep., 1984, page 49). Because the regressions of catch rate on lagged and unlagged fishing effort were not significant, a general production analysis could not be done.

d) Catch projections

Because the VPA involved the use of variable M, STACFIS agreed that the estimation procedure required more complete documentation before it could be accepted. This will be forthcoming at the June 1986 Meeting.

Plots of catch rate on fishing effort showed substantial scatter, and it was considered possible that this may be due to seasonal and/or annual changes in availability through migration or some other factor.

Commercial length frequencies from Div. 3L indicated a wide range of lengths contributing to the fishery. Fish taken in Div. 3N tended to be smaller, but this may be due to untrawlable bottom at greater depths. Length frequencies from USSR surveys indicated that there will be good recruitment to the fishery in Div. 3N by the late 1980's. Based on these observations, STACFIS advises that the TAC for 1986 should remain at 25,000 tons.

e) Future research

As noted above, it is believed that the variability in the catch-rate series may be due in part to changes in availability, possibly through seasonal or yearly migrations. The USSR length frequencies indicate that the length distribution in Div. 3L resembles that in Div. 3K, whereas the Div. 3N frequencies more closely resemble those of Div. 3O. Migrations across these stock boundaries could result in the varability in catch rates. Considerable discussion centered around the possibility that the 'Div. 3LN' stock may be a mixture of stocks. STACFIS therefore encourages scientists to examine their data bases in an attempt to resolve this issue.

9. Silver Hake in Divisions 4V, 4W and 4X (SCR Doc. 85/33, 34, 35, 36, 60, 64, 67; 68; SCS Doc. 85/14 (part II), 15)

a) Introduction

The silver hake fishery was conducted over the entire Scotian Shelf until 1977 when it was restricted to areas seaward of the small-mesh-gear line (SMGL). Nominal catches peaked at 300,000 tons in 1973 and fluctuated between 36,000 and 60,000 tons until 1984, when approximately 74,000 tons were caught. Average annual catches before 1977 were higher than those after 1976, and this may have been caused by several factors, among which were lower TACs, different patterns of country allocations since 1976, introduction of the SMGL and season in 1977, and by-catch limitations.

Percentages caught of the total allocations for non-Canadian fleets have fluctuated between 64 and 90%, the highest proportions being in 1982 (90%) and 1984 (86%). Catch rates in the 1984 fishery remained high in the later months, unlike those in 1983, and most of the allocations were taken by September. Catches in 1984 were highest in July with 16,000 tons (35%) being caught. Catches in April to June accounted for 59% of the total landings. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 120 | 100 | 70 | 80 | 70 | 90 | 80 | 80 | 80 | 100 | 100 |
| Catch | 116 | 97 | 37 | 48 | 52 | 45 | 45 | 60 | 36[1] | 74[1] | |

[1] Provisional data.

b) Input data

i) Commercial fishery data

Catch and effort data for USSR tonnage-class otter trawlers were extracted from ICNAF and NAFO Statistical Bulletins for the 1970-82 period. The 1983 data were from provisional NAFO statistics, and the 1984 data were from the Canadian International Observer Program (IOP). Only data for the April-September period were used.

The age compositions of removals in the 1970-83 period were from the previous assessment (SCR Doc. 84/85). The 1983 catch composition was adjusted to the reported nominal catch in that year. The 1984 catch composition was developed from length and age samples that were collected at sea aboard commercial vessels. Age composition of the 1984 catch was estimated independently by Canadian and USSR scientists. Comparative age reading experiments indicated good agreement between Canadian and USSR age readers, but the estimated age compositions of the 1984 catch were significantly different. This is believed to be due to differences in sampling of the catches by the two countries. Because the Canadian sampling was much more intensive and covered the entire fishery, STACFIS agreed to use the Canadian age composition of removals for 1984.

An attempt was made to relate mean maturity stage to abundance indices and timing of migration (SCR Doc. 85/34). The results were inconclusive, and it was suggested that a more detailed analysis, based on daily rather than monthly mean observations, may clarify the hypothesized relationships.

ii) Data from research surveys

Population estimates and year-class strengths were derived from three independent surveys; The Canadian July (1972-84) and March (1979-84) surveys, and the joint Canadian-USSR juvenile surveys (1978-84) (SCR Doc. 85/68). A conversion factor of 2.3 was used to adjust the July survey results prior to 1982 because of a change in survey vessel and gear in that year (SCR Doc. 85/64, 84/82). Data from the three surveys are poorly correlated.

An assessment of silver hake abundance estimates from the Canadian surveys was presented (SCR Doc. 85/67). Estimates of abundance at age within a cohort from the March and July surveys were compared with VPA estimates from past assessments (SCR Doc. 84/85), but the results were inconclusive. The Canadian surveys, both March and July 1984, indicate that the 1983 year-class at age 1 is stronger than any observed in either series. The 1982 year-class at age 1 was the third highest in the July survey data and second highest in the March survey data. In the March survey data, the 1982 year-class at age 1 was greater than the 1981 year-class, whereas, in the July survey data, it was smaller than the 1981 year-class. The 1982 year-class at age 2 was about average in the July 1984 survey data and above average in the March 1984 survey data.

During 1978-84, the USSR and Canada have conducted joint stratified-random surveys for juvenile silver hake on the Scotian Shelf. The gear used during 1978-80 was a Soviet-designed juvenile bottom trawl. There was some doubt, however, as to its ability to sample the total juvenile population, because young silver hake were thought to be high in the water column at night and perhaps below the trawl during the day. During 1981-84, 24-hour fishing was replaced by 12-hour fishing during periods of darkness using the International Young Gadoid Trawl (IGYPT) used by member countries of the International Council for the Exploration of the Sea (ICES). This pelagic trawl was chosen because it could better sample juvenile silver hake. A comparative survey between the two gears was conducted in 1983 but the results were inconclusive. A 1984 survey was planned but, after further discussion, it was concluded by scientists from both countries that further comparative surveys would not be useful in providing a conversion factor between the two gears.

In 1981, a special "core" survey area was suggested to include locations where large concentrations of juvenile silver hake were caught in both the joint Canada-USSR surveys and the Canadian Scotian Shelf Ichthyoplankton Program surveys. Further investigations in 1984 indicated that the core area should be extended to include all of Sable Island Bank and Browns Bank.

The juvenile survey results indicate that the 1981 and 1983 year-classes are strong, the 1982 year-class is weak and the 1984 year-class is intermediate. They also indicate that the 1981 year-class is considerably stronger than the 1983 year-class.

iii) Environmental data

The high catch rates of 1982 were attributed in part to the lower-than-normal water temperatures on the Scotian Shelf during the peak fishing months of May and June (SCR Doc. 84/85). This cannot be given as the reason for the high catch rates in 1984, because water temperatures during the peak period of the fishery showed no obvious anomalies relative to the 1970-80 average (SCR Doc. 85/68) and were above those reported in 1982 (SCR Doc. 85/60).

c) Estimation of parameters and assessment results

One paper (SCR Doc. 85/36) contained a VPA which used estimates of natural mortality that varied with age, but the available documentation was insufficient to fully evaluate this analysis. STACFIS agreed that more detailed explanation of the method was required before it would be considered for future assessments of silver hake. Therefore, as in previous assessments, a constant natural mortality coefficient of 0.4 was used.

An analysis of Z-values, based on survival rate from Canadian July surveys and USSR commercial catch rates was undertaken (SCR Doc. 85/35). The average Z-values from both data series were highly variable and could not be used to estimate terminal F or natural mortality (M). It was considered necessary to provide a more detailed description of the estimation method for weighting Z-values in order to evaluate the feasibility of its utilization in the future.

Several methods to estimate fishing mortality in 1984 were attempted without satisfactory results (SCR Doc. 85/68). STACFIS again abandoned the use of sequential population analysis to estimate the size of the stock in 1984, but noted that attempts to assess this stock by sequential methods should continue. No estimates of fishing mortality in recent years were provided.

d) Prognosis and catch projections

Abundance indices consistently indicate that the 1981 and 1983 year-classes are strong. However, estimates of the strength of the 1982 year-class are highly variable, with indications that it may be anywhere from weak to above average strength. Data from the juvenile survey indicate that the 1984 year-class is of average size. The 1981 and 1983 year-classes accounted for 65% of the catch biomass in 1984. Both of these year-classes will contribute to the 1985 fishery, but only one of these, the large 1983 year-class, will contribute significantly to the 1986 fishery. The size of the 1982 year-class is indeterminable but it could constitute about 20% of the catch (by weight) in 1986. The 1984 year-class could make a significant contribution to the catch in 1986, but the magnitude of the contribution could not be quantified.

STACFIS considers that the silver hake stock is at least as large as it was when the TAC of 100,000 tons was first established, and therefore advises that the current TAC of 100,000 tons be maintained for 1986.

e) Future studies

STACFIS emphasized that recruitment predictions are the primary determinant of catch levels that are advised, and, because silver hake is a short-lived species with few year-classes supporting the fishery in each year, that this will continue to be so even if accuracy of estimation of other stock assessment parameters can be improved substantially. Results of Canada-USSR 0-group surveys to date are most encouraging. Since the methods used by both countries to calculate abundance indices of juvenile silver hake appear to differ, these should be fully documented for the June 1986 Meeting and the best estimation procedure investigated. The present core survey area does not include all areas where 0-group silver hake have occurred in significant quantities, and consideration should be given to expanding the area of coverage to include Sable Island Bank and Browns Bank. An active research program, directed towards improving the precision of estimates, is encouraged.

Continued research into the use of sequential population analysis is also encouraged. In particular, the use of commercial catch rates as an abundance index needs to be evaluated. It has been hypothesized that oceanographic conditions and biological factors influence the timing of silver hake migrations out of the fishing area, biasing abundance indices based on commercial catch rates. Studies which examine the influence of oceanographic and biological factors on silver hake distribution are necessary, so that this hypothesis can be evaluated.

Abundance estimates of silver hake from Canadian bottom-trawl surveys in July and March are highly variable, but their utility in determination of stock status has not yet been exhaustively investigated, although a good start on this task was made at the present meeting. Continuation of this work is encouraged and, in particular, analytical methods, which might reduce variability of estimates, and relationships of survey abundance indices with commercial catch rates should be considered. If variability problems should prove to result from unsuitability of survey gear or design and are not resolveable by using new analytical methods, the practicality of instituting a specialized silver hake abundance survey should be considered.

10. American Plaice in Division 3M (SCS Doc. 85/14, part I)

a) Introduction

This stock has been under TAC regulation since 1974 and nominal catches since then have ranged between 600 and 1,900 tons. Vessels from the USSR have taken the majority of the catch in most years, with most of the catch apparently taken as by-catches in the cod and redfish fisheries. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Catch | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2[1] | 1[1] | |

[1] Provisional data.

b) Input data

Research vessel data. Biomass estimates from Canadian research vessel surveys have shown some fluctuation since the series began in 1978, with the 1984 and 1985 values being close to the average for the 1978-85 period. Biomass estimates from USSR research vessel surveys show only a slight change from 1984 to 1985.

c) Catch projections

With stock size as indicated by research vessel surveys showing relative stability, and with no evidence to indicate a change in the TAC, STACFIS advises that the TAC for 1986 should remain at the present level of 2,000 tons.

11. American Plaice in Divisions 3L, 3N and 3O (SCR Doc. 85/51; SCS Doc. 85/14 (part I))

a) Introduction

This stock has been exploited consistently since the early 1950's and the nominal catch reached a peak of 94,000 tons in 1967. USSR vessels took significant catches during 1965-76, but the fishery has been conducted mainly by Canadian trawlers since 1976, with catch averaging about 45,000 tons. In recent years, approximately 60% of the nominal catch has been taken in Div. 3L, 30% in Div. 3N and the remaining 10% from Div. 3O. Inshore catches of this stock, which come from Div. 3L only, have been between 2,500 and 4,500 tons in recent years.

TAC regulation was introduced for this stock in 1973, and the TAC has been set at levels from 47,000 to 60,000 tons since that time. In most years, catches have been close to the TAC, but catches were significantly below the TAC in 1983 and 1984. The lower catches in these years are attributable to a reduction in fishing effort by the Canada (N) otter-trawler fleet. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 60 | 47 | 47 | 47 | 47 | 47 | 55 | 55 | 55 | 55 | 49 |
| Catch | 43 | 52 | 44 | 50 | 49 | 49 | 50 | 50 | 38[1] | 34[1] | |

[1] Provisional data.

b) Input data

i) Commercial fishery

Catches rates from the directed fishery by Canadian otter trawlers (tonnage classes 4 and 5) for American plaice in Div. 3L and 3N declined steadily from about 0.9 tons/hr in the early to mid-1960's to about 0.4 tons/hr in the mid-1970's. Since then, catch

rates have increased to about 0.58 tons/hr in 1980-82 and to 0.62 and 0.65 tons/hr in 1983 and 1984 respectively. However, catches in the directed fishery in 1983 and 1984 were about 50% of the average 1980-82 due to reduction in fishing effort.

The age composition and weight-at-age data for the 1984 fishery were derived from samples of the landings of Canadian trawlers from Div. 3L and 3N and inshore vessels from Div. 3L. The calculated catch was 9% greater than the nominal catch that was reported for Div. 3L and 3N in 1984, a difference that was considered acceptable by STACFIS. STACFIS noted that estimates of catch-at-age continue to represent landings only, and, as such, did not include discards. However, estimates of discarding for the 1978-82 period show a significant increase in the discard rate of ages 6-10 fish from 1980 to 1982. The apparent decrease in the proportion of the catch at ages 6-9 from 1983 to 1984 may be explained in part by discarding of these age-groups.

ii) Research vessel surveys

Data from Canadian research vessel surveys, conducted in the spring during 1971-82 in Div. 3L and 3N, indicated a decline in abundance from 1980 to 1982, although the number of age 8 and older fish increased during this period. There was no comparable survey in 1983, and the 1984 survey failed to cover a significant portion of the stock distribution in Div. 3L because of vessel problems.

Data from Canadian research vessel surveys in autumn during 1981-84 in Div. 3L showed a slight decline in abundance from 1981 to 1983, followed by a slight increase in 1984. To adjust for differences between the vessel-gear-combinations which were used in the 1981-82 and the 1983-84 surveys, conversions were applied to the American plaice length frequencies as follows: fish less than 28 cm in length from the 1981-82 surveys were multiplied by 0.5 and those greater than or equal to 28 cm were multiplied by 1.3. These conversion factors were derived from a comparative fishing experiment by the two vessels in 1983. Although these conversions affect the population estimates on an age-by-age basis, estimates of the total population did not change significantly, when the uncoverted and converted results from the 1981 and 1982 surveys were compared.

Results from USSR surveys in Div. 3L, 3N and 3O (SCS Doc. 85/14, part I) showed a 10% decrease in population size (numbers) from 1983 to 1984 but a 20% increase in biomass over the same period, indicating a larger average size of fish in the research catches in 1984.

c) Estimation of parameters

i) Partial recruitment

Values for partial recruitment in 1984 were calculated from average fishing mortalities in the 1981-84 period in a preliminary cohort analysis at a terminal F-value of 0.30. The resulting F-values were then averaged and normalized at age 13. These values were then used in a cohort analysis with the iterative procedure continuing until the difference between input and averaged output values was minimal. The same procedure was used in the previous assessment of this stock. STACFIS considered that this was an adequate representation of the partial recruitment pattern in 1984, with the exception of the value for age 11. This value was considered to be too low in the light of the unusually high proportion of catch at age 11 in 1984 and the historical partial recruitment values at age 11. Consequently, it was decided to adjust this value by giving this year-class a value at age 6 in 1979 which was approximately equal to the geometric mean of the age 6 population in 1974-78 from cohort analysis. The accepted partial recruitment vector for 1984, with the adjustment at age 11, is as follows:

| Age (yr) | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13+ |
|---|---|---|---|---|---|---|---|---|
| Partial recruitment | 0.01 | 0.02 | 0.04 | 0.10 | 0.22 | 0.71 | 0.79 | 1.00 |

STACFIS noted that this partial recruitment vector was considerably different from that which was used in the previous assessment, with the values for ages 6-9 being substantially lower in the present vector than the previous ones. In view of the marked decrease in the proportions of ages 6-9 fish in 1984, these differences were considered to be real. A comparison of population estimates from survey data with commercial data in 1984 indicated a partial recruitment vector similar to the above.

ii) Natural mortality

The value of M (0.2) in the present assessment was the same as that used in previous assessments of this stock.

iii) Fishing mortality

The value of terminal F ($F_t$) in 1984 was determined on the basis of two unweighted least squares regressions: (1) average midyear exploitable biomass from cohort analysis against CPUE of Canadian offshore otter trawlers in Div. 3L and 3N for 1965-82; and (2) actual midyear exploitable biomass from cohort analysis against the same CPUE data.

In the first case, average midyear exploitable biomass was calculated by multiplying the midyear biomass estimates at age from cohort analysis by the average (1960-84) selectivity coefficients at age as determined from the fishing mortality matrix. This is the same procedure that was used in the previous assessment of this stock. The correlation coefficients (r) were the same for regressions at $F_t = 0.275$ and $F_t = 0.35$. The sum of the calculated 1983 and 1984 residuals was close to zero for the regression using the values from the cohort analysis at $F_t = 0.35$.

In the second case, the biomass values were obtained by multiplying the midyear population biomass from cohort analysis by yearly partial recruitment estimates at age as determined from the fishing mortality matrix. Although these regressions were significant, correlation coefficients (r) were only about 0.62 and were the same for the regressions at $F_t = 0.25$ and $F_t = 0.30$. The 1983 residual had a large negative value over the range of $F_t$ tested, but the 1984 residual was closer to zero for the regression at $F_t = 0.25$. STACFIS noted that the regression of population numbers (age 8+) from cohort analysis against population numbers (age 8+) from research vessel surveys for 1971-82 was used for the determination of $F_t$ in the previous assessment. However, since there was no comparable survey in 1983 and the spring survey in 1984 was not complete, STACFIS agreed that this relationship could not be used for determining $F_t$ in this assessment.

STACFIS concluded that $F_t$ in 1984 was between 0.25 and 0.35, with the relationship of average midyear exploitable biomass against CPUE indicating the upper bound, as was the case in the 1984 assessment. The midpoint of the indicated range ($F_t = 0.30$) for 1984 was selected for use in the assessment.

d) Assessment results

The cohort analysis at $F_t = 0.30$ showed a relatively stable age 8+ population size during 1979-81, followed by an increase to 1984. STACFIS noted the relatively high population numbers of ages 10 and 11 fish in 1984, but considered that these estimates are reasonable in view of the catch of these ages in 1984 and the relative strengths of these year-classes in recent Canadian surveys. STACFIS also noted the low population values in the cohort analysis for ages 6 and 7 in 1984 and concluded that these estimates were not realistic when compared to survey estimates of the relative size of these year-classes. It was agreed that the estimates of these year-classes in the cohort population in 1984 were unlikely to be accurate in view of the sensitivity of these calculations to slight changes in the low partial recruitment values at age 6 (0.01) and age 7 (0.02).

Results from general production analysis indicated a yield at 2/3 MSY effort of between 37,000 and 47,000 tons (based on the 1984 CPUE value) for Div. 3L and 3N. A plot of CPUE against effort for the 1960-84 period suggested the two relationships from which those figures were derived. The value of 37,000 tons was obtained from the regression of CPUE against effort for 1961-63 and 1973-84, and the value of 47,000 tons was derived from the data for 1960 and 1964-71. It should be noted that these values for yield were derived using unlagged data.

e) Catch projections

The parameters that were used in the catch projections are listed in Table 10. Population size at age 6 in 1985 and 1986 was set at the geometric mean of the 1974-78 values. The assumed catch for 1985 (Div. 3LN only) was 44,000 tons. STACFIS decided to use the long term (1960-78) average partial recruitment values for catch projections. This vector was used to calculated the $F_{0.1}$ value of 0.262 for this stock. The values at ages 6-10 are intermediate between the partial recruitment values calculated for the 1984 population and those used in the 1983 and 1984 catch projections for this stock. STACFIS noted that the contribution of age 6-8 fish to the catch in these years had been overestimated considerably and attributed this to the high values for the partial recruitment used in the catch projections for these years.

The projected catch in 1986 for Div. 3L and 3N at $F_{0.1}$ is 51,000 tons. As in previous years, an amount for Div. 3O, usually approximately equal to the average catch in recent years, has been added to the Div. 3LN value to produce at TAC for the stock. Catches in Div. 3O averaged 3,800 tons during 1979-84. Therefore, STACFIS advises that a catch of 55,000 tons in 1986 would correspond to fishing at $F_{0.1}$. This increase in the advised yield

Table 10. American plaice in Div. 3L, 3N and 3O: parameters used in the catch projections.

| Age (yr) | Population in 1984 (000) | Catch in 1984 (000) | Mean wt. 1982-84 (kg) | Partial recruitment |
|---|---|---|---|---|
| 6 | 237,158[1] | 89 | 0.341 | 0.025 |
| 7 | 180,438[1] | 460 | 0.415 | 0.100 |
| 8 | 163,624 | 1,718 | 0.490 | 0.220 |
| 9 | 158,119 | 4,085 | 0.576 | 0.300 |
| 10 | 140,655 | 8,235 | 0.608 | 0.470 |
| 11 | 64,867 | 11,247 | 0.657 | 0.580 |
| 12 | 40,584 | 7,793 | 0.794 | 0.730 |
| 13 | 18,697 | 4,414 | 1.041 | 1.000 |
| 14 | 9,183 | 2,168 | 1.334 | 1.000 |
| 15 | 3,956 | 934 | 1.735 | 1.000 |
| 16 | 1,478 | 349 | | 1.000 |
| 17 | 339 | 80 | | 1.000 |
| 18 | 55 | 13 | | 1.000 |
| 19 | 4 | 1 | | 1.000 |

[1] Geometric mean of 1974-78 values from VPA at $F_t = 0.3$.

at $F_{0.1}$ from 1985 to 1986 results mainly from the fact that the catch in 1984 was only 62% of the TAC, thus giving a weighted F for 1984 which was significantly lower than the weighted $F_{0.1}$ value. This together with lower than projected fishing mortality on younger ages resulted in a higher projected stock size.

12. Witch Flounder in Divisions 3N and 3O (SCR Doc. 85/44)

a) Introduction

Catches of witch flounder have ranged from 8,000 tons in 1974 to approximately 2,400 tons in 1980 and 1981. Provisional data from 1984 indicate a catch of about 2,700 tons, a decline from the last 2 years. Recent catches and TACs (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 10 | 10 | 10 | 10 | 7 | 7 | 5 | 5 | 5 | 5 | 5 |
| Catch | 6 | 6 | 6 | 3 | 3 | 2 | 2 | 4 | 4[1] | 3[1] | |

[1] Provisional data.

b) Input data

Catch and effort statistics were available for Canadian trawlers which fished the southwest slope of the Grand Bank (Div. 3O) during winter and spring in 1972-84. The fishery for witch flounder was considered to be a directed fishery when witch flounder was the dominant species by weight in the catch. The catch rate peaked at 0.712 tons/hr in 1972 and declined rapidly to 0.252 tons/hr in 1975, during the period when catches were highest. The catch rate was considered stable from 1975 to 1979 but increased to 0.667 tons/hr in 1982, the highest since 1972. Catch rates of 0.3-0.4 tons/hr in the last 2 years are near the average for the last 10-12 years.

c) Catch projections

Considering the catch-rate information and age composition of commercial catches over the last 3 years, the stock is believed to be in stable condition at current catch levels. STACFIS therefore advises that the TAC of 5,000 tons for 1985 should remain in effect for 1986.

13. Yellowtail Flounder in Divisions 3L, 3N and 3O (SCR Doc. 85/50; SCS Doc. 85/14 (part I))

a) Introduction

Nominal catches since 1967 have ranged from 8,000 tons in 1976 to 39,000 tons in 1973 and have averaged about 13,000 tons during 1979-1984. Trawlers from the USSR took significant catches in the 1966-75 period, but the fishery has been conducted almost exclusively by

Canadian vessels since then. The majority of the nominal catches from this stock was taken in Div. 3N. The catch in Div. 3L in 1984 was over 5,000 tons, which is the highest in this division since 1972. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 35 | 9 | 12 | 15 | 18 | 18 | 21 | 23 | 19 | 17 | 15 |
| Catch | 23 | 8 | 12 | 15 | 18 | 12 | 15 | 12 | 9[1] | 13[1] | |

[1] Provisional data.

b) Input data

i) Commercial fishery

Average catch rates of yellowtail flounder by Canada (N) otter trawlers (tonnage classes 4 and 5) declined from about 0.6 tons/hr during 1969-72 to about 0.4 tons/hr during 1974-77, and then increased steadily to a level of 0.64 tons/hr in 1980. Catch rates have been stable in the last 3 years at a level between 0.53 and 0.56 tons/hr.

The age composition and weight-at-age data for 1984 were derived from samples of the landings of Canadian trawlers in Div. 3LNO. The catch of age-groups 4 and 5 has declined since 1981 and the catch of age-groups 6 and 7 has increased, with latter groups comprising 85% of the catch by number in 1984. Age composition and weight-at-age data for 1968-83 were the same as those used in the previous assessment of this stock.

ii) Research vessel surveys

Canadian research vessel surveys were conducted in Div. 3LN during 1971-85. The 1971-82 and 1984-85 survey were carried out by different research vessels. In order to standardize the population estimates over the entire series, the estimates from the 1971-82 surveys were multiplied by a conversion factor of 1.4 for this species, based on comparative fishing experiments. These estimates indicated a relatively stable population size during 1978-82. There was no comparable survey in 1983, but the 1984 survey showed a significant increase over the 1982 level. However, results from the 1985 survey for Div. 3N only, where most of the stock biomass is found, indicate that the population size there may be close to the level observed in the 1978-82 period. USSR research vessel surveys in Div. 3NO showed very little change in the population estimate from 1983 to 1984.

c) Estimation of parameters

i) Partial recruitment

The significant change in age composition of the commercial catch in 1984 suggested a change in the partial recruitment pattern from that of previous assessments. Calculation of partial recruitment values from average fishing mortality coefficients was considered inappropriate, and use of the survey data did not yield realistic results, as has been the case for this stock in the past. In view of the relatively small number of age-groups which contribute significantly to the commercial catch, the historical patterns of catch-at-age were examined to see if similarities to 1984 existed. It was decided that the 1969-71 period was appropriate, and the partial recruitment values were calculated by average F-values in these years from a preliminary cohort analysis. STACFIS noted that this method involved certain assumptions but agreed that it provided a reasonable estimate of partial recruitment for 1984. These values are as follows:

| Age (yr) | 4 | 5 | 6 | 7-10 |
|---|---|---|---|---|
| Partial recruitment | 0.002 | 0.071 | 0.510 | 1.00 |

ii) Natural mortality

The value of M (0.3) was the same as that used in previous assessments.

iii) Fishing mortality

Significant correlations were obtained in regressions of population biomass (age 5+) from cohort analysis on commercial catch rates for 1968-84, fishing mortality weighted

by population numbers (age 5+) from cohort analysis on fishing effort for 1968-84, and population numbers (age 5+) (both beginning of year and mid-year) from cohort analysis on population numbers (age 5+) from Canadian research vessel surveys. Based on minimizing the residuals of the last two points (last point only for the survey data, as no 1983 data exist) and examination of the correlation coefficients, STACFIS concluded that terminal F was between 0.45 and 0.50 and selected the midpoint (0.475) for use in the assessment.

d) Assessment results

The analysis indicated a relatively stable stock size during 1978-82, with a slight increase in 1984. STACFIS again noted the continuing pattern of very high fishing mortality values (>1.00) which were evident for age 7-10 in many years. However, because both commercial and research abundance indices showed relative stock stability, these high fishing mortality values over 1.00 for ages 7-10 could not be rationalized. Therefore, STACFIS concluded that the analysis was not reliable enough to form the basis for catch projections but the the cohort analysis was useful for indicating trends in population size.

e) Catch projections

With all available information indicating stability of the stock, STACFIS advises that the TAC for 1986 should remain at the current level of 15,000 tons.

14. Greenland Halibut in Subareas 0 and 1 (SCS Doc. 85/14, part I)

a) Introduction

Nominal catches peaked at 25,000 tons in 1975 but have been less than 20,000 tons annually since 1975 and less than 10,000 tons annually since 1980. In recent years, the fishery for Greenland halibut in Subarea 0 has been conducted by USSR vessels. However, in 1984 the USSR catch in 1984 was only 109 tons. The fishery in Subarea 1 is mainly prosecuted by Greenland fishermen in the deep fjords. In 1984, the inshore fishery accounted for 5,811 tons, with the remaining catch of 14 tons being taken by trawlers of the Federal Republic of Germany. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | - | 20 | 20 | 20 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Catch | 25 | 16 | 13 | 12 | 19 | 8 | 10 | 9 | 9[1] | 6[1] | |

[1] Provisional data.

b) Input data

The only available information on this stock in 1984 was from a survey that was conducted by the USSR in the autumn-winter of 1984/85 in Div. 0B. Due to severe ice conditions, however, the survey area was very restricted, and the resulting biomass estimate was somewhat lower than that in 1983. The length frequency data indicated that large mature fish were not as abundant in the catches as in the past. This was believed to be due to the fact that the area where these fish normally occur was not surveyed in 1984. Furthermore, it is thought that many mature fish may have already migrated to the spawning grounds in deep water of Davis Strait at about 67°N latitude

c) Catch projections

With the lack of adequate data to perform an analytical assessment of this stock, STACFIS has no basis to advise a change in the present TAC of 25,000 tons.

15. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 85/43; SCS Doc. 85/14, part I).

a) Introduction

Nominal catches of Greenland halibut were in the range of 25,000-35,000 tons during 1969-77 and peaked at 39,000 tons in 1978. Since that time, catches have steadily declined to a level near 25,000 tons in 1984. The main prosecutors of this fishery have been Canada, USSR, Poland and German Democratic Republic. In recent years, however, Canadian vessels have accounted for about 70-80% of the total catch. The main components of this fishery in 1984 were offshore otter trawlers from Canada, USSR, Poland, German Democratic Republic and Japan, which accounted for 55% of the reported catch, with the remainder being taken in the Canadian gillnet fishery. Catches have usually been taken in Div. 2J, 3K and 3L, but a substantial proportion of the catch in recent years has come from Div. 2H. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 40 | 30 | 30 | 30 | 30 | 35 | 55[1] | 55[1] | 55[1] | 55[1] | 75 |
| Catch | 29 | 25 | 32 | 39 | 34 | 33 | 31 | 26 | 28[2] | 25[2] | |

[1] TAC for Divisions 2J, 3K and 3L only.
[2] Provisional data.

b) Input data

Information on directed fishing effort by Canada(N) trawlers was available for 1980-84, although this was based upon relatively low levels of directed catch. Similar information was available for Poland from the Canadian observer program in 1979 and 1981-84. While Canadian catch rates may be confounded by learning, Polish catch rates decreased in Div. 3K and increased in Div. 2H over the period. This has been attributed to the growth of the strong year-classes of the early 1970's, which moved northward with age. In the 1984 fishery, however, these strong year-classes were not a significant proportion of the catch, because they were unavailable in the area where the fishery occurred. Subsequent year-classes appear to be moderate to strong and should result in an increase in catch rates.

Research vessel data indicate that Greenland halibut are widely distributed along the coasts of Labrador and eastern Newfoundland and in deep water along the slope of the northern Grand Bank. The areas of highest abundance are generally in deep water along the continental slope and the deep channels between banks. Larger fish tend to be found in deeper water than smaller fish and are more prevalent in the more northerly areas. It is believed that, as the fish approach maturity, they follow a migration pattern toward Davis Strait where the main spawning areas are located.

Information from both Canadian and USSR surveys indicates that the minimum trawlable biomass in Subarea 2 and Div. 3K and 3L is in excess of 435,000 tons. This value is considered minimal, because much of the deepwater area where most of the larger fish live was not surveyed, and available evidence indicates that catchability of Greenland halibut is low. The survey data also indicate the 1979 and 1980 year-classes are probably as strong as, or stronger than, any that have been observed in the last 15 years and should contribute significantly to the fishery over the next few years. Furthermore, information from shrimp surveys off Labrador in the last 2 years indicate that the year-classes of the early 1980's, particularly the 1983 year-class, may also be strong, although it is still too early to assess their strengths with a high decrease of confidence.

c) Estimation of parameters and assessment results

Age composition and mean weight-at-age data for the fishery during 1975-83 were taken directly from the previous assessment, and the corresponding estimates for 1984 were derived from the data in SCR Doc. 85/43. The sum of products from multiplying the catch-at-age and weight-at-age vectors for 1984, indicated an error of less than 1% relative to the nominal catch.

Partial recruitment values for the 1984 fishery were derived from a comparison of the catch-at-age data from the 1984 survey in Div. 2J+3K and the estimated commercial catch-at-age for the 1984 fishery. It was noted that Greenland halibut may not be fully-recruited to the research-vessel survey gear until beyond age 5 and that partial recruitment of the younger ages may be overestimated. It was further noted that the survey does not cover the deep water and the more northerly areas where the highest abundance of large fish occurs. This implies that partial recruitment values for the older fish are overestimated and that SPA estimates of abundance by using this partial recruitment vector are minimal.

As in the recent past, it was not possible to estimate fishing mortality on fully-recruited age-groups with any degree of accuracy. In considering the results of the assessment in June 1984 (NAFO Sci. Coun. Rep., page 56) and the available data for 1984, STACFIS believes that fishing mortality on this stock is very low, probably less than $F = 0.10$.

d) Catch projections

After evaluating the available data on the recently low levels of fishing mortality, the presence of strong incoming year-classes and the high estimates of biomass, STACFIS advises that a catch of 100,000 tons from Subarea 2 and Div. 3KL in 1986 would not exceed $F_{0.1} = 0.28$.

e) Recommendation

STACFIS noted that the Greenland halibut stocks have been assessed for many years. In conjunction with these assessments, a significant amount of biological data has been

brought forward but much information is probably still unpublished. In view of the state of knowledge of Greenland halibut in the North Atlantic as a whole, it was considered that a meeting of fisheries experts to review the biology of the species would be most informative. STACFIS agreed that the problems and questions concerning the species could be evaluated by holding a symposium. Such a symposium could considerably advance the knowledge of Greenland halibut. STACFIS therefore

reccommends

*that a theme entitled the "Biology and Ecology of Greenland Halibut in the North Atlantic" should be considered for a future Special Session of the Scientific Council.*

STACFIS considered that this topic might be suitable as a topic for the Special Session in 1987. However, a final decision was deferred to the September 1985 Meeting so that STACFIS representatives have the opportunity (i) to canvass Greenland halibut experts to determine the extent of interest in such a session and the approximate number of contributed papers that could be expected, and (ii) to consider alternative topics such as including other species (e.g. blue hake and grenadiers) as part of the Special Session.

16. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 85/46)

a) Introduction

Only a USSR catch of 25 tons has been reported from this stock to date for 1984. There has been almost no directed fishery since 1978, recent catches being taken as by-catch in the Greenland halibut fishery. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 10 | 14 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Catch | 5 | 9 | 3 | 6 | 7 | 2 | + | + | + | + | |

b) Input data

Catch and effort statistics, as published in ICNAF and NAFO Statistical Bulletins for 1968-1978, were incorporated in a multiplicative model in order to derive a standardized catch rate series.

c) Estimation of parameters

A least squares regression of the standardized catch rate on standardized effort, using unlagged data, was significant ($r = 0.72$). A general production analysis, using the relationship derived from the above regression, indicated a MSY of 9,500 tons and a yield at 2/3 MSY effort of 8,400 tons. Analysis with lagged data was not carried out because of the short time series.

d) Catch projections

The general production analysis, utilizing a revised catch rate series, indicated a yield at 2/3 MSY effort which was only slightly higher than that from previous analyses (8,400 tons vs 8,000 tons). All of these analyses have used unlagged effort data only. Because of the short time series available, lagging of these data is not possible, although it was agreed that a lag of about 6-8 years would be appropriate for this species.

In recent years, the catches have been below 1,000 tons and have been by-catches only. In the absence of new information, STACFIS has no basis to advise a change in the TAC of 8,000 tons for 1986.

17. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 85/46)

a) Introduction

The TAC again was not fully utilized in 1984, with the reported catches totalling only 4,000 tons. Catches by the German Democratic Republic exceeded those by the USSR in both 1983 and 1984, this being a reversal of the historic pattern. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 32 | 35 | 35 | 35 | 35 | 30 | 27 | 27 | 11 | 11 | 11 |
| Catch | 27 | 21 | 15 | 21 | 8 | 2 | 7 | 4 | 4[1] | 4[1] | |

[1] Provisional data.

b) Input data

Catch and effort data were extracted from ICNAF and NAFO Statistical Bulletins for the 1967-1983 period. In addition, catch and effort data from the observer program were available for the 1978-1984 period. These data were used in the multiplicative model to derive two separate standardized catch-rate series.

No recent research data are available.

c) Estimation of parameters

Insufficent data are available for an analytical assessment of this stock. Least squares regressions of the standardized catch rates from the ICNAF and NAFO statistics on standardized effort (unlagged and lagged 6, 8 and 10 years) were either not significant or were significant with a postive slope. As a result, no general production analysis could be performed.

d) Catch projections

Low catches relative to the TACs in recent years were, in part, due to by-catch restrictions on Greenland halibut. STACFIS has noted previously (NAFO Sci. Coun. Rep., 1984, page 57) that the present 10% by-catch limitation for Greenland halibut is restrictive. There are no new data to suggest a revision of the recommended levels of 20% for Div. 3K and 30% for Subarea 2. The two catch-rate series indicate that rates have stabilized in recent years. Because of the low catches during the same period, it is not known if these rates are indicative of stock status. Because of this and the lack of any other data, STACFIS has no basis to advise a change in the TAC of 11,000 tons for 1986.

18. Wolffishes in Subarea 1

a) Introduction

The nominal catch for this area includes two species: Atlantic wolffish (Anarhichas lupus) and spotted wolffish (A. minor). Since 1957, the total combined catch has been in the range of 2,000-6,000 tons. There is some indication that the offically-reported catches for 1977-79 were overestimated. Recent catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|---|---|---|
| Catch | 6 | 6 | 6 | 6 | 17 | 5 | 4 | 4 | 3[1] | 2[1] |

[1] Provisional data.

b) Input data

The decrease in catch in 1984 below the long-term catch level may be attributed to reduced effort and consequently lower by-catches of wolffish in the offshore trawl fishery for cod and redfish. Only 15% of the total wolffish catch in 1984 was taken as by-catch in the offshore trawl fishery for cod and redfish, whereas the major amount was taken in a directed longline fishery by small vessels in inshore areas.

Specific statistics have not been provided for the two species, but, from a breakdown based on estimated species compositions for inshore catches of 90% and 10% (by weight) and for offshore catches of 32% and 68% for spotted wolffish and Atlantic wolffish respectively, the following provisional 1984 catches by species were derived:

| Species | Catch (tons) Inshore | Offshore | Total | % |
|---|---|---|---|---|
| Spotted wolffish (A. minor) | 1,120 | 120 | 1,240 | 77 |
| Atlantic wolffish (A. lupus) | 124 | 256 | 380 | 23 |
| Total wolffish | 1,244 | 376 | 1,620 | 100 |

The percentage species composition of the total wolffish catch in 1984 is, however, the same as given for the catch of 1983 (NAFO Sci. Coun. Rep., 1984, page 58) although the species breakdown for the offshore catches was derived by applying more recent data. This breakdown was derived from 1983 survey biomass estimates provided by the Federal Republic of Germany for the offshore stock components. Spotted wolffish at 6,234 tons ± 41.6% and Atlantic wolffish at 13,336 tons ± 32.3% corresponded to 32% and 68% respectively of the total trawlable biomass of wolffish.

c) Catch projections

Until more biological data and detailed fishery statistics for the two species become available, it is not possible to carry out a detailed assessment. However, taking into account the available statistics and information presented earlier (NAFO Sci. Coun. Studies No. 7, pages 35-40; NAFO Sci. Coun. Rep. for 1979-80, pages 85-86), catch in the range of 5,000-6,000 tons, corresponding to a long-term average catch, seems to be reasonable.

Biological data for both species from recent surveys (1982-84) and sampling of commercial catches are presently being analyzed and will be presented to STACFIS in 1986.

19. Capelin in *Divisions 3L, 3N and 3O* (SCR Doc. 85/52, 54, 55, 56, 73, 76)

a) Introduction

Nominal catches of caplein in these divisions increased from about 1,600 tons in 1971 to 166,000 tons in 1975 and declined to 12,000 tons in 1979. No offshore fishing was allowed in the region during 1979-84. Provisional statistics for 1984 indicate a total catch of 33,000 tons in the inshore fishery of Div. 3L by purse seines, beach seines and traps during June and July. Recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Advised TAC[1] | 200 | 200 | 200 | 200 | 16 | 16 | 30 | -[2] | 60 | 38 | 60 |
| Effective TAC[1] | 180[3] | 180[3] | 200 | 200 | 10 | 16 | 30 | 30 | 30 | 26 | 26 |
| Catch | 166 | 144 | 74 | 30 | 12 | 14 | 24 | 27 | 25[4] | 33[4] | |

[1] For Div. 3L only in 1979-85.
[2] Managment measures adopted by Fisheries Commission without STACFIS advice (NAFO Sci. Coun. Rep., 1981, page 83).
[3] Countries without allocations could each take up to 5,000 tons.
[4] Provisional data.

b) Input data

i) Commercial fishery (SCR Doc. 85/76)

A logbook survey of the inshore capelin fishery in Div. 3L, which was designed to provide estimates of catch-per-unit-effort, was initiated in 1981. The catch rates of trap nets and purse seines in the following table (where catches are derived from the addition of the quantities actually landed and the quantities of discards from logbooks) show similar patterns over the 4-year period, increasing from 1981 to 1983 and declining in 1984.

| | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|
| Trap nets (tons/day) | 2.7 | 3.7 | 4.6 | 3.5 |
| Purse seines (tons/day) | 9.4 | 16.4 | 18.8 | 14.3 |

Discarding of capelin in 1984 was much lower than in 1983 and comparable to estimates for 1982. The reported by-catch of cod in 1984 was low (1.2%), and these results are similar to previous years.

The 1980 year-class of capelin accounted for 55% of the commercial catch (by numbers) in the 1984 inshore fishery and the 1981 year-class at 40% was next in abundance.

ii) Research data (SCR Doc. 85/52, 55, 56, 73)

A Canadian acoustic survey (SCR Doc. 85/73) in Div. 3L during 24 April-13 May 1984, provided a capelin biomass estimate of 421,000 tons, which compares to an estimate of 122,000 tons from a comparable survey in 1983. This difference is attributable to the presence of the 1982 year-class which dominated (68% by number) in the 1984 survey. One-year-old capelin are not taken in abundance in the April surveys. The 1984 estimate was considered to be an underestimate, because a portion of the planned survey could not be completed due to ice cover and capelin were detected at the edge of the ice.

A Canadian acoustic survey was also conducted in Div. 3L and 3N during 16 June-2 July 1984. The 1983 and 1982 year-classes (55 and 36% by number respectively) dominated

in Div. 3L, whereas the 1981 year-class (42% by number) dominated in Div. 3N. Small capelin of the 1983 year-class accounted for 30% of the capelin by number in Div. 3N. The presence of these small fish was unusual but they occurred in only one trawl catch. These fish accounted for less than 4% of the total biomass estimate of 113,000 tons in Div. 3N. The comparable estimate of capelin in Div. 3N during the 1983 acoustic survey was 190,000 tons. The biomass estimate of caplein in Div. 3L during the 1984 survey as 540,000 tons, compared to an estimate of 164,000 tons from a similar survey in 1983. STACFIS noted that no corrections are made to the Canadian acoustic estimates, but it is known that capelin move into the upper water layers at night and cannot always be detected by the acoustic equipment. Because of this, the Canadian acoustic estimates are probably underestimates.

An acoustic survey by the USSR (SCR Doc. 85/55) in Div. 3LNO during 1 May-13 June 1984 provided a biomass estimate of 2,655,000 tons (corrected for diurnal vertical migrations). The 1983 year-class (65%) dominated by number but the 1980 and 1981 year-classes (37 and 30% respectively) dominated by weight. STACFIS experienced difficulty in evaluating the results of this survey and was unable to compare the estimates of year-class strength with those from the Canadian survey. From the available data, it was not possible to determine how the age-composition had been estimated or how the estimates of abundance of year-classes had been derived from the acoustic data. In addition, estimates of abundance were not derived separately for the capelin occurring in Div. 3L and 30 and in the spawning area in Div. 3N.

Estimates of mean weight of one-year-old capelin from USSR acoustic surveys in 1983 and 1984 (SCR Doc. 84/39 and 85/55) were 1.7 and 1.0 g respectively, and these weights were noted to be much lower than comparable mean weights of one-year-old fish from catches in Div. 3L during 1972-78:

| | Mean weights (g) of 1-year-old capelin | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 |
| Male | 9.8 | 3.0 | 4.7 | 6.2 | 6.1 | 4.9 | 3.7 |
| Females | 7.7 | 4.2 | 5.9 | 4.5 | 4.7 | 9.4 | 3.8 |

STACFIS could not determine whether these differences were due to selectivity of larger fish in the age group by the fishery or due to changes in growth rate. Since the maturation rate of capelin may be related to growth rate, changes in growth rate could have an important effect on maturation rates that are used in the projections. Consequently, STACFIS recommends that this observation be the subject of further study.

USSR prerecruit capelin surveys were conducted in southern Div. 3K and northern Div. 3L during 11-15 December 1984 and in Div. 3LNO during 30 December 1984-14 January 1985 (SCR Doc. 85/52). The 1984 year-class was estimated to be 4-21 times lower than the 1983 year-class, depending on the method of analyzing the data. It was noted that these surveys in 1984 were about 1.5 months later than in 1983, and that this had not been taken into account in the comparisons. Although absolute estimates of capelin abundance could not be calculated from these surveys, STACFIS noted that such surveys might provide relative estimates of year-class strength and therefore encourages further research in this area.

c) Estimation of parameters (SCR Doc. 85/54)

The virtual population analysis of the capelin stocks in Div. 2J+3KLNO was not reviewed in detail for the following reasons: (i) the historical estimates of abundance which resulted from the analysis could not be partitioned to provide abundance estimates for the capelin stocks occurring in Div. 2J+3K, Div. 3L and Div. 3NO; (ii) new estimates of age-specific natural mortality rates were presented, but STACFIS could not evaluate the results because of lack of detailed information on the method; and (iii) virtual population analysis may not be valid for a short-lived species with high natural mortality rates and especially with the low fishing mortality rates which are thought to have occurred in recent years.

d) Catch projections

Stock size projections for capelin in Div. 3L were made by using estimates of year-class size from acoustic surveys. Results from past years indicated that age-groups 3 and 4 will comprise the bulk of the mature stock in 1986. Evidence from Canadian acoustic surveys indicated that the 1982 year-class was about 10 times the size of the 1981 year-class and about 3 times the size of the 1980 year-class. The 1983 year-class at age 1 was approximately equal in abundance to the 1982 year-class at the same age. Estimates of abundance of one-

year-old capelin in USSR acoustic surveys in 1983 and 1984 indicated that the 1983 year-class was 3-4 times large than the 1982 year-class. Because of the problems in evaluating the results of the USSR acoustic survey, the fact that the Canadian acoustic estimate was probably an underestimated and the potentially larger variation in acoustic estimates, STACFIS could not estimate precisely the abundance of the 1983 year-class. However, it was concluded that this year-class was probably as large as the 1982 year-class at age 1 and, in fact, may have been larger. Consequently, an estimate of 100 billion fish at age 1 (as in the June 1984 assessment) was used in the stock projections. The 1982 year-class at age 2 was estimated as the average derived from the Canadian and USSR acoustic surveys in June 1984. The 1981 year-class was not used in the projections. Five-year-old capelin are usually not an important component of the mature spawning stock, and, since the 1981 year-class was considered to be weak, STACFIS concluded that the 1981 year-class would make an insignificant contribution to the spawning stock in 1986. Other parameters used in the projections were the same as those used in the June 1984 assessment (Table 11).

Table 11. Capelin in Div. 3L: parameters used in projections of stock size.

| Age (yr) | Spawning mortality | Proportion mature | 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 |

The results of the projections, using the above estimates of year-class strength and the parameters in Table 11 together with M = 0.30 (between spawning periods) and a spawning date of 1 June, are given in Table 12.

Table 12. Capelin in Div. 3L: projections of stock size for 1985.

| Age (yr) | Number of fish (millions) | | | |
|---|---|---|---|---|
| | Jun 1984 | Jan 1985 | Jan 1986 | Jun 1986 |
| 1 | 100,000 | | | |
| 2 | 79,000 | 85,100 | | |
| 3 | | 68,000 | 63,800 | 56,300 |
| 4 | | | 32,600 | 28,800 |
| Biomass of mature fish (tons) | | | | 1,300,000 |

STACFIS continues to consider an exploitation rate of 10% to be appropriate for capelin, and accordingly advises a TAC of 130,000 tons for Div. 3L in 1986. STACFIS noted that a TAC of 130,000 tons in 1986 would be approximately double the highest advised TAC in recent years.

The estimates of the size of the 1982 and 1983 year-classes were derived from acoustic surveys and therefore exhibit large variances. STACFIS was more confident in the estimate of the size of the 1982 year-class, because it has been observed in acoustic surveys in two years (1983 and 1984), whereas the 1983 year-class has been observed only in 1984. The 1983 year-class accounts for about 45% of the projected mature biomass in 1986. In addition, the estimates of the size of the mature portion of the stock in June 1986 are dependent on the estimates of the age-specific proportion of mature capelin and the age-specific mortalities, both of which probably exhibit significant annual variation. It was also recognized that capelin represent an important source of food for predators, especially cod.

No stock projections were made for capelin in Div. 3NO because estimates of year-class size for this stock were not available. The estimate of stock size for 1984 was about one-half of the comparable estimate in 1983 and one-quarter the comparable estimate for 1982. Because the biomass is still below historical levels, STACFIS advises a continuation of the fishery closure for Div. 3N and 3O in 1986. STACFIS considered, but could not evaluate, the possibility that this stock has reached equilibrium levels lower than those estimated during the mid-1970's. Because of this, it could not be determined whether a fishery should be resumed in this area. In order to test this hypothesis, STACFIS therefore

recommends

*that a complete review and analysis of available data for capelin in Div. 3N and 3O be presented at the June 1986 Meeting.*

20. Squid-Illex in Subareas 2 to 6 (SCR Doc. 85/25, 26, 27, 47, 69; SCS Doc. 85/11, 13)

a) Introduction

Nominal catches of short-finned squid (Illex illecebrosus) in the Northwest Atlantic from 1976 to 1984 are given in Table 13. In Subareas 2-4, the total catch peaked at 162,000 tons in 1979, declined rapidly to 400 tons in 1983 and increased to nearly 800 tons in 1984. In Subareas 5 and 6, the total catch peaked at 25,000 tons in 1976 and 1977 and averaged 16,000 tons during 1978-83. Provisional data for 1984 indicate a catch of about 10,000 tons.

Table 13. Nominal catches (tons) of short-finned squid in the Northwest Atlantic, 1976-84.

| Year | SA 2 | SA 3 | SA 4 | Total SA 2-4 | Total SA 5-6 | Overall total |
|---|---|---|---|---|---|---|
| 1976 | - | 11,257 | 30,510 | 41,767 | 24,936 | 66,703 |
| 1977 | 6 | 32,748 | 50,726 | 83,480 | 24,883 | 108,363 |
| 1978 | 7 | 41,369 | 52,688 | 94,064 | 17,568 | 111,632 |
| 1979 | 1 | 88,832 | 73,259 | 162,092 | 17,341 | 179,433 |
| 1980 | 1 | 34,779 | 34,826 | 69,606 | 17,864 | 87,470 |
| 1981 | - | 18,061 | 14,142 | 32,203 | 15,574 | 47,777 |
| 1982 | - | 11,164 | 1,744 | 12,908 | 18,188 | 31,096 |
| 1983[1] | - | - | 421 | 421 | 11,598 | 12,019 |
| 1984[1] | - | 368 | 404 | 772 | 9,938 | 10,710 |

[1] Provisional data.

In Subarea 3, there were no offshore catches in 1984 and only 368 tons were taken in the inshore fishery. No squid were caught in this area in 1984.

In Subarea 4, the total catch was only 404 tons of which 403 tons were caught offshore, largely as by-catch (96%) in the silver hake fishery.

In Subareas 5 and 6, the total reported catch was 9,938 tons, virtually all of which was taken in Subarea 6 and most of which (9,300 tons) was taken by United States vessels.

With regard to the management regime in Subareas 3-4, recent TACs and catches (000 tons) are as follows:

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 25[1] | 25[1] | 25[1] | 100 | 120 | 150 | 150 | 150 | 150 | 150 | 150 |
| Catch | 18 | 42 | 83 | 94 | 162 | 70 | 33 | 13 | 0.4[2] | 0.8[2] | |

[1] Countries without specific allocation could each take up to 3,000 tons.
[2] Provisional data.

b) Input data

i) Abundance indices (SCR Doc. 85/25, 26, 27)

Commercial catch rates were available only for the offshore international fishery in Div. 4VWX in 1984. This index (Table 14) reflected the same pattern as that observed in the research vessel surveys of the area, decreasing from 5.5 tons per day in 1983 to 2.3 tons per day in 1984, and was on a par with that seen in 1982 (2.4 tons/day). The extremely low fishing effort of 7 days in 1984 was the lowest in the time series.

Abundance indices were available from Canadian surveys in Div. 4VWX for 1972-84 and from USA groundfish surveys in Subareas 5+6 for 1972-83 (Table 14). Estimates of abundance were available also from French surveys in Div. 4VWX. The Canadian estimates of relative abundance from July surveys showed a decrease from 28.4 squid per tow in 1983 to 13.5 squid per tow in 1984. The decline was associated, in part, with many fewer small squid being caught in 1984 than in 1983. The French survey of Div. 4VWX in September (based on 18 standard strata) indicated a decrease in minimum trawlable numbers from 90 million squid in 1983 to 36 million in 1984, well below the previous low estimate of 54 million in 1982.

Table 14. Abundance indices for short-finned squid in Subareas 3 to 6, 1972-84, based on stratified-random trawl surveys and commercial fishery data.

| | Stratified-random surveys | | | Commercial fishery data | | | | |
|---|---|---|---|---|---|---|---|---|
| | Canada[1] | France[2] | USA[3] | France[4] | France[5] | Japan[6] | International[7] | |
| | 4VWX | 4VWX | 5Z+6 | 3Ps | 3P+4VW | 4VWX | Jul-Sep in 4VWX | |
| Year | Jul | Aug-Sep | Sep-Nov | Jun-Oct | Aug-Oct | Sep | (t/day) | (days) |
| 1972 | 8.1 | - | 3.5 | - | - | - | - | |
| 1973 | 8.3 | - | 1.3 | - | - | - | - | |
| 1974 | 11.6 | - | 3.0 | - | - | - | - | |
| 1975 | 35.4 | - | 12.4 | - | - | - | - | |
| 1976 | 187.9 | - | 28.7 | - | - | - | - | |
| 1977 | 51.3 | - | 15.8 | - | - | - | 14.6 | 1,921 |
| 1978 | 19.5 | - | 28.4 | - | - | 233 | 9.0 | 2,274 |
| 1979 | 73.6 | - | 32.1 | 36.9 | 17.0 | 667 | 17.5 | 1,619 |
| 1980 | 16.3 | 657 | 17.0 | 37.7 | 5.5 | 69 | 11.3 | 1,703 |
| 1981 | 23.9 | 204 | 54.8 | 6.3 | - | 49 | 15.7 | 626 |
| 1982 | 5.5 | 54 | 4.3 | 0.8 | - | - | 2.4 | 88 |
| 1983 | 28.4 | 90 | 2.0 | - | - | - | 5.5 | 61 |
| 1984 | 13.5 | 36 | - | - | - | - | 2.3 | 7 |

[1] Mean number per tow, (SCR 85/27).
[2] Abundance (millions of squid) for 18 standard strata (SCR 85/VI/27).
[3] Mean number per tow.
[4] Tons per dory season, inshore (SCR 83/VI/38).
[5] Tons per day fishing, offshore (SCR 81/VI/37).
[6] Biomass estimates (000 tons) (SCR 82/VI/22).
[7] Catch rates and fishing effort for offshore fishing fleets (85/VI/26).

ii) Distribution (SCR Doc. 85/25, 27, 69)

In March 1984, squid were virtually absent from Div. 4VWX but a small aggregation was observed in Subdiv. 5Ze on the northeast corner of Georges Bank. By July, squid had migrated to the western and central areas of the Scotian Shelf and were much more widely dispersed than during the same period in 1983, having a distribution very similar to that seen in most years. This general distribution pattern remained essentially the same throughtout September and October, with the exception that squid distribution extended into the Bay of Fundy by October. Catch rates were consistently low, indicating no major concentrations. Commercial and research data for Subarea 3 in 1984 indicated that squid were in extremely low abundance both inshore and on the Grand Bank.

The mean bottom temperature (7.3°C) on the Scotian Shelf during the July 1984 groundfish survey was the highest recorded in the 1972-84 time series of surveys. Although bottom temperature had previously appeared to be correlated with squid abundance, the analysis of large-scale density patterns in relation to bottom temperatures indicates no clear relationship. Some preference for higher temperatures (>6°C) does appear to exist, but marginally lower temperatures do not appear to be limiting. Low squid abundance in inshore Newfoundland waters during 1984 was also not obviously related to inshore water temperatures, because the temperature at Holyrood reached about 16°C in late August and remained above 5°C until at least November.

Investigations of the distribution of larval and juvenile Illex (believed to be Illex illecebrosus) between Cape Hatteras and southern Florida showed a wide distribution of these early life stages in the Gulf Stream Frontal Zone. Distributional patterns, in conjunction with oceanographic and length-frequency data, indicate that a major spawning area exists in the Cape Canaveral area. The data also raise the possibility that other spawning areas may exist farther to the south in the Gulf of Mexico or the Carribean Sea. Understanding of these distributions is currently hampered by taxonomical uncertainties surrounding the genus Illex.

iii) Biological characteristics (SCR Doc. 85/25, 26, 27, 47, 69)

In 1984, short-finned squid arrived on the Scotian Shelf about 1-2 months earlier than in 1983. Upon their arrival in 1984, they were larger than the first arrivals in 1983 but were similar in size to those observed in the same period during 1978-82. The distinct bimodality, observed in July 1984, has not been regularly observed during this time of the year, although it is common in September-October. Squid captured in a research survey on Grand Bank and St. Pierre Bank during late June 1984 were considerably smaller than those seen in previous years and much smaller than those

taken on the Scotian Shelf during the same period. Their size range and mean corresponded closely with those of the second cohort which was observed in the Scotian Shelf population during July 1984. As is often seen, the abundance of the second modal group of the Scotian Shelf population had increased by October and gained a relative abundance over that of the first modal group, likely as a result of emigration of the larger squid. Maturities of squid on the Scotian Shelf during 1984 were much less advanced than those observed during 1980-83 (except those of 1982, which were essentially the same as those for 1984). The length frequency pattern of females in September 1984 was similar to that observed in 1983 when maturation of females was much more advanced than in 1984. This indicates that the relationship between reproductive state and somatic growth may vary considerably from year to year.

Knowledge of the larval and juvenile distributions of Illex sp. in relation to water masses over the Blake Plateau was significantly advanced during two cruises in which more than 500 type "C" larvae and 1,200 Illex juveniles were captured. The capture of newly-hatched larvae (about 1 mm ML) from mid-December 1984 to late January 1985 provided further evidence of a protracted spawning period in the area south of Cape Hatteras.

The large size of the larval collection from these cruises holds promise for resolution of taxonomic questions which are critical to the species identification. A study of morphological changes with growth of larval, transitional and juvenile Illex illecebrosus showed that the tentacular index, often used as a taxonomic character, is highly variable and is very unsatisfactory for this purpose. This study also examined chromatophore patterns on the dorsal surface of the head as a taxonomic character and the use of head width as opposed to mantle length as a more consistent and reliable length measurement.

c) Catch projections

No new information was available for prediction of squid biomass in 1986. Therefore STACFIS has no reason to change its advice from that which was formulated in 1980 (NAFO Sci. Coun. Rep. for 1979-80, pages 39-40 and 57-59) and advises that the TAC for 1986 should remain at 150,000 tons.

d) Future research requirements

Because an understanding of the basic life history and stock characteristics of Illex illecebrosus is important to the future management of this resource, STACFIS

recommends

*i) continuation of larval-juvenile surveys to identify spawning areas and factors influencing recruitment of squid to the fisheries;*

*ii) continuation and expansion of larval-juvenile surveys in the northern areas off Georges Bank, Scotian Shelf and the Grand Bank to more adequately cover the distributional range of squid between approximately 70°W and 50°W; and*

*iii) adoption for the surveys of opening and closing gear and improved oceanographic instrumentation in order to more clearly define distributions relative to water masses and Gulf Stream dynamics.*

21. Shrimp in Subareas 0 and 1 (SCS Doc. 85/2, 8)

The shrimp stocks in Davis Strait and Denmark Strait were assessed and advice for the fishery in 1985 were given by the Scientific Council at its meeting in January 1985 (SCS Doc. 85/2). Requests by Denmark (on behalf of Greenland) and by Canada for advice regarding the 1986 fisheries were received for consideration at the June 1985 Meeting. As in the past, STACFIS, for various reasons, recommended that the matter be deferred to an interim meeting (January 1986).

The Scientific Council was, however, requested by Denmark (on behalf of Greenland) to provide additional advice to that in its January 1985 report. The background for the request is the technical measure, established by the Greenland Home Rule Government, to the effect that shrimp which weigh 2 g or more must not be discarded (SCS Doc. 85/8). STACFIS, while not in a position to fully answer the questions at the present meeting due to insufficient data, provides the following advice, pending further discussion of the matter at its interim meeting.

a) The catches which are given in the January 1985 report (SCS Doc. 85/2, table 8) are intended to be total catches. However, although some discards are included, it seems evident that actual total discards are considerably higher. STACFIS is presently not in a position to estimate total discards.

b) Although some commercial samples are available, the uncertainty as to whether they represent actual catch or utilized part of the catch makes it impossible for STACFIS to advise on the size distribution of the catches, especially so far as small 2-5 g shrimp are concerned. STACFIS is expected to have better data available at its interim meeting.

c) If the regulation is properly adhered to for any given TAC, total removals by fishing should be lower than they would otherwise be with the present fishing pattern. A more specific answer requires a much better data base, especially information on length-weight composition of catches by area and season.

d) Mesh size regulation can minimize the catch of small shrimp. However, under the present circumstances with a mesh size regulation (40 mm) already in effect, STACFIS did not find it possible to provide further advice at this meeting and deferred the matter to its interim meeting in early 1986, pointing out the necessity for selectivity data. No data were available which indicate practical possibilities for introducing closed areas (nursery grounds) in the offshore area, but the matter will be kept under consideration as far as data allow.

e) In view of the various uncertainties and the lack of proper data, STACFIS is not in position to reconsider the advice already given for 1985, and therefore reiterates that the overall TAC for the offshore grounds in Subarea 1 and the adjacent parts of Subarea 0 should not exceed 36,000 tons in 1985.

f) STACFIS refers to the recommendations from its January 1985 Meeting, especially with regard to the reporting of discards which should be closely monitored to ensure reliability and consistency with observer reports.

The Committee noted the requests of Canada and of Denmark on behalf of Greenland for advice on management in 1986 of the shrimp stock in Subareas 0 and 1, and the Danish (Greenland) request that advice on shrimp at East Greenland be provided in cooperation with ICES. Considering that annual yields are likely to have a major contribution from recruits of the year and noting the current lack of ability to predict recruitment, STACFIS still finds it more appropriate, at least so far for 1986 is concerned, to assess the stocks and to advise on management at a mid-term meeting, when fishery and research data will be available for the year immediately prior to the year for which advice is requested.

STACFIS did note, however, that TAC advice for 1985, which was provided at the January 1985 Meeting, was based on average catches over a period for which catch rates and stock biomass estimates from photographic surveys indicate a rather stable fishable stock and not on estimates of recruitment in 1985. STACFIS therefore agreed that reconsideration of the justification for a special meeting in January of each year is required, and that this matter should be reviewed at the June 1986 Meeting. It was further agreed that the agenda for the next midterm meeting to deal with assessment of the shrimp stocks should include the following items: (i) if quantitative estimates of recruitment are not available for 1986, when can STACFIS expect to have the information on which to base recruitment predictions? and (ii) how big a change in assessment parameters, in particular commercial catch rates and photographic survey estimates of stock size, and recruitment estimates if such should be derived, would be required before this would be interpreted as indicating a significant change in stock abundance, and how might advice on the TAC change as a result?

## III. ENVIRONMENTAL RESEARCH

### 1. Introduction

The fourth meeting of the Subcommittee on Environmental Research was held at the Bedford, Institute of Oceanography, Dartmouth, Nova Scotia, during 10-11 June 1985, with M. Stein (EEC) as Chairman. The detailed report is at Annex 1 but a brief summary follows.

### 2. Review of Environmetnal Studies in 1984

A total of 19 documents referred to environmental conditions in Subareas 1-6 during 1984. Colder-than-normal conditions occurred in the West Greenland, Labrador and Grand Bank areas, whereas temperatures over the continental shelf south of New England were generally higher than normal and the highest positive anomalies during October-December coincided with the presence of a Gulf Stream ring along the slope. It was hypothesised that the two coldest years from more than 20 years of observations at Fyllas Bank (West Greenland) (1972 and 1983) were linked to El Niño-type events through large-scale atmospheric circulation.

### 3. Overview of Environmental Conditions in 1984 (SCR Doc. 85/74)

As a continuation of a project which began in 1983, the 1985 presentation provided an overview of (i) sea-surface temperature data from Chesapeake Bay to Labrador, the Labrador Sea and the

Cape Farewell area, (ii) effects of warm-core rings on surface waters off the southern Scotian Shelf, (iii) sea-ice formation and icebergs, and (iv) meteorological observations on air temperatures and sea-surface pressure. Air temperature anomalies were below normal off Baffin Island, northern Quebec, Labrador and northern Newfoundland, whereas the southern parts of the NAFO area were warmer than normal. Anomalous high pressure systems over the North Atlantic led to anomalous southerly winds over the southern part of the NAFO area.

4. Influence of Environmental Factors on Distribution, Movements and Migrations of Marine Species in the Northwest Atlantic

It was noted that the responses to a letter from the Chairman of STACFIS, requesting information from scientists involved in NAFO stock assessment work, did not fully reflect the extent of the problem. To provide a more extensive review of the problem of environmentally-induced variation in catchability and the effects of such variation on stock assessments, a small working group was formed. The task of this group would be to further develop knowledge on the topic and report their findings to the June 1986 Meeting.

5. Special Session on Recent Advance in Understanding Recruitment Mechanisms

With regard to the theme for the Special Session in September 1986, four areas of focus for the Flemish Cap and Georges Bank studies were outlined: (i) environmental aspects pertaining to circulation and retention of fish eggs and larvae, (ii) food and feeding of larvae relating to survival, (iii) predation on juveniles relating to survival, and (iv) stock effects of growth, maturity and fecundity relating to recruitment as abundance varies. It was agreed that contributions to the Special Session should concentrate on these topics.

## IV. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Shrimp Ageing Workshop

At its meeting in September 1984, STACFIS recommended that participants in the 1981 Shrimp Ageing Workshop be contacted in early 1986 to see if there has been sufficient progress to warrant another Shrimp Ageing Workshop. This earlier recommendation was reaffirmed at this meeting.

2. Ageing Studies of Silver Hake (SCR Doc. 85/66)

Independent ageing of silver hake by USSR and Canadian researchers has resulted in different estimates of age composition. To identify sources of disagreement, otolith samples have been exchanged on a regular basis since 1982. The results of a study conducted in 1984 indicated that the initial agreement in ageing the otoliths was 74%. After comparing the result of that study and reexamining the Canadian age readings, overall agreement was increased to 82%. Agreement for ages 1 and 2 was 100%, but agreement for ages 3-7 was variable and indicated that the USSR ageing usually resulted in the fish being aged 1 or 2 years higher than in Canadian ageing. Apparently, most ageing differences were attributed to interpretation of the growth rings near the edge of the otolith. STACFIS was encouraged by the high level of agreement between Canadian and USSR age readers for young fish, but urged that investigation of differences in age interpretation of age 3+ fish should be continued.

## V. REVIEW OF SCIENTIFIC PAPERS

1. Estimates of Discards in the Newfoundland Offshore Fleet (1983) (SCR Doc. 85/75)

In the third year (1983) of a long-term study of discarding patterns (discarding refers to selective removal of undersized, damaged or otherwise unmarketable fish) for the Newfoundland offshore fleet, several trends were identified. An increase in the rate of discarding was apparent for those species caught in the Div. 2J+3KL cod fishery. There was a five-fold increase in discarding of redfish in Div. 2J and 3K over that of the previous year. The observed 12% discard rate for American plaice in Div. 2J and 3K in 1982 and 1983 was up significantly from that of 1981. Discarding of cod in this fishery has also increased. Discarding of cod showed a substantial decrease in Div. 3NO, but remained low and stable in most other fisheries.

2. Age-specific Natural Mortality in Silver Hake Due to Cannibalism (SCR Doc. 85/77)

An expanded VPA model was developed to incorporate cannibalism as a 'defined' portion of natural mortality (M) for silver hake on the Scotian Shelf. The residual M for all age-groups was estimated to be 0.15. The mortality due to cannibalism ranged from 0.7 to 1.8 for age-groups 1 to 3 respectively with a subsequent decrease to almost zero for older fish. These values lead to estimated population structures that are very strongly skewed toward the younger age-groups.

STACFIS has strong reservations concerning the high estimated levels of mortality due to cannibalism. These values suggest survival rates of only 3% to age 4. As a result, the estimates of numbers at ages 1-3 in this VPA are several orders of magnitude greater than numbers indicated in routine VPAs. Concern was also expressed that mortality due to cannibalism increased for ages 1 to 3 and than declined to almost zero at age 4 because this trend seemed unrealistic. However, STACFIS urged that the work should be continued.

3. Effect of Changing Effort Pattern in the Roundnose Grenadier Fishery (SCR Doc. 85/16)

Previously, the decline in grenadier catches had been attributed to a decrease in stock abundance and a shift, with increasing age, in the distribution of Greenland halibut to greater depths, thus leading to increased overlap in the distribution of these species. Consequently, by-catches of Greenland halibut increased beyond the 10% by-catch limitation which hindered the directed fishery for roundnose grenadier in areas of significant overlap. This study confirmed a general outward shift in the distribution and center of abundance of Greenland halibut but also identified a third factor (effort location) as affecting both levels of by-catch and catch rate of the directed species. Depth and area fished were found to be related to by-catch levels of both Greenland halibut and redfish. As such, the observed substantial shift in effort location from 1978 to 1983 caused considerable variability in species mix and catch rates in the roundnose grenadier fishery. The study indicated lower by-catches of Greenland halibut in the south, lower by-catches of redfish in the north, and lower levels in general with increasing depth for the above two species. Catch rates of grenadier generally declined in depths less than about 750 m.

4. Opening Date of the Scotian Shelf Silver Hake Fishery (SCR Doc. 85/78)

To minimize by-catch of mature haddock which were thought to be spawning seaward of the small-mesh-gear-line in March and early April, an opening date of 15 April for the Scotian Shelf silver hake fishery was established in 1977. An experimental fishery by Cuban vessels to evaluate an opening date of 1 April for the silver hake fishery was initiated in 1984 and continued in 1985. Haddock catches were well below the 1% by-catch level in both years (0.3% in 1984 and 0.01% in 1985). Other species such as cod, pollock and redfish were all below the regulated 10% by-catch level in both years. At present, the low by-catches of haddock and other finfish, together with the relatively good catch rates for silver hake during the April 1-14 period, indicates that the opening date for this fishery could be advanced from 15 April to 1 April. However, STACFIS was informed that the haddock stocks on the Scotian Shelf are at low levels and that by-catches of this species could increase as the stocks recover.

5. Arctic Cod in Divisions 2J, 3K and 3L (SCR Doc. 85/42)

Estimates of abundance of Arctic cod (Boreogadus saida) were obtained from Canadian research vessel surveys, which have been conducted in Div. 2J since 1977, Div. 3K since 1978, Div. 3L in the spring during 1971-82 and in the autumn of 1971 and since 1981. Estimates of abundance and biomass in Div. 2J ranged from 6.6 million to 75.4 million fish (200-1,000 tons). They were most abundant in strata with depths ranging from 101 to 300 m. Abundance and biomass estimates for Div. 3K showed considerable fluctuations over the time period surveyed, ranging from less than 1 million to 26 million fish (18-974 tons). In this division, Arctic cod were most abundant on the coastal shelf of northern Newfoundland and the inside slopes of Funk Island Bank. Estimates of abundance and biomass from spring and autumn surveys in Div. 3L were lower than those in Div. 2J and 3K. In some years, peaks in biomass in Div. 2J corresponded to troughs in Div. 3K, and vice versa. A possible explanation was the year-classes migrated from one division to another. This could be investigated further if available ageing data were analyzed.

6. Arctic Cod in Divisions 2G and 2H (SCR Doc. 85/41)

Estimates of minimum trawlable biomass of Arctic cod (B. saida) in Div. 2G and 2H were determined from post-stratified Canadian research vessel transect surveys in 1978, 1979 and 1981. For Div. 2G, estimates declined from 584,000 tons in 1978 to 101,000 tons in 1979 and to 47,000 tons in 1981. For Div. 2H, estimates fluctuated from 550 tons in 1978 to 3,500 tons in 1979 and to 640 tons in 1981. Arctic cod were most abundant in depths of 101-200 m, with few fish being taken deeper than 300 m. It is considered that bottom trawling may not be a particularly effective method for surveying this species because large quantities have been detected in the water column up to 50 m from the bottom. A more effective method would be the use of acoustics and some otter-trawling at selected stations to obtain samples.

7. Parasitic Fauna of American Plaice (SCR Doc. 85/58)

American plaice from several areas of the Northwest Atlantic (Hamilton Inlet Bank, Ritu Bank, Grand Bank and Flemish Cap) were examined for parasite infestation. Twenty species of parasites were recorded. Differences were noted both in the specific parasite composition and in the degree of infestation from different areas. The study appears to confirm the previously-published conclusion that American plaice from the four areas noted above belong to separate groups with very limited intermingling beyond the larvae stage.

8. Spiny Dogfish off Northeastern United States (SCR Doc. 84/105)

Analysis of American bottom-trawl survey data for 1968-83 indicates a change in the size composition of the spiny dogfish population. Large female dogfish (>100 cm total length) were rare in the late 1960's and early 1970's but were frequently observed in more recent surveys. Also, the abundance of juvenile dogfish (≤35 cm, ages 0-1) has increased in recent years. Abrupt annual changes in abundance indices are believed to be related to availability, seasonal changes in dogfish distribution or timing of the surveys. Preliminary estimates of food consumption indicated that a significant component of the diet of large dogfish (>60 cm) is fish (about 70%), particularly sand lance and Atlantic mackerel. Squid (Illex and Loligo) accounted for about 19% of the diet of smaller dogfish (≤60 cm).

9. Benthosema glaciale on the Southern Grand Bank (SCR Doc. 85/57)

The length and age composition of glacier lanternfish (B. glaciale) on the southern Grand Bank were examined from data collected during USSR research vessel surveys in 1982-85. Standard lengths were measured to the nearest millimeter and age determinations were made from otoliths. Although the age composition was composed of age-groups 2-5, age-groups 3 and 4 were dominant in the catches with respective mean lengths of 5.2 to 6.3 cm. The lack of 1-year-old fish in the catches was believed to be related to trawl selectivity. STACFIS encourages such studies on non-commercial species and welcomes further analysis on larval data in order to identify spawning and nursery areas.

## VI. OTHER MATTERS

1. Combined Assessment of the Cod Stocks at West and East Greenland

The cod stock at West Greenland (NAFO Subarea 1) is closely related to that at East Greenland (ICES Subarea XIV). Considerable migration of cod from West Greenland to East Greenland and further to Iceland has been observed. On the other hand, drift of larvae from Iceland and East Greenland contributes to the recruitment of the West Greenland stock in varying quantities. Assessing the two stocks simultaneously would result in a better understanding and evaluation of the stock interactions and their influence on the state of the stocks. This can be achevied by an extended meeting of the ICES Working Group on cod stocks off East Greenland, which usually meets in January in order to provide management advice for the current year.

The combined assessment could be presented to STACFIS as a research document at the June meeting, together with the usual projections for the West Greenland stock. ICES would receive the same assessments together with management considerations for the East Greenland stock in the format of an ICES working group report. This arrangement does not require any administrative action by the NAFO Secretariat.

2. Special Session on Design and Evaluation of Biological Surveys in Relation to Stock Assessments

The Special Session of the Scientific Council will be held during 4-6 September 1985 at the Bedford Institute, Dartmouth, Nova Scotia, Canada, in advance of the Scientific Council Meeting which will be held in conjunction with the 7th Annual Meeting of NAFO in Havana, Cuba, on 9-13 September 1985. Titles and abstracts of 35 potential contributions have been received and accepted. Authors have been informed accordingly and have been requested to submit completed manuscripts to the NAFO Secretariat by 20 August 1985. The contributions cover fairly well the range of topics in the agenda for the Special Session.

3. New Arrangements for Conducting Stock Assessments

A review of the arrangements which were initiated at this meeting for conducting the stock assessments was deferred to the September 1985 Meeting due to lack of time.

4. Acknowledgements

Before adjourning the meeting, the Chairman thanked the participants for their support in making this meeting a successful one and expressed his appreciation to the Secretariat for their help.

ANNEX 1. REPORT OF SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH

Chairman: M. Stein Rapporteur: K. Drinkwater

The Subcommittee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 10-11 June 1985, to consider environmental-related topics and report on various matters referred to it by STACFIS. Scientists attended from Canada, Cuba, Denmark (Greenland), EEC (Federal Republic of Germany and France), Japan, Portugal, Spain, USA and USSR.

The Subcommittee reviewed the following documents: SCR Doc. 84/95; 85/17, 18, 19, 20, 21; 22, 23, 24, 29, 30, 31, 45, 56, 59, 60, 61, 62, 69, 70, 71, 72, 74; SCS Doc. 85/16, 17. In addition, undocumented presentations were made by several participants.

1. MEDS Report for 1984/85 (SCR Doc. 85/71)

a) Data collected in 1984

It was reported that approximately 8,400 oceanographic stations were occupied within the NAFO area during 1984, of which data for 2,900 were sent directly to MEDS while data for another 1,700 were received through IGOSS. Only Canada and the USSR sent data directly to MEDS. Cruise tracks of the processed data were presented in the report together with contoured plots of temperature and salinity along NAFO standard sections. MEDS has become operational in the processing of CTD data during the past year and it is expected that this will result in a significant rise in the data acquisition rate in the following years.

b) Historical data holdings

Data were received from over 7,500 historical stations during 1984, a substantial increase from the previous year's total of only 800. Overall, MEDS now has data for approximately 220,000 stations throughout the NAFO region, with the majority covering the southern subareas. A list of hydrocast and BT stations by NAFO subarea and month was provided in the report. Almost all of the 1983 data that were identified but not received at the time of the June 1984 meeting still are outstanding.

c) Review of environmental conditions

A review of temperature and salinity conditions in the NAFO region was undertaken by MEDS on the basis of available cruise data for 1984. Data within 1° squares were averaged seasonally, and anomalies from climatological means in the Levitus Atlas were calculated at four depths from 0 to 500 m. The data suggested colder-than-normal surface water throughout most of the year in the Labrador Sea, and over the continental shelves from the Labrador Shelf to the Mid-Atlantic Bight. In the region of the Gulf Stream eastward of 40°W longtitude, temperatures were slightly above normal. Although less salinity data were available, there was an indication of fresher-than-normal water throughout the year over the Scotian Shelf and the Grand Bank. In general, the subsurface conditions were found to reflect those at the surface.

2. Review of Environmental Studies in 1984

a) Subareas 0 and 1 (SCR Doc. 85/17, 29, 30, 31, 61, 62)

Colder-than-normal conditions occurred in this region during most of 1984, continuing a trend that began in 1982. Autumn water temperatures on Fyllas Bank, were slightly warmer than at the same time in 1983, but still 1984 was one of the coldest years since measurements began in 1950. Monthly mean air temperatures for January and February 1984 were about 12°C below normal and were the lowest on record in over 100 years. Heavy ice conditions were reported for the winters of 1982/83 and 1983/84. Although severe conditions were also predicted for the winter of 1984/85, a change in meteorological conditions prevented extensive ice formation that resulted in a light ice year. It was noted that the two coldest periods in over 20 years on Fyllas Bank occurred in 1972 and 1983, a time when two strong El Nino-type events occurred in 2 successive years in the South Pacific Ocean. It was suggested that the linkage is through large-scale atmospheric circulation.

High-frequency (hourly) variability in temperature and salinity was investigated on Fyllas Bank. The variability in the deep layers was of tidal origin, whereas wind through horizontal advection resulted in variability in the surface layers. An investigation of the water characteristics in the Deep Labrador Sea identified Labrador Sea water to a depth of almost 2,000 m, which had formed by convection during the previous winter.

Factors influencing the year-class strength of cod off West Greenland were also investigated, including temperature, density stratification, larval abundance and spawning stock biomass. Temperature provided the best index, although larval abundance was loosely correlated with the year-class strength of cod. No connection was observed between density stratification and spawning stock or year-class strength of cod.

b) Subareas 2 and 3 (SCR Doc. 85/56, 59; SCS Doc. 85/16)

Very cold conditions relative to the 1964-84 mean were reported along southern Labrador and on the northern and eastern slopes of the Grand Banks in the spring and summer of both 1983 and 1984. Intrusions of cold (below zero) Labrador Current water were observed, for the first time since 1960, along the northern and eastern slopes of Flemish Cap during April-July 1984. Autumn temperatures and salinities on the southern Labrador Shelf were the lowest since observations began in 1964. Along the southern Grand Bank, temperatures were higher than normal in 1983 and 1984. Surface dynamic topography showed the Labrador Current along the slope and a large anticyclonic circulation over the southern Grand Bank. Over the Flemish Cap, the circulation in summer was indicated to be cyclonic, which was opposite to the mean conditions and which occurred only once before in the 1977-83 period. In a study by USSR scientists, the composition and content of dissolved organic matter was suggested as an index of production and useful for indicating fish concentrations. French scientists reported results from winter and autumn cruises in Subdiv. 3Ps, indicating rapid cooling from spring to autumn in 1984.

c) Subareas 4, 5 and 6 (SCR Doc. 85/18, 19, 20, 21, 22, 23, 24, 60)

Ongoing environmental studies by the USA were presented in seven documents. The shelf-slope front during 1984 was positioned near its long-term mean (1974-83). Much of the variability in frontal locations off Georges Bank (Div. 5Ze) was due to the effects of warm-core rings. The number of rings formed in 1984 west of 60°W was eight, one less than long-term mean. The average lifetime of the rings was slightly over 3 months (compared to a mean of 4 months), and the total number of ring-months was the second lowest in over 10 years. Bottom temperatures over the continental shelf south of New England were generally higher than normal and the highest positive anomalies during October-December coincided with the presence of a Gulf Stream ring along the slope. Temperature, salinity and Continuous Plankton Recorder data collected from ships of opportunity were reported along transects across the Gulf of Maine and the New York Bight. Compared to the 1961-84 period, the monthly means of "total phytoplankton" for each transect were similar with above-normal values which were highest in October-November. The means of "total copepods" in the Gulf of Maine were well below normal for the second year in a row. The thermal structure across the Mid-Atlantic Bight off New Jersey was presented. Sea surface temperature (SST) data off southwest Nova Scotia, in the Gulf of Maine and on Georges Bank from ships of opportunity showed no consistent anomaly patterns throughout the year relative to the base period (1948-1967). However, high positive anomalies were noted off southeastern Nova Scotia in June and August. In the Mid-Atlantic Bight, negative anomalies were observed in January, February and July. Water temperatures on the Scotian Shelf were measured by USSR scientists from 1977 to 1984 as part of studies on silver hake spawning. Surface temperatures in 1984 were the lowest recorded during that period, whereas subsurface temperatures were generally higher than average.

3. Overview of Environmental Conditions in 1984 (SCR Doc. 85/74)

The overview paper consisted of a summary of data from available documents and annual reports and presented additional oceanographic and meteorological data sets. Highlights not covered in Section 2 above include the following:

a) Coastal SST data from Subareas 4 and 5 showed near-normal annual means relative to 1951-60.

b) Offshore SST data from ships of opportunity showed negative annual anomalies in the Labrador Sea and Subarea 1, positive anomalies over the continental shelves from the Labrador Shelf to the Mid-Atlantic Bight and negative anomalies in the Gulf Stream and the western Slope Water. The positive anomalies declined sharply from 1983, however.

c) At Station 27 off St. John's, Newfoundland (Div. 3L), subsurface temperatures were lower than normal relative to 1946-77 for the third consecutive year, similar to conditions off West Greenland. Surface salinities were lower than normal for the second year in a row, and the mid-summer salinities were some of the lowest ever recorded.

d) Warm-core rings entrained large quantities of surface water off the southern Scotian Shelf (Div. 4WX) during September-November.

e) Wave heights and frequency of large waves continued to decrease rapidly over the Scotian Shelf and the Grand Bank from peaks in the early 1980's. In the Labrador Sea, the frequency of large waves increased over 1983 but was still less than that of the peak in 1982.

f) Ice formed early and left late off northeastern Newfoundland and over the southern Labrador Shelf.

g) The number of icebergs crossing 48°N latitude in 1984 was the highest in over 100 years. This is partially a result of new observational techniques using Side Looking Airborne Radar (SLAR). Intercalibrations of SLAR with former visual methods are needed before a true relative comparison can be made between present and past iceberg statistics.

h) Annual air temperature anomalies were below normal off Baffin Island, northern Quebec, Labrador and northern Newfoundland, and above normal in the southern NAFO regions, but in neither case did anomalies exceed one standard deviation.

i) During winter, spring and summer of 1984, anomalously high pressure systems dominated the atmospheric circulation patterns over the North Atlantic. These produced anomalous southerly winds over the southern NAFO regions. In the autumn, a strong low pressure anomaly developed over the eastern North Atlantic.

Differences in SST anomalies reported in SCR Doc. 85/23, 71 and 74 were noted in discussions. Such differences most likely arise from using different climatological means and point to the necessity of using a common base period. If a commmon base period is unavailable, the source of the climatological means or its base period must be clearly stated.

4. Remote Sensing Activities at Bedford Institute of Oceanography (BIO)

A new VAX-750 image analysis system was installed at BIO during the past year and several scientific programs are presently underway. Thermal imagery (NOAA TIROS satellite) for the east coast of Canada is being recorded at the Atmospheric Environment Service (AES) in Downsview, Ontario, and the data are stored at BIO for use by scientists. Two direct remote-sensing experiments were undertaken during the past year. The first was designed to compare the active NASA Airborne Oceanographic Laser system with the passive Canadian Fluorescence Line Imager. A second project provides wave and current data for ground-truthing scatterometers and airborne SAR (Synthetic Aperture Radar) systems.

5. Synoptic Sea-Surface Temperature (SST) Maps

Three SST maps which are rountinely available for the NAFO region south of 50°N were briefly discussed. Weekly SST maps, covering the region from Cape Hatteras to northern Newfoundland, are provided by the Canadian Forces METOC Center in Halifax. They are primarily based on data from ships of opportunity, but use of satellite imagery has improved this product during the last year. For the same area, Oceanographic Analysis Maps, based on infrared satellite imagery and data from ships of opportunity, are published at a rate of 3 per week by the U.S. National Weather Service. These are the best SST maps available and are particularly useful for cruise planning and information on Gulf Stream rings, shelf-slope fronts, Gulf Stream position and Shelf Water entrainment by rings. For the Bay of Fundy and Scotian Shelf regions, AES provides SST maps from enhanced infrared imagery, but, at present, these are produced only once per month.

6. Environmental Aspects of the Flemish Cap Project

The Environmental Subcommittee considered three separate topics relevant to the Flemish Cap Project.

a) Contributed studies

The Committee first considered SCR Doc. 84/95, which had been deferred from the September 1984 meeting. This paper contained the results of USSR ichthyoplankton surveys in the Flemish Cap area during the spring-summer period of 1978-81 and 1983. Redfish larvae dominated the samples. The spawning period covered March to May, with peaks in late April, and the area extended along the southwest slope of the bank around to and including the northern slope at depths of 350-800 m. A second peak in spawning occurred in July-August. The timing and peak abundances were similar to previously-published Canadian data (Anderson, 1984)[1]. Newly-extruded larvae tend to concentrate near surface, and it was suggested that they are entrained onto the center of the bank by the anticyclonic circulation pattern. The paper hypothesized that year-class

[1] ANDERSON, J. T. 1984. Early life history of redfish (*Sebastes* spp.) on Flemish Cap. Can. J. Fish. Aquat. Sci., 41: 1106-1116.

strength of redfish, as well as cod and American plaice, will be low during those years when the anticyclonic gyre breaks down. Results from a spring 1984 survey were also presented (SCR Doc. 85/45). It was noted that pre-1984 larvae measurements were total lengths, whereas those of 1984 were standard lengths. As the Canadian data are generally given in standard length, it was suggested and agreed upon by the USSR scientists that a conversion factor relating total to standard length be provided. The issue of larval retention on Flemish Cap led to the recommendation that station-by-station length-frequencies be examined to determine the possible extent of larval retention. The issue of comparability of sampling between Canadian and USSR researchers was raised. The USSR scientists indicated that they are presently working on data pertaining to this question.

The results from cod stomach analyses undertaken since 1978 (SCR Doc. 85/72) indicated that redfish comprised a significant component of the cod diet, up to 90% in large cod. The size composition of the redfish in the stomachs was a function of cod size with larger cod eating larger, and hence older, redfish. In general, however, the total biomass of consumed redfish decreased with increasing size. From the stomach analyses, laboratory results on digestion rates for capelin, and total cod biomass estimates, it was suggested that the cod could consume within a few days all of the juvenile redfish based on estimates from trawl surveys, implying that present juvenile redfish abundances may be underestimated.

b) Review of activities by country

Canadian scientists noted that the winter stratified-random groundfish survey, begun in 1977, was again conducted in February of both 1984 and 1985. Routine hydrographic data were also collected in both years with measurements in August and during the groundfish survey in winter. The larval fish surveys ended in 1982. The USSR scientists indicated that their work on the Flemish Cap would continue, including the collection of hydrographic data.

c) 1986 Special Session on "Recent Advances in Understanding Recruitment Mechanisms"

The final item dealt with proposed presentations for the Special Session in September 1986. In review, it was outlined that initially there are four areas of focus for the study: environmental aspects pertaining to circulation and retention of fish eggs and larvae; food and feeding of larvae relating to survival; predation on juveniles relating to survival; and stock effects of growth, maturity and fecundity relating to recruitment as abundance varies. It was suggested that contributions to the Special Session concentrate on these topics, aiming at a synthesis of existing information relating to recruitment. It was noted that any analyses of the adequacy of the study design would be welcomed. It was further suggested that the analyses of new data be submitted to the Scientific Council by June 1986 so that this information will be available to analysts prior to the September 1986 Special Session. It should be noted that the reports of the Larval Herring Task Force will be incorporated into the 1986 Special Session.

7. Distribution of Squid Larvae and Juveniles in Relation to Oceanography

The results from two cruises in December 1984 and January 1985 (SCR Doc. 85/69), to investigate the distribution of squid larvae and juveniles at the western edge of the Gulf Stream in the vicinity of and to the south of Cape Hatteras, were described with emphasis on the physical oceanography. During December, the highest abundances of squid larvae were observed near the topographic feature known as the Charleston Bump. In an across-stream transect, a prominent upward doming of the isotherms was observed inshore of the Gulf Stream. A peak in abundance of squid larvae was observed in this feature, but it is unknown if the larvae were concentrated there because of increased production from the upwelling or if these larvae were simply associated with the particular water mass and more of them were brought into the sampled depth range by the upwelling. The fronts between the Gulf Stream, the Slope Water and the Shelf Water were highly convoluted and indicated the presence of cyclonic cold-core frontal eddies. During the January cruise, the Slope Water-Gulf Stream front was sharply defined north of Cape Hatteras, and the few larvae that were caught were in the frontal zone. Near the Charleston Bump, the upward doming of the isotherms was again observed, although confined to depths below 50 m. Again, squid larvae concentrations were highest over this region.

8. Other Environmentally-related Work on Squid and Other Species

No papers were submitted and no discussion arose under this topic.

9. Influence of Environmental Factors on Distribution, Movements and Migrations of Marine Species in the Northwest Atlantic

At last year's meeting STACFIS agreed with an *ad hoc* working group set up by the Environmental Subcommittee that environmental effects on migration and distribution were important problems in fisheries and merited further research. To help achieve progress and narrow the scope, it was agreed to concentrate on environmental aspects relating to availability that were relevant to stock assessments. It was therefore decided (i) to compile a bibliography of historical studies on availability problems in the Northwest Atlantic, (ii) to solicit contributions on availability-related problems from scientists involved in NAFO stock assessments, and (iii) that the topic would be included as part of the Special Session on Biological Surveys. Item (iii) was agreed upon by the Scientific Council last year. Item (i) was assembled and presented in SCR Doc. 85/70. The bibliography consisted of 65 ICNAF and NAFO publications (other than meeting documents) and 52 papers from other literature sources back to 1977. It was noted in discussion that only about half of the 117 papers actually dealt with catchability and that half of the ICNAF/NAFO papers had appeared in the ICNAF Spec. Publ. 6 in 1965. The low number of papers was considered to reflect how little we know of the problem. Item (ii) was considered in the form of responses to a letter from the Chairman of STACFIS requesting information from scientists involved in NAFO stock assessment work. Availability was felt to be a problem with some stocks. Views were expressed that the responses alone did not fully reflect the extent of the problem or examine it closely enough. R. Halliday and A. Pinhorn of Canada, M. Grosslein of the USA (or a substitute Woods Hole representative) and the Chairman of the Environmental Subcommittee (M. Stein) agreed to provide a more extensive review of the problem of catchability, especially of environmentally-induced variations to stock assessments, and to report their findings at the June 1986 Meeting. The Chairman suggested additional members could be added if the designated members felt it was needed.

10. National Representatives

The Subcommittee was informed of no known changes in national representatives responsible for submitting oceanographic data to MEDS. The present list comprises: R. Keeley (Canada), R. J. Dominguez (Cuba), E. Buch (Denmark), M. Melguen (France), D. Kohnke (Federal Republic of Germany), B. Schreiber (German Democratic Republic), S. Kawahara (Japan), R. Leinebo (Norway), S. Grimm (Poland), G. I. Luka (USSR), P. Edwards (United Kingdom), and E. Ridley (USA).

11. Other Matters

a) International Recruitment Experiment Project (IREP)

The Director-General of the Bedford Institute of Oceanography (A. Longhurst) provided an update on IREP. The project, as originally planned, was to undertake short-term experiments on sardine-anchovy recruitment at several locations and that the use of these results could replace the need for long-term studies at one location. Egg and larval surveys would be carried out, using the La Jolla method, to estimate egg production. This would be followed 6-9 months later with a juvenile survey. The daily ring ageing technique would be used to determine the age of young fish. A committee chaired by A. Bakun was set up to plan details of the experiments and 5 sites (1 off western North America, 2 off western South America, 1 off eastern South America, and 1 off Portugal) were planned. At present the only sardine-anchovy recruitment experiment to be funded is the joint project of the USA and Mexico off California which is scheduled to proceed in 1986. The remaining experiments are seeking funds.

IREP also discussed possible recruitment experiments on other stocks and identified potential sites. These included cod in the Gulf of St. Lawrence and haddock on Georges Bank. It was noted in discussion that the guiding group of experts on the IOC (Intergovernmental Oceanographic Commission) program of Ocean Science in relation to Living Resources (OSLR), recommended "that the conveners of the NAFO Special Session on the Biology and Ecology of Squid (Dartmouth, Nova Scotia, 5-7 September 1984) be contacted by the Chairman to request that this meeting consider an OSLR/IREP-oriented program in elucidating the problems involved in recruitment variability in squid stocks." As a follow-up, an ad hoc working group consisting of T. Rowell, R. W. Trites and R. K. O'Dor has been in contact with the Chairman (A.Bakun) concerning this possibility, and have arranged, with the endorsement of the IOC secretariat, to convene an initial meeting to consider an OSLR/IREP squid program in conjunction with the upcoming workshop/symposium at Banyuls-sur-mer, France, in late June 1985, which is being organized by the Cephalopod International Advisory Committee.

b) Marine Environment and Ecosystems Subcommittee (MEES)

MEES is a subcommittee of the Canadian Atlantic Fisheries Scientific Advisory Council (CAFSAC), and its brief summary of its operation was presented by the Chairman of that subcommittee (R. Mahon). Its mandate is to examine issues relevant to fisheries and to provide advice

to Canadian fisheries management personnel. He stated that MEES is presently concerned with (i) environmental effects on fish recruitment, (ii) interactions between specific stocks (e.g. cod-capelin, haddock-silver hake), (iii) mixed fisheries and the establishment of TACs, and (iv) the connection between biology and socio-economic factors. In relation to (i) a workshop is planned for autumn of 1985 to examine environment-fish relationships and, in particular, to determine how well previously-published models have performed in recent years.

c) NATO Workshop on Freshwater Effects on the Marine Ecosystem

During May 1985, an advanced scientific workshop was held in Norway to review the effects of freshwater runoff on production in the marine environment. K. Drinkwater briefed the Subcommittee on the results. A major recommendation was to investigate the possibility of an international multidisciplinary experiment to examine the effects of freshwater runoff on the physics, biology and fisheries in the Icelandic Coastal Current. The workshop proceedings will be published in book form in October 1985.

12. Acknowledgements

There being no further business, the Chairman thanked the participants for their cooperation and contributions.

APPENDIX II. REPORT OF STANDING COMMITTEE ON RESEARCH COORDINATION (STACREC)

Acting Chairman: D. B. Atkinson Rapporteurs: D. Cross, R. Wells

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 17 June 1985 to consider and report on the matters referred to it by the Scientific Council (see Appendix IV for agenda) dealing mainly with fisheries statistics, biological sampling and biological surveys. Scientists attended from Canada, Cuba, Denmark (Greenland), EEC (Federal Republic of Germany, France, Commission of European Communities and Eurostat), Japan, Portugal, Spain and USSR, and an observer attended from FAO.

## I. STATISTICS AND SAMPLING

### 1. Fishery Statistics

a) CWP activities relevant to NAFO (SCS Doc. 85/3)

The Committee noted the report of the 12th Session of the Coordinating Working Party on Atlantic Fishery Statistics which was held in Copenhagen, Denmark, on 25 July-1 August 1984. Mr. D. Cross, in his capacity as Deputy Secretary of the CWP, reviewed this report and drew the Committee's attention to those items of particular interest to NAFO, notably the detection of discrepancies in statistics held by different international agencies, the compilation of a handbook of fishery statistics, and a manual on fishing logbooks.

The Committee decided that, in order to avoid the situation that arose at the 12th Session of the CWP whereby the designated NAFO member country failed to participate, an additional member country would be designated as an eventual substitute at future sessions. It was agreed that a decision on the composition of NAFO participation at the 13th Session of the CWP, to be held at Rome in February 1987, would be made at the June 1986 Meeting. It was, however, noted that several topics of importance to NAFO (notably the procedures to be adopted to eliminate discrepancies in data bases) were on the agenda of the Inter-Agency Consultation on Atlantic Fishery Statistics to be held in London on 5-6 October 1985, and the Committee stressed the need of participation by the NAFO Secretariat at this meeting.

b) Progress report on activities in 1984/85 (SCS Doc. 85/21)

The Committee noted with regret that the late submission of STATLANT 21B data has continued to delay publication of the Statistical Bulletin. Volume 32 for 1982 was published in December 1984, nearly one year behind schedule. Recently the situation has deteriorated with only 11 of the 24 reporting components of Contracting and non-Contracting Parties complying with the deadline of 30 June 1984 for the submission of 1983 data. Reports for France (M), France (SP) and the United Kingdom were still awaited at the end of June 1985. The Committee thus

recommends

*that the Scientific Council draw the attention of the Fisheries Commission to the deleterious effect of the late submission of STATLANT data on the work of the Council and request that representations be made to all Contracting Parties to respect their obligations under Article VI(3) of the NAFO Convention as to the timely submission of catch statistics.*

c) Updating of fisheries statistics database

The Secretariat reported that the historical series in the data base has been extended back to 1962. The Committee considered these data were valuable and of considerable interest and therefore

recommends

*that the Secretariat arrange for the production in early 1986 of a summary document containing a 22-year time series of catches of selected species by stock and country for the 1962-83 period.*

d) Review of reporting requirements (STATLANT 21A and 21B)

The Committee noted that a change in the Canadian statistical reporting system would result in separate STATLANT reports being submitted for the Gulf region but that the existing time series would not be disrupted because the method of presentation would permit the partition of the data between the former Maritimes and Newfoundland regions.

e) Effort data and pro-rating

The Committee noted that concern was being expressed in some quarters that pro-rating resulting from the non-availability of complete effort data could affect the accuracy of stock assessments. The Committee decided that, as a first evaluation of the situation, the Secretariat should contact the statistical services of Contracting Parties for further information as to the extent of pro-rating.

2. Biological Sampling (SCS Doc. 85/18, 19)

a) Progress report on activities in 1984/85

An inventory of sampling data for the 1979-83 period and a preliminary list for 1984 were presented according to pre-1979 procedures and formats with appropriate flexibility for certain stocks as agreed on at the September 1984 Meeting. Representatives of the Scientific Council are urged to examine these lists so as to provide whatever additional length frequencies and age-length keys that may be available at national laboratories.

b) Updating of sampling database

No further progress has been made in processing historical data before 1967, because effort has been concentrated on reformating the post-1978 data into the agreed formats.

c) Revised forms for sampling data

Current formats are available and requests for 1979-84 sampling data were sent to national laboratories in early 1985.

d) Deadlines for submission of sampling data

A suitable deadline for submission to the Secretariat of all sampling data in final form would be 30 June. STACREC noted the need for timely submission of data for assessment purposes but suggested that it may be most practical for the Chairman of STACFIS to arrange with individual scientists for sampling data for particular stocks to be made available to designated assessment experts with copies to the Secretariat prior to assessment meetings.

3. Review of Scientific Observer Program

The level of coverage by Canadian observers on vessels fishing within the NAFO regulatory area in 1984 at 134 observed fishing days was similar to that of 1983 when 145 days were observed.

4. List of Fishing Vessels (1983)

The Secretariat had in Jnauary 1984 requested each country to update its 1980 list to cover all fishing vessels which operated in the Northwest Atlantic during 1983. After some considerable delay in the receipt of this information, the list was published in April 1985.

5. Tagging Activities Reported for 1984 (SCS Doc. 85/4 + addendum)

The Committee noted the summary of tagging activities and the provision of information concerning current activity throughout the year by means of circular letters, and urged that this useful series be continued.

## II. BIOLOGICAL SURVEYS

1. Review of Survey Activity in 1984

The Committee noted that the Secretariat had designed a form for use by national laboratories in reporting inventories of surveys conducted in 1984, in accordance with a recommendation from the June 1984 Meeting. The resultant submissions enabled the timely compilation of the list of surveys in 1984 (Table 1).

2. Survey Plans for 1985 and Early 1986

A similar form for the provision of information on surveys planned for 1985 and early 1986 resulted in the list given in Table 2.

3. Review of Stratification Schemes

Accurate charts are still not available for Subarea 0 and Div. 2G and 2H. A stratification scheme based on charts presently available has been compiled and used (SCR Doc. 82/100). The review of stratification of Subarea 1 is in progress and changes are expected generally to be minor.

## 4. Coordination of Squid and Other Surveys in 1985 and 1986

No proposals for review were submitted because such coordination is most often done on a bilateral basis. This item will be considered in future only if requests for coordination of surveys have been received.

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1984.

| Sub-area | Div. | Country | Months | Type of survey | No. of sets |
|---|---|---|---|---|---|
| | | | STRATIFIED-RANDOM SURVEYS | | |
| E. Greenl. | | DEU | 10 | Cod (OTB) | 46 |
| 0+1 | A,ABC | GRL | 7-8 | Shrimp (OTB) | 26 |
| | " | " | 7-8 | Shrimp (photo) | 37 |
| 1 | BCDEF | DEU | 10-11 | Cod (OTB) | 158 |
| 2+3 | HJK | CAN-N | 7 | Shrimp | 161 |
| | JK | " | 10-11 | Groundfish | 185 |
| 3 | K | CAN-N | 11-12 | Groundfish | 117 |
| | L | " | 1-2,4-5 | Groundfish | 366 |
| | | " | 7-8,11 | Groundfish | |
| | M | " | 1 | Groundfish | 171 |
| | NO | " | 4-5 | Groundfish | 120 |
| | Ps | " | 4 | Groundfish | 96 |
| | | FRA | 2-3 | Groundfish | 87 |
| | | " | 10-11 | Groundfish | 97 |
| | Pn | " | 2 | Cod (OTB) | 10 |
| 3+4 | Pn,RS | CAN-G | 1 | Groundfish | 200 |
| 4 | R | FRA | 1-2 | Cod | 52 |
| | RS | CAN-Q | 10-12 | Shrimp | 149 |
| | RST | CAN-G | 6-7 | Redfish | 108 |
| | T | " | 8-10 | Groundfish | 107 |
| | | CAN-Q | 9 | Scallops | 150 |
| | VWX | FRA | 8-9 | Squid | 126 |
| | | CAN-SF | 10 | Groundfish | 169 |
| | | USSR | 10-11 | Silver hake juveniles | 136 |
| | X | CAN-SF | 3 | Groundfish | 174 |
| | | " | 7 | Groundfish | 143 |
| 5 | YZ | USA | 4-5 | Groundfish | 165 |
| | | " | 10-11 | Groundfish | 212 |
| | | " | 2 | Herring | 146 |
| | | " | 7-8 | Clams | 130 |
| | | " | 8 | Scallops | 223 |
| 6 | A | USA | 2 | Herring | 104 |
| | AB | " | 7-8 | Scallops | 262 |
| | | " | 8-9 | Clams | 261 |
| | ABC | " | 3-4 | Groundfish | 170 |
| | | " | 9 | Groundfish | 189 |
| | | | OTHER SURVEYS | | |
| E. Greenl. | | GRL | 6 | Seals | - |
| | | " | 9 | Whales | - |
| | | " | 10 | Groundfish & shrimp (res.) | 4 |
| 0 | B | USSR | 9-12 | Groundfish (G. halibut, grenadier) & oceanography | ... |
| 0+1 | ABCDE | CAN-N | 3-4 | Seals (sighting) | - |
| 1 | ABCD | GRL | 6-7 | Plankton | 97 |
| | | " | 6-9 | Whales (aircraft) | - |
| | ACDE | " | 2-4,6,9 | Groundfish & shrimp (res.) | 62 |
| | BCE | " | 1-3,5,7 | Groundfish & shrimp (com.) | 6 |
| | | " | 10-11 | | |
| 2 | J | CAN-N | 7-8 | Cod (sampling) | - |
| 2+3 | JK | CAN-N | 3 | Seals (sampling) | - |
| | JKLM | " | 7-8 | Oceanography | - |
| | GHJK | USSR | 9-12 | Groundfish (G. halibut, grenadier) & oceangraphy | ... |
| | JKLNO | " | 11-12 | Capelin & redfish | ... |
| 3 | K | CAN-N | 4-5 | Seals (sighting, sampling) | - |
| | | " | 9-10 | Cod tagging | - |
| | KLMNO | USSR | 4-7 | Groundfish, oceanography & redfish selectivity | ... |
| | L | CAN-N | 5-7 | Cod tagging | ... |
| | | " | 6 | Herring larvae | ... |
| | | " | 7-9 | Herring & capelin larvae | ... |
| | | " | 5-7 | Capelin tagging | - |
| | | " | 4-5 | Capelin acoustics | - |
| | | " | 10-11 | Pelagic acoustics | - |
| | | " | 5-6 | Cod acoustics | - |
| | | " | 5,7-8,10 | Crab | ... |
| | LN | " | 6-7 | Capelin acoustics | - |
| | | " | 7 | Oceanography | - |
| | LNO | USSR | 4-6 | Capelin & redfish | ... |
| | OPs | CAN-N | 6 | Squid | 78 |
| | Ps | " | 1 | Pelagic acoustics | - |
| | | " | 3-4,9 | Oceanography | - |
| | | " | 4 | Herring | ... |
| | | " | 5 | Scallop tagging | 155 |
| | | " | 9 | Scallops | 268 |
| | | FRA | 10 | Scallops | 106 |
| 3+4 | PnTVn | CAN-G | 11 | Herring acoustics | - |
| 4 | R | CAN-N | 8 | Redfish acoustics | - |
| | | " | 6-7 | Scallops | 32 |
| | RS | CAN-Q | 5-6 | Cod tagging | 55 |
| | | " | 9 | Ichthyoplankton | 156 |
| | RST | CAN-G | 5 | Herring spawning (diving) | - |
| | T | " | 8 | Herring acoustics | - |
| | | CAN-Q | 5-6 | Crab tagging | 383 |
| | TVn | " | 6-7 | Mackerel eggs & larvae | 134 |
| | Vn | CAN-SF | 2 | Herring acoustics | 7 |
| | V_W | CAN-N | 2-3 | Squid | ... |
| | VWX | CAN-SF | 4 | Comparative trawl study | 48 |
| | | " | 5 | Comparative trawl study | 42 |
| | | " | 10 | Deepsea trawling | 62 |
| | X | " | 1 | Acoustics | - |
| | | " | 3 | Cod & haddock tagging | 180 |
| | | " | 5 | Shrimp | 30 |
| | | " | 5 | Scallops | 158 |
| | | " | 6 | Juvenile haddock | 66 |
| | | " | 6 | Comparative trawl study | 40 |
| | | " | 8 | Lobster | 224 |
| | | " | 9 | Acoustics (trawling) | 37 |
| | | " | 9 | Squid | 118 |
| | | " | 10 | Scallops | 285 |
| | | " | 11 | Larval herring | 157 |
| | | " | 11 | Benthos | 36 |
| 4+5 | XZe | CAN-SF | 2 | Cod & haddock tagging | 280 |
| | | " | 2 | Ichthyoplankton | 74 |
| | | " | 3 | Ichthyoplankton | 54 |
| | | " | 4 | Ichthyoplankton | 62 |
| | | " | 5 | Ichthyoplankton | 70 |
| | | " | 6 | Ichthyoplankton | 84 |
| | | " | 8 | Scallops | 159 |
| | XYZ | " | 10 | Silver hake | 114 |
| | | " | 11 | Pollock | 88 |
| 4-6 | Offshore | CAN-SF | 1 | Larval squid | 5 |
| | XYZABC | USA | 1-2 | Ichthyoplankton, phyto-plankton & oceanography | 161 |
| | | " | 5-6 | " " | 181 |
| | | " | 10-12 | " " | 146 |
| | | " | 2-4 | Fish eggs & larvae | 155 |
| | | " | 7-8 | Fish eggs & larvae | 119 |
| | | " | 9-11 | Fish eggs & larvae | 158 |
| 5 | Y | CAN-SF | 2-3 | Larval herring | 111 |
| | Z | USA | 6-11 | Juvenile gadids | 200 |
| 5+6 | ZABC | USA | 7 | Fish eggs & larvae | 70 |
| | | " | 7-8 | Fish eggs & larvae | 107 |
| 6 | ABC | USA | 5-6 | Fish eggs & larvae | 41 |

Table 2. Biological surveys planned for the NAFO Area in 1985 and early 1986.

| Country | Area | Type of survey | Dates |
|---|---|---|---|
| | | STRATIFIED-RANDOM SURVEYS - 1985 | |
| CAN-N | 2HJ+3K | Shrimp | Jul 21-Aug 21 |
| | 2J+3K | Groundfish | Oct 22-Dec 03 |
| | 3KL | Cod | May 31-Jun 17 |
| | 3L | Groundfish | Apr 17-May 27 |
| | | Groundfish | Jul 17-Aug 26 |
| | | Groundfish | Oct 09-Nov 18 |
| | 3NO | Groundfish | Apr 15-May 10 |
| | | Flatfish | Aug 28-Sep 16 |
| CAN-Q | 3Pn+4RST | Groundfish | Jan |
| | 4RST | Shrimp | Sep-Oct |
| | 4T | Scallops | Aug |
| CAN-G | 4RST | Redfish | Aug 05-Sep 04 |
| | 4T | Groundfish | Sep 03-Oct 04 |
| | 4T | Comparative fishing | Sep 06-27 |
| CAN-SF | 4VWX | Groundfish | Jul 01-26 |
| | | Squid | Sep 03-30 |
| | | Groundfish | Oct 07-18 |
| | 4X | Groundfish | Feb 18-Mar 08 |
| DEU | E. Greenl. | Cod (OTB) | Sep 24-Nov 04 |
| | 1BCDEF | Cod (OTB) | Nov 07-Dec 19 |
| | 2J | Cod (OTB) | Oct 15-Nov 24 |
| FRA | 3Ps | Groundfish | Feb 08-Mar 11 |
| | 4R | Cod | Jan 19-Feb 02 |
| GRL | 0A+1ABC | Shrimp (OTB) | Jul-Aug |
| USSR | 0B+2GHJ | Greenland halibut | Nov-Dec |
| | 3KLMNO | Groundfish | Mar-Jul |
| | 4VWX | Juvenile silver hake | Oct-Nov |
| USA | 4X | Groundfish | Apr 01-19 |
| | 5YZ | Groundfish & herring | Feb 11-22 |
| | | Groundfish | Mar 18-Apr 20 |
| | | Groundfish | Sep 30-Nov 08 |
| | 5+6 | Scallops | Jul 22-Aug 31 |
| | 6 | Groundfish & herring | Feb 11-22 |
| | | Groundfish | Feb 25-Mar 29 |
| | | Groundfish | Sep 09-Oct 11 |
| | | OTHER SURVEYS - 1985 | |
| CAN-N | 2J | Cod tagging | Jul 10-Aug 09 |
| | 2J+3K | Capelin acoustics | Sep 24-Oct 20 |
| | 2J+3KL | Salmon | Nov 20-Dec 09 |
| | | Hydrography | Jul 29-Aug 16 |
| | 3KL | Capelin tagging | Jun 10-Jul 05 |
| | | Herring | Oct 15-Nov 08 |
| | 3L | Capelin acoustics | May 07-29 |
| | | Oceanography | Mar 28-Apr 03 |
| | | Cod tagging | May 27-Jun 17 |
| | | Pelagic larvae | Jun 17-28 |
| | | Pelagic larvae | Jul 15-31 |
| | | Pelagic larvae | Aug 12-29 |
| | | Pelagic larvae | Sep 13-27 |
| | | Pelagic larvae | Oct 15-Nov 01 |
| | | Pelagic fish | Nov 12-30 |
| | | Crab | Jun 03-13 |
| | | Crab | Aug 05-20 |
| | | Crab | Sep 30-Oct 11 |
| | | Crab | Nov 05-14 |
| | 3LNO | Juvenile flatfish | Jun 14-[illegible] |
| | | Capelin acoustics | Jun 19-Jul 08 |
| | | Gear trials | Sep 18-Oct 07 |
| | 3NOPs | Squid | May 29-Jun 12 |
| | 3Ps | Scallops | Apr 04-16 |
| | | Scallops | Sep 12-22 |
| | 4R | Crab | Apr 01-19 |
| | | Redfish acoustics | Jul 10-29 |
| CAN-Q | 4RS | Shrimp larvae | May-Jun |
| | 4ST | Crab (photography) | Aug |
| | | Crab tagging | May |
| | 4T | Crab growth | Jun-Sep |
| | 4TVn | Mackerel eggs & larvae | Jun 19-Jul 10 |
| CAN-G | 4T | Herring spawning (diving) | May 01-31 |
| | | Herring acoustics | Nov 04-29 |
| CAN-SF | 4Vn | Herring acoustics | Jan 16-Mar 01 |
| | | Shrimp | Apr 15-26 |
| | | Shrimp | Oct 07-18 |
| | 4VWX | Benthos | Apr 01-12 |
| | | Diamond mesh experiment | Apr 22-May 03 |
| | | Diamond mesh experiment | May 20-31 |
| | | Deepsea trawling | Sep 23-Oct 04 |
| | | Comparative fishing | Oct 21-Nov 01 |
| | | Pollock & silver hake | Dec 02-13 |
| | 4X | Gear trials | Jan 28-Feb 01 |
| | | Haddock tagging | Feb 28-Mar 08 |
| | | Acoustics experiment | Mar 18-29 |
| | | Ichthyoplankton | May 06-17 |
| | | Acoustics experiment | May 06-17 |
| | | Live fish; gear test | Jul 01-05 |
| | | Scallops | Sep 30-Oct 11 |
| | | Live fish | Oct 14-18 |
| | | Gear trials | Nov 04-15 |
| | | Lobster | Nov 18-29 |
| | 4X+5Ze | Ichthyoplankton | Feb 04-22 |
| | | Cod tagging | Mar 11-29 |
| | | Ichthyoplankton | Apr 01-19 |
| | | Scallops | May 13-24 |
| | | Ichthyoplankton | Jun 03-14 |
| | | Juvenile haddock | Jun 17-28 |
| | | Haddock tagging | Jul 22-Aug 02 |
| | | Larval herring | Oct 21-Nov 15 |
| | 4X+5Z | Lobster larvae | Jul 08-26 |
| | | Scallops | Aug 05-30 |
| | 4-6 | Larval squid (offshore) | Jan 02-Feb 01 |
| FRA | 3Ps | Scallops | Mar 14-24 |
| GRL | E. Greenl. | Marine mammals (aircraft) | Jun |
| | | Shrimp (commercial) | Sep |
| | 0A+1ABC | Shrimp (photography) | Jul-Aug |
| | 1A | Marine mammals (aircraft) | Jun |
| | 1ABC | Shrimp (commercial) | Jan-Dec |
| | 1ABCD | Plankton | Apr, Jul, Oct |
| | 1BCD | Whales (aircraft) | Jun-Jul |
| | 1BCDEF | Cod (commercial) | Jan-Dec |
| | 1CDE | Groundfish & shrimp (res.) | Jan-Dec |
| USSR | 2J+3K | Capelin acoustics | Oct 15-Nov 05 |
| | 3LNO | Capelin acoustics | May 15-Jun 25 |
| | | Capelin acoustics | Nov 05-20 |
| | 3M | Ichthyoplankton | Apr 05-20 |
| | 2+3 | Hydrography & ichthyoplankton | Apr-Jul(?) |
| | 4VWX | Silver hake juveniles | Oct-Nov |
| USA | 4X+5YZ +6ABC | Ichthyoplankton, phytoplankton & oceanography | Jan-Feb |
| | | " " | Mar-Apr |
| | | " " | May-Jun |
| | | " " | Aug |
| | | " " | Sep-Oct |
| | | " " | Nov-Dec |
| | | SURVEYS PLANNED FOR EARLY 1986 | |
| CAN-N | 3L | Groundfish | Jan 22-Mar 03 |
| | 3M | Groundfish | Jan 31-Feb 19 |
| | 3Ps | Groundfish | Mar 05-24 |
| | | Cod tagging | Mar 14-25 |
| | 4VW | Squid | Feb 21-Mar 12 |
| CAN-SF | 4Vn | Herring acoustics | Jan 13-28 |
| | 4VWX | Groundfish | Mar 03-28 |
| | 4X | Acoustics experiment | Mar 17-28 |
| | 4-6 | Larval squid (offshore) | Jan 02-Feb 03 |
| USSR | 0B+2GHJ | Greenland halibut | Jan |
| USA | 4X | Groundfish | Apr 14-25 |
| | 5YZ | Groundfish & herring | Feb 10-21 |
| | | Groundfish | Mar 17-Apr 25 |
| | 6 | Groundfish & herring | Feb 03-28 |
| | 6 | Groundfish | Feb 24-Mar 28 |
| | 4X+5+6 | Ichthyoplankton, phytoplankton & oceanography | Jan-Feb |
| | | " " | Mar-Apr |
| | | " " | May-Jun |

5. Time Series of Survey Data

The Committee noted that Soviet surveys since 1981 are being done using the stratified-random sampling scheme. It is intended that future surveys for Greenland halibut and roundnose grenadier in Subarea 1 be completed using stratification charts as provided by France (St. Pierre laboratory).

Surveys by the Soviet Union over the 1959-80 period have been conducted with a number of different vessels but with comparable horse power and fishing gear. All survey results from the entire period are considered comparable by the Soviet scientists. Changes in vessel, gear and fishing design have likely been made by several countries and recorded at various times. The cumulative effect of these changes upon consistency of results should be examined. STACREC accordingly

recommends

*that appropriate documentation of survey design, vessel and gear used, operation of gear, sampling procedures and other factors potentially affecting survey results be provided to STACREC at its June 1986 Meeting.*

To assist in the reporting of such data, the Secretariat is requested to consult with relevant laboratories and prepare a draft format for consideration at the September 1985 Meeting of the Scientific Council. At the June 1986 Meeting, it is intended that a working group be formed to examine the reported data and recommend to STACREC appropriate measures for the future improvement of various time series of survey data and the most appropriate methods of analyzing historical data to derive abundance indices for stock assessment purposes.

## III. OTHER MATTERS

1. Review of Relevant Documents

a) Estimates of discarding (SCR Doc. 85/28, 75; SCS Doc. 85/3)

Estimates of discards on vessels of the Canadian (Newfoundland) fleet in 1983 showed low discards in the cod fisheries, somewhat higher discards in the redfish fisheries and consistently higher discards in the flatfish fisheries on the Grand Bank. STACREC also noted the detailed length and age compositions of discarded cod in the Spanish fishery in 1984. Such data are very useful in the assessment process. It was pointed out that the CWP report noted the need for discard information but that such data were normally obtained from ad hoc studies.

2. The Maritime Boundary Between Canada and the USA in Relation to NAFO Statistical Boundaries

The recent decision by the International Court of Justice was noted. It is apparent that this boundary will be used for a variety of purposes related to fisheries management. The Committee noted the desirability of the provision of fishery statistics consistent with long-term series and, in particular, noted the guidelines (for considerations relating to modifications of statistical boundaries) developed by ICES and provided in the Report of the 12th Session of CWP (Annex 1). STACREC proposed that any necessary statistical boundary changes be decided at the September 1985 Meeting and that interested members provide a review of data relevant to such considerations based on the above-noted guidelines to the extent that they are applicable.

3. Additional Species

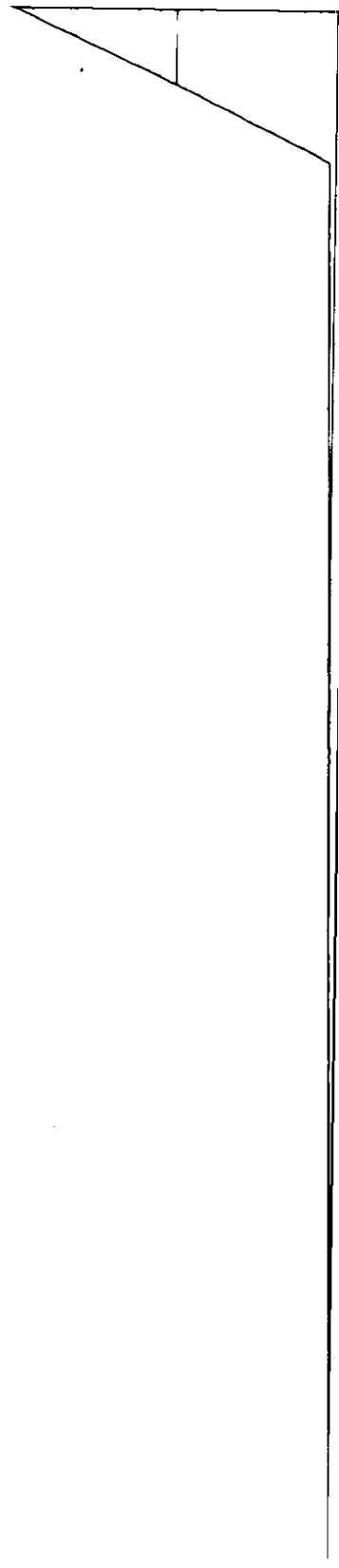
The Secretariat reported that a new species (blue antimora) has been recorded on STATLANT 21 forms, and STACREC

recommends

*that the Secretariat take the necessary measures to add blue antimora (Antimora rostrata) to the NAFO List of Species Items.*

4. Acknowledgements

There being no further business, the Chairman thanked the rapporteurs for their assistance throughout the meeting and expressed appreciation to all participants for their contributions and to the Secretariat for their continued efficient work.



## ANNEX 1. GUIDELINES CONCERNING CHANGES IN BOUNDARIES OF MAJOR FISHING AREAS

There have been no changes in the boundaries of the major fishing areas since the 11th Session of the CWP (July 1982). However, new statistical grids have been or are to be proposed for several of the areas (e.g. CECAF, WECAFC, CCAMLR). The CWP noted the working principle on boundary changes which were established and approved at the 1982 meeting (FAO Fish. Rep., No. 274, p. 9), namely

a) changes in the existing system should be considered only when strong reasons for doing so have been clearly demonstrated and documented;

b) in addition to the advantages, consideration of changes must take into account the disadvantages which would follow if alterations were to be implemented;

c) possible alterations to existing statistical areas could take the form of a change in a boundary or the creation of subdivisions within a statistical area;

d) if the need for a change is accepted, the nature and extent of the alteration should be determined principally on the basis of biological considerations, taking into account the distribution of fisheries and possible effect on the existing statistical data series, together with administrative/political considerations; and

e) any proposal to alter a statistical area must also be supported by the following documentation:

   i) evidence of the distribution of the exploitable phase of the major stocks concerned;

   ii) a list of all other stocks occurring within or around the boundary of the fishing area concerned;

   iii) information on the movements of these stocks within or across the boundaries;

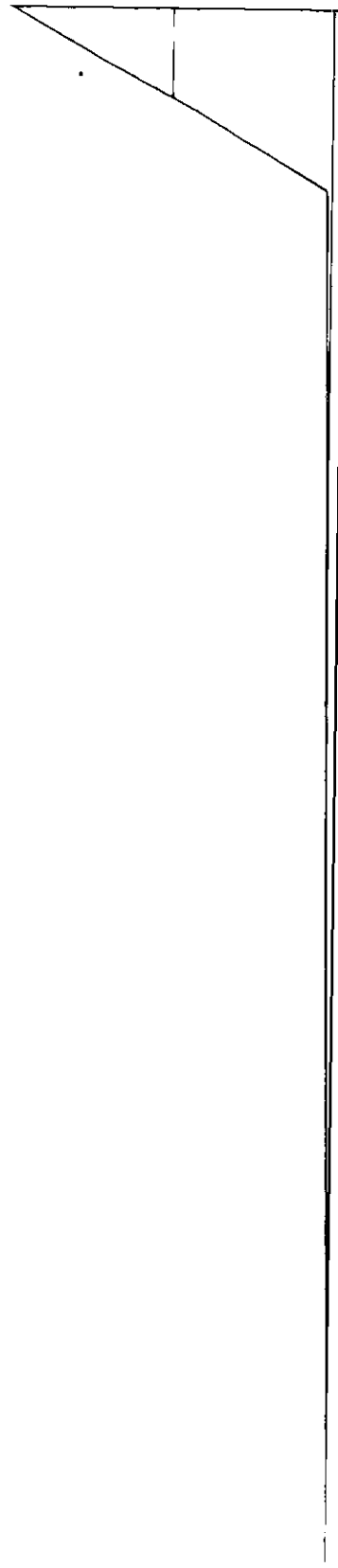
   iv) the distribution of fisheries in and around the area concerned;

   v) details of natural marine boundaries, such as bottom topography; and

   vi) an analysis of how implementation of the proposals would be likely to affect long-term data series.

The CWP requested that these proposed changes be reviewed with respect to these criteria before they are adopted.

[Extract from CWP Report (SCS Doc. 85/3, pages 23-24)]



## APPENDIX III. REPORT OF STANDING COMMITTEE ON PUBLICATION (STACPUB)

Chairman: J. Messtorff (EEC) Rapporteur: R. G. Halliday (Canada)

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 10, 17 and 19 June 1985. In attendance at all sessions were J. Messtorff (Chairman), Sv. Aa. Horsted (Denmark-Greenland), R. G. Halliday and A. T. Pinhorn (Canada), S. Kawahara (Japan), and M. G. Larraneta (Spain). Also in attendance were the Chairman of the Scientific Council (V. A. Rikhter), the Executive Secretary (Capt. J. C. E. Cardoso), the Assistant Executive Secretary (V. M. Hodder) and, for the first session only, the Adminstrative Assistant (W. H. Champion).

1. Review of Scientific Publications Since June 1984

a) Journal of Northwest Atlantic Fishery Science

i) Volume 5 was completed in November 1984 with the issue of No. 2, containing 10 papers, 1 obituary and 3 notices, making a total of 226 pages for the volume.

ii) Volume 6(1), containing 9 papers, 1 obituary and 2 notices (about 100 pages) is in the final stages of preparation, and printing should be completed before the end of June 1985.

b) NAFO Scientific Council Studies

i) Number 7, containing 9 papers and 2 notices (98 pages), was published in August 1984.

ii) Number 8, containing 12 papers and 2 notices (96 pages), was published in April 1985.

iii) Number 9, which will contain many of the papers from the Special Session on Squids in 1984, is expected to be produced in October 1985.

c) NAFO Scientific Council Reports

The volume containing the reports of meetings in January, June and September 1984 (126 pages) was published in December 1984 and distributed in January 1985.

d) NAFO Statistical Bulletin

i) Volume 32 for 1982 (284 pages) was published in December 1984. Production was delayed by about 8 months due to the late receipt of some data.

ii) Volume 33 for 1983 was scheduled for production in April 1985, but data for France is still missing and production is delayed until its receipt.

iii) The reissuing of Vol. 27-31 for 1977-81, required to correct errors in the original submissions from some countries, is progressing well with Vol. 29-31 already reissued and Vol. 27-28 to be made available later in 1985.

e) List of Fishing Vessels (for 1983)

This volume, containing lists of fishing vessels reported for 21 countries (or country components) (48 pages) was published in March 1985.

f) Index and List of Titles of Meeting Documents

Instead of preparing a separate provisional index for 1984, this material was incorporated in a volume entitled "NAFO Index of Meeting Documents, 1979-84" (146 pages), which was published in March 1985. In addition to the indexes and list of titles of the Scientific Council's research and summary documents, the volume contains lists of General Council and Fisheries Commission documents.

The summary document providing a provisional index for NAFO Journal and Studies papers to date could not be prepared in time for this meeting but will be completed prior to the June 1986 Meeting.

g) Sampling Yearbook

No volumes have been issued since the last ICNAF volume (No. 23 for 1978) which was an inventory of data available from the Secretariat. Following the decision by the Scientific

Council in 1984 to follow essentially the same format for data submission as used by ICNAF (with minor changes for a few stocks), data for 1979-84 are now being accumulated. Provisional lists of data for 1979-83 and 1984 (not all of which are yet available in the Secretariat) were produced as summary documents for this meeting. These lists are too incomplete to consider publication at this time.

The standardized inventory of samples for the 12-year period 1967-78 is now ready for publication and will be produced later in 1985.

2. Editorial Matters Regarding Scientific Publications

a) Editorial Board activities

Receipt of papers for the Journal of Northwest Atlantic Fishery Science and their disposition were reviewed (following table):

| Period | Journal | Studies | Rejected | Under review | Total |
|---|---|---|---|---|---|
| 1979-Dec 1981 | 24 | 2 | 5 | - | 31 |
| Jan-Dec 1982 | 21 | 1 | 4 | 3 | 29 |
| Jan-Dec 1983 | 20 | 3 | 8 | 2 | 33 |
| Jan-Dec 1984 | 8 | 6 | 3 | 5 | 22 |
| Jan-May 1985 | 2 | - | 1 | 5 | 8 |
| Totals: | 75 | 12 | 21 | 15 | 123 |

The number of papers that were received during 1984 for possible publication (22) was considerably lower than the numbers received in 1982 and 1983, and the trend continued into 1985. There is also an indication that rejection rate is increasing. While this decrease in submissions may prove to be a temporary one, STACPUB gave the matter further considerations in relation to overall publication policy and in particular to policy regarding the Studies series (see below).

b) Editorial Board appointments

i) Editor

As reported at the September 1984 meeting, the resignation of the present Journal editor (V. M. Hodder) was received, effective 30 June 1985. The Chairman reported on the responses received to his enquires concerning the degree of interest among the potential candidates identified by the Committee last September. As a result the Committee is please to

recommend

*that the position of Editor for the Journal of Northwest Atlantic Fishery Science be offered to Mr. Bernard E. Skud of the United States National Marine Fisheries Service, Narragansett Laboratory, Rhode Island, U.S.A.*

It was noted that an unsolicited proposal to provide editorial service to the Council had been received from the Huntsman Marine Laboratory of St. Andrews, New Brunswick, Canada, presumably on a commercial basis. However, the Committee requested that the Chairman, in thanking this organization for their offer, inform the Director that the Council requires scientific editorial services only and prefers to obtain these on a volunteer basis from interested individuals in the scientific community.

ii) Associate Editor for Biological Oceanography

Mr. Hodder reported that, on receipt of the resignation of A. J. Lee as Associate Editor for Biological Oceanography, effective 31 May 1985, he had contacted STACPUB members by mail to obtain views on potential candidates. Based on the views received, he contacted some of the identified candidates to determine willingness to serve. As a result, it is possible for STACPUB to

recommend

*that the position of Associate Editor for Biological Oceanography be offerred to G. A. Robinson, Institute for Marine Environmental Research, Plymouth, United Kingdom.*

The Editor, Mr. Hodder, was requested to express the sincere thanks of the Council to Mr. Lee for his years of service on the Editorial Board. He was also requested to thank others, on behalf of STACPUB, who had expressed a willingness to serve.

c) Role and Scope of Studies Series

STACPUB reconfirmed its view that the Council's interests were best served by having a primary journal and a secondary unrefereed publication, the Scientific Council Studies. It was suggested that the editorial standards which have been applied to Studies papers may be the cause of confusion or dissatisfaction on the part of the authors who may feel that standards applied are higher than they would normally expect for a secondary publication. Special issues, such as the squid symposium papers, raise particular problems when the papers range widely in quality and a number may well meet primary publication standards. The idea of instituting a Special Publications series such as that supported by ICNAF for symposia proceedings does not provide a solution to this latter problem, because the Council does not attract sufficient papers to support three publication series. Indeed, as noted above, the Journal is facing a problem from reduced submission of papers even as matters now stand. It was pointed out that Journal submissions have in part originated from papers presented at special sessions, and the decision to produce a special volume of Studies based on the squid symposium papers had contributed to the Journal's present problem.

It was decided that the production of special volumes of symposia proceedings is contributing to a number of problems and dissatisfaction with the Council's publication policy. It is proposed that, in future, all papers available to the Council for publication be considered for publication in Journal or Studies purely on their own merits and that special volumes will not normally be considered. This decision was reached with some reluctance, as the value of special volumes to clients is recognized.

It was further decided that the editorial standards for Studies should be examined and decided upon by STACPUB, and that a clear statement of these should be available to potential contributors, to avoid future confusion about the status of this publication. The editor of Studies (V. M. Hodder) was requested to provide draft guidelines for editorial standards for consideration by STACPUB at the September 1985 Meeting.

It was noted that close liaison will be required between the Editors of the Journal and Studies so that papers submitted are given full consideration for publication in either series whichever is the more suitable. The editors are requested to establish a suitable mechanism to achieve this.

d) Review of Terms of Reference for Editors and Associate Editors

The new arrangements which will result in the Journal Editor not being a member of the Secretariat required modification of the terms of reference setting out the relationship between the Editor and the Secretariat. The revised version is at Annex 1.

3. Promotion and Distribution of Scientific Publications

The free distribution list has declined slightly for 1985 and remains slightly under 500 while subscriptions have increased to 60. Volume 4 of the Journal continues to be in strong demand. These trends were considered satisfactory. As requested at the June 1984 Meeting, the Executive Secretary provided a statement of production costs and revenues for Council publications produced in the last year. STACPUB noted this with interest and requested that next year's report include also information on revenues derived during the year from the publications of the previous years, to complete the balance sheet.

4. Progress Report on Microfiche Project

Contract arrangements for placing on microfiche all research related ICNAF meeting documents have been completed and costs are projected to be under the budgeted amount. Substantial preparatory work by the Secretariat is required before documents are ready for shipping to the contracted company. Those for 1973-79 are expected to be ready for shipment in July but completion of the project will not be before sometime in 1986.

There have been further expressions of interest by libraries in purchase of sets of microfiche copies of these documents, and it is now quite clear that all expenditures by NAFO will be recouped.

5. Papers for Possible Publication

The disposition of papers identified in 1984 as potentially suitable for publication by the Council was reviewed. Of the 45 so identified, 15 have been published or accepted for publication, a

further 13 are still under consideration, and one has been rejected. Authors of the remaining papers have not provided manuscripts for the editor's consideration.

The Committee reviewed two research documents which were deferred from 1984 and those which were presented to the Council so far in 1985 and requested the Executive Secretary to invite the authors of the following documents to submit suitably revised manuscripts for possible publication in the Journal or Studies series: SCR Doc. 84/95, 105; SCR Doc. 85/9, 14, 16, 47, 58, 62, 69, 74.

There was concern expressed in the Committee that oceanographic papers, which were quite numerous, may not be receiving adequate consideration by the Committee, and it was decided to invite the chairman of STACREC and STACFIS to participate in the selection process.

6. Acknowledgements

The Chairman thanked all members for their participation, and the Rapporteur and Secretariat for their support of the Committee's work; in particular, he expressed the gratitude of the Committee and, indeed, on behalf of the whole Scientific Council, for the excellent work which had been performed by the Assistant Executive Secretary (V. M. Hodder) as Editor of the Journal.

ANNEX 1. TERMS OF REFERENCE FOR JOURNAL EDITORS (Revised June 1985)

The Editor will be responsible for all scientific and literary aspects of the publications and the Executive Secretary is responsible for all technical and production aspects of them, although he may delegate that responsibility to one or more persons of the Secretariat. Authors will be encouraged to submit manuscripts directly to the Editor and all manuscripts received by the Secretariat for publication in the Journal should be directed to the Editor. The Editor should keep the Executive Secretary or his designate fully informed of the progress and acceptance of papers for each issue to ensure efficient production within the schedules approved by STACPUB.

Appointments to the Editorial Board will be subject to annual review by STACPUB, but there are no restrictions on terms of appointment. Associate Editors are responsible for recommending to the Editor acceptance or rejection of papers based on their scientific quality in relation to Journal standards. Papers recommended for acceptance are to be submitted to the Editor, edited with regard to language usage, format and style as set out by the Editor. It is the responsibility of the Associate Editors to select appropriate referees when these are required and to conduct all necessary communication with the referees and authors regarding revisions to the content or form of manuscripts until such time as the Associate Editor can decide on the suitability of the manuscript for publication. The Editor has over-riding authority on all decisions regarding acceptance of manuscripts and in resolving disagreements between Associate Editors. Associate Editors can proposed manuscripts for inclusion in the Journal and are expected to encourage submission of manuscripts suitable for publication in the Journal.

APPENDIX IV. AGENDA FOR THE JUNE 1985 MEETING OF THE SCIENTIFIC COUNCIL

I. Opening (Chairman: V. A. Rikhter)

1. Appointment of rapporteur
2. Adoption of agenda
3. Plan of work

II. Fishery Science (STACFIS Chairman: J. E. Carscadden)

1. General review of catches and fishing activity in 1984

2. Assessment of finfish and invertebrate stocks

a) Stocks in the NAFO Regulatory Area, as required by the Fisheries Commission:

- Cod (3M)
- Redfish (3M)
- American plaice (3M)

b) Stocks within or partly within the Canadian 200-mile fishery zone in Subarea 2, 3 and 4, for which advice on conservation measures in 1986 has been requested by Canada (Annex 3):

- Cod (2J+3KL, 3NO)
- Redfish (3LN)
- Silver hake (4VWX)
- American plaice (3LNO)
- Witch flounder (3NO)
- Yellowtail flounder (3LNO)
- Greenland halibut (2+3KL)
- Roundnose grenadier (2+3)
- Capelin (3L, 3NO)
- Squid-*Illex* (3+4)

c) Stock overlapping the Canadian and EEC fishery zones in Subarea 3, for which advice on conservation measures in 1986 has been requested by Canada (Annex 3) and the EEC (Annex 1):

- Cod (3Ps)

d) Stocks within the fishery zone in Subarea 1 and at East Greenland, for which advice on conservation measures in 1986 has been requested by Denmark on behalf of Greenland (Annex 2):

- Cod (1)
- Redfish (1)
- Wolffishes (1)
- Northern shrimp (East Greenland)

e) Stocks overlapping the Canadian and Greenland fishery zones in Subareas 0 and 1, for which advice on conservation measures in 1986 has been requested by the coastal states involved (Annexes 2, 3 and 4):

- Greenland halibut (0+1)
- Roundnose grenadier (0+1)
- Northern shrimp (0+1)

3. Environmental research (Subcommittee Chairman: M. Stein)

a) Marine Environmental Data Service report for 1984
b) Review of environmental studies in 1984
c) Overview of environmental conditions in 1984
d) Update of remote-sensing activities
e) Synoptic sea-surface temperature maps
f) Environmental aspects of Flemish Cap Project
g) Distribution of squid larvae and juveniles re oceanography
h) Other environmentally-related work on squid and other species
i) Influence of environmental factors on distribution, movements and migrations of marine species in the Northwest Atlantic (*NAFO Sci. Coun. Rep.*, 1984, pages 91-92)
j) Other matters

4. Flemish Cap research

   a) Consideration of paper on USSR ichthyoplankton studies in 1978-83 (SCR Doc. 84/IX/95)

   b) Other matters

5. Ageing techniques and validation studies

   (Continuing studies involve problems with ageing redfish, roundnose grenadier, cod in Div. 3M, and proposal for second workshop on ageing shrimp to be initiated in early 1986.)

6. Gear and selectivity studies (if any)

7. Review of research documents not considered in items (1) to (6) above

   a) Papers deferred from 1984 meetings
   b) Papers documented for present meeting

8. Other matters

   a) Progress report of Task Force on Larval Herring (M. D. Grosslein, Task Force Leader)

   b) Progress report on contributions for Special Session in September 1985 on "Design and Evaluation of Biological Surveys in Relation to Stock Assessments" (J. Messtorff, Convener) (Circular Letter 84/73 and 85/28)

   c) Review of new arrangements for conducting stock assessments

   d) Proposed theme for Annual Meeting in September 1987.

   e) Other business

III. Research Coordination (STACREC Chairman: J. M. Jensen)

1. Statistics and sampling

   a) CWP activities relevant to NAFO

      i) Report of CWP Session, July 1984
      ii) Participation in next CWP Session, Feb 1987

   b) Fishery statistics

      i) Progress report on activities in 1984/85
      ii) Updating of fishery statistics database
      iii) Review reporting requirements (STATLANT 21A and 21B)
      iv) Effort data and prorating

   c) Biological sampling

      i) Progress report on activities in 1984/85
      ii) Updating of sampling database
      iii) Revised forms for reporting sampling data

2. Biological surveys

   a) Review of survey activity in 1984
   b) Survey plans for 1985 and early 1986
   c) Review of stratification schemes
   d) Coordination of squid and other surveys in 1985 and 1986
   e) Other matters

3. Review of Scientific Observer Program

4. List of fishing vessels (1983)

5. Tagging activities reported for 1984

6. Review of relevant documents not considered in items (1) to (5) above

7. Other matters

IV. Publication (STACPUB Chairman: J. Messtorff)

1. Review of scientific publications since June 1984

2. Editorial matters regarding scientific publications

   a) Editorial Board activities
   b) Editorial Board appointments
   c) Role and scope of *NAFO Scientific Council Studies*

3. Promotion and distribution of scientific publications

4. Progress report on microfiche project

5. Papers for possible publication

   a) Review of proposals from 1984 meetings
   b) Proposals for publication from 1985 and outstanding 1984 documents

6. Other matters

V. Collaboration with other Organizations

1. Report of third meeting of NAFO/ICES study group on redfish off Greenland (if any)

2. Twelfth session of CWP at Copenhagen, Denmark, 25 July-1 August 1984 (SCS Doc. 85/3, Serial No. N957)

3. Thirteenth session of CWP, Rome, Italy, February 1987

VI. Adoption of Reports

1. Provisional Report of Scientific Council, January 1985 (SCS Doc. 85/I/2)

2. Committee reports from this meeting (STACFIS, STACREC and STACPUB)

VII. Future Scientific Council Meetings, 1985 and 1986

VIII. Special Sessions

1. Arrangements for Special Session "Recent Advances in Understanding Recruitment in Marine Fishes of the Northwest Atlantic, with Particular Emphasis on Georges Bank and Flemish Cap, to be held in September 1986.

2. Theme for Special Session in September 1987

IX. Nomination of Officers for 1985-87

1. Scientific Council Chairman and Vice-chairman

2. Standing Committee Chairmen (STACFIS and STACREC)

X. Other Matters

1. Discussion and revision of proposed Rule of Procedure 3.7

XI. Adjournment

## ANNEX 1. EEC REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1986 OF THE COD STOCK IN SUBDIVISION 3Ps

1. The EEC requests the Scientific Council of NAFO to provide advice, subject to the concurrence of the other coastal state concerned, for the stock of Atlantic cod occurring in Subdivision 3Ps.

2. The present state of exploitation should be reviewed and options for management in 1986 given. Where possible, these should be expressed graphically in terms of catch in 1986 and the size of the spawning stock biomass on 1 January 1987 for a range of values of F which covers at least -50% to +25% of F in 1984.

E. Gallagher, Director General
Directorate General for Fisheries
Commission for the European Communities
Brussels, Belgium

## ANNEX 2. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1986 OF CERTAIN STOCKS IN SUBAREA 1

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1985 Meeting to provide advice on the status of the stocks and on the scientific basis for management in 1986 and as many years onward as the data allow for the following stocks:

   a) Stocks occurring in Subarea 1

      Atlantic cod
      Redfish by species, if possible
      Wolffish by species (spotted and striped), if possible

   b) Stocks overlapping Subareas 0 and 1 (subject to the concurrence of Canada)

      Greenland halibut
      Roundnose grenadier
      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 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 examples of options:

      i) $F = F_{0.1}$ from 1986 onward
      ii) $F = F_{(max)}$ from 1986 onward
      iii) $F = F_{(1984)}$ from 1986 onward
      iv) A steady catch level from 1986 onward with the annual catch level equal to (1) TAC for 1985 (25,000), (2) any other qualified estimate of the 1985 catch, and (3) the catch for 1985 calculated by the above options for $F_{(1986)}$.

      The maximum potential for rebuilding the spawning stock (i.e. complete stop of cod fishing) should also be analyzed up to and including the stock size by January 1989.

      A graph should be produced illustrating the resulting spawning stock by 1 January 1987 for any given 1986 catch level between zero and that for $F_{(max)}$, assuming that the catch level in 1985 is equal to the above-mentioned TAC for that year.

      The possibility and the advantages and disadvantages of combining, in future, the annual analyses of cod at West and East Greenland should be discussed.

   b) For redfish and wolffish in Subarea 1, options for management should, if possible, be expressed graphically in terms of catches in 1986 and the stock and spawning stock biomass by 1 January 1987 for a range of F-values covering at least half to double that in 1984.

   c) For Greenland halibut and roundnose grenadier in Subareas 0+1, the guidelines provided above for redfish and wolffish in Subarea 1, supplemented by any other guidelines provided by Canada, should form the basis for the analyses and advice.

d) The Scientific Council should feel free to report on such other invertebrate 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.

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.

K. Trolle
Ministry for Greenland
Copenhagen, Denmark

## ANNEX 3. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1986 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1985 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1986:

Cod (Div. 2J, 3K and 3L; Div. 3N and 3O; Div. 3Ps)
Redfish (Div. 3L and 3N)
American plaice (Div. 3L, 3N and 3O)
Witch flounder (Div. 3N and 3O)
Yellowtail flounder (Div. 3L, 3N and 3O)
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; Div. 3N and 3O)
Squid (Subareas 3 and 4)

It is further suggested that, subject to the concurrence of the other coastal states concerned, the Scientific Council, prior to the 1985 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1986 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 and for the Flemish Cap (Div. 3M) stocks:

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 a general reference point, the implications of continuing to fish at $F_{0.1}$ in 1986 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those expected at the $F_{0.1}$ level. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1986 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 weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stock.

L. S. Parsons, Assistant Deputy Minister
Atlantic Fisheries, Department of Fisheries and Oceans
Ottawa, Ontario

## ANNEX 4. DENMARK (GREENLAND) REQUEST FOR FURTHER ADVICE ON THE SHRIMP FISHERY IN SUBAREA 1

1. Paragraph 2 of Article 6 of the regulation of the Greenland Home Rule Government establishing certain technical measures for the regulation of fisheries stipulates that shrimp which weigh 2 g or more must not be discarded.

2. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO to provide advice on the following:

   a) Whether the catches which are given in its reports, upon which TACs for shrimp in Greenland waters are based, are total catches or only landings (i.e. total catches minus rejects).

   b) The estimated total catches, if the reported data are landings.

   c) The weight distribution of the total catches and the proportion of small shrimp (2-5 g) therein.

   d) The probable conservation of the above regulation on the long-term available yield.

   e) Whether the regulation has any consequence for the size of the recommended TACs for 1985.

   f) What practical technical measures (such as minimum mesh sizes, closed areas, etc.), if any, could be taken to minimize the catches of small shrimp (2-50 g).

Received via the Ministry of
Fisheries and Trade
Greenland Home Rule Government

APPENDIX V. LIST OF PARTICIPANTS AT JUNE 1985 MEETING OF SCIENTIFIC COUNCIL

## CANADA

| | |
|---|---|
| Anderson, J. | Northwest Atlantic Fisheries Centre, P. O. Box 5667, St. John's, Newfoundland |
| Atkinson, D. B. | " " " " " " " |
| Carscadden, J. E. | " " " " " " " |
| Baird, J. W. | " " " " " " " |
| Bishop, C. A. | " " " " " " " |
| Bowering, W. R. | " " " " " " " |
| Brodie, W. B. | " " " " " " " |
| Kulka, D. | " " " " " " " |
| Lilly, G. | " " " " " " " |
| Miller, D. | " " " " " " " |
| Nakashima, B. | " " " " " " " |
| Pinhorn, A. T. | " " " " " " " |
| Pitt, T. K. | " " " " " " " |
| Wells, R. | " " " " " " " |
| Winters, G. H. | " " " " " " " |
| Fanning, L. P. | Marine Fish Division, DFO, Bedford Institute of Oceanography, Dartmouth, Nova Scotia |
| Halliday, R. G. | " " " " " " " |
| Koeller, P. A. | " " " " " " " |
| Mahon, R. | " " " " " " " |
| O'Boyle R. | " " " " " " " |
| Sinclair, A. F. | " " " " " " " |
| Waldron, D. E. | " " " " " " " |
| Zwanenburg, K. C. T. | " " " " " " " |
| Drinkwater, K. | Marine Ecology Lab., DFO, Bedford Institute of Oceanography, Dartmouth, Nova Scotia |
| Frank, K. | " " " " " " " |
| Lambert, T. C. | " " " " " " " |
| Trites, R. W. | " " " " " " " |
| Rowell, T. W. | Invertebrates and Marine Plants Div., DFO, P. O. Box 550, Halifax, Nova Scotia |
| Young, J. H. | " " " " " " " |
| Gavaris, S. | Marine Fish Division, DFO, Biological Station, St. Andrews, New Brunswick |
| Hunt, J. J. | " " " " " " " |
| Clay, D. | Marine Fisheries Div., DFO, Gulf Fisheries Center, P.O. Box 5030, Moncton, New Brunswick |
| Beckett, J. S. | Resource Services Directorate, DFO, 200 Kent Street, Ottawa, Ontario |
| Keeley, J. R. | Marine Environmental Data Service, 200 Kent Street, Ottawa, Ontario |
| Fréchet, A. | Fisheries Research Branch, DFO, P. O. Box 15,500, Quebec City, Quebec |

## CUBA

| | |
|---|---|
| Dominguez, R. | Flota Cubana de Pesca, Ave. Pesquera esq. Desamparados, Havana |

## DENMARK (GREENLAND)

| | |
|---|---|
| Horsted, Sv. Aa. | Grønlands Fiskeri-og Miljoundersogelser, Tagensvej 135, 1, DK-2200 Kobenhavn N |
| Lehmann, K. M. | " " " " " " " |

## EUROPEAN ECONOMIC COMMUNITY (EEC)

| | |
|---|---|
| Cross, D. | Eurostat, Batiment Jean Monnet, B. P. 1907, Luxembourg |
| Kopp, J. K. | IFREMER, B. P. 4240, 97500 Saint Pierre et Miquelon, France |
| Noé, R. | Commission of European Communities, 200 rue de la Loi, Brussels, Belgium |
| Maucorps, A. | IFREMER, B. P. 1049, F-44037 Nantes-Cedex, France |
| Messtorff, J. | Institut fur Seefischerei, Fischkai, D-2850 Bremerhavn 29, Federal Republic of Germany |
| Schumacher, A. | Institut fur Seefischerei, Palmaille 9, D-2000 Hamburg, Federal Republic of Germany |
| Stein, M. | " " " " " " " " |

## JAPAN

| | |
|---|---|
| Kawahara, S. | Far Sea Fisheries Research Laboratory, 7-1 Orido, 5-Chome, Shimizu 424 |

List of Participants (continued)

PORTUGAL

| | |
|---|---|
| Boavida, J. G. | Secretaria da Estado das Pescas, Av. 24 Julho 80, 1200 Lisbon |
| Coelho, M. L. | Instituto Nacional de Investigacao das Pescas, Av. de Brasilia, 1400 Alges |

SPAIN

| | |
|---|---|
| Larrañeta, M. G. | Instituto Investigaciones Pesqueras, Muelle de Bouzas, Vigo |
| Vazquez, A. | " " " " " " |

UNION OF SOVIET SOCIALIST REPUBLICS (USSR)

| | |
|---|---|
| Kovalev, S. | PINRO, 6 Knipovich Street, Murmansk |
| Rikhter, V. A. | AtlantNIRO, 5 Dmitry Donskoy Street, Kaliningrad |
| Solodovniic, V. | Ministry of Fisheries of the USSR, 12 Rozhdestvensky Bould, Moscow |

OBSERVERS

| | |
|---|---|
| Grosslein, M. D. | Northeast Fisheries Center, National Marine Fisheries Service, Woods Hole, Mass. |
| DeLuca, F. | FIDI, Food and Agriculture Organization (FAO), 00100 Rome, Italy |

APPENDIX VI. LIST OF RESEARCH AND SUMMARY DOCUMENTS, 1985

RESEARCH DOCUMENTS (SCR)

A. SCIENTIFIC COUNCIL MEETING - JANUARY 1985

| | | |
|---|---|---|
| 85/1 | N935 | BOWEN, W. D., and D. E. SERGEANT. A mark-recapture estimate of 1983 harp seal pup production in the Northwest Atlantic. (14 pages) |
| 85/2 | N936 | BOWEN, W. D. An estimate of the proportion of recovered harp seal tags not returned for reward: the 1983 mark-recapture experiment. (7 pages) |
| 85/3 | N937 | CARLSSON, D. M. Data on the shrimp fishery in NAFO Subarea 1 in 1983 and 1984. (46 pages) |
| 85/4 | N938 | PARSONS, D. G., P. J. VEITCH, and G. E. TUCKER. Catch, effort, CPUE and biological data from the Canadian fishery for shrimp (Pandalus borealis) in Division 0A, 1984. (19 pages) |
| 85/5 | N939 | SMEDSTAD, O. M. Preliminary report of a cruise with M/T Masi to East Greenland waters in September 1984. (6 pages) |
| 85/6 | N940 | SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (Pandalus borealis) off West Greenland in 1984. (8 pages) |
| 85/7 | N941 | SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (Pandalus borealis) in East Greenland waters in 1984. (6 pages) |
| 85/8 | N952 | KANNEWORFF, P. Biomass of shrimp (Pandalus borealis) in NAFO Subarea 1 in 1981-84, estimated by means of bottom photography. (18 pages) |
| 85/9 | N943 | KAPEL, F. O. Trends in catches of harp and hooded seals in Greenland, 1939-83. (19 pages) |
| 85/10 | N944 | POULARD, J. C., and B. FONTAINE. Catch, effort and biological data of shrimp (Pandalus borealis) in the French fishery off East Greenland in 1984. (12 pages) |
| 85/11 | N945 | HALLGRIMSSON, I., and U. SKÚLADÓTTIR. The Icelandic shrimp (Pandalus borealis) fishery in Denmark Strait in 1984. (4 pages) |
| 85/12 | N946 | CARLSSON, D. M. Data on the shrimp fishery at East Greenland in 1984 compared to earlier years. (13 pages) |
| 85/13 | N947 | LARSEN, F. Report on harp seal recoveries in Greenland, 1981-84. (4 pages) |
| 85/14 | N948 | HAY, K., R. A. MYERS, and W. D. BOWEN. Estimation of pup production of hooded seal (Cystophora cristata) in the Northwest Atlantic during March 1984. (39 pages) |
| 85/15 | N949 | SKÚLADÓTTIR, U. The sustainable yield of Pandalus borealis in the Denmark Strait area. (4 pages) |

B. SCIENTIFIC COUNCIL MEETING - JUNE 1985

| | | |
|---|---|---|
| 85/16 | N956 | KULKA, D. W. The effect of changing effort patterns of catch composition in the roundnose grenadier fishery, 1978-83. (19 pages) |
| 85/17 | N958 | STEIN, M. Cold water off West Greenland - teleconnection with El Nino? (4 pages) |
| 85/18 | N959 | ARMSTRONG, R. S. Bottom temperatures on the continental shelf and slope south of New England during 1984. (7 pages) |
| 85/19 | N960 | PRICE, C. A. Anticyclonic warm core Gulf Stream rings off the northeastern United States during 1984. (12 pages) |
| 85/20 | N961 | JOSSI, J. W., and D. E. SMITH. The continuous plankton recorder survey: Massachusetts to Cape Sable, Nova Scotia, and New York to the Gulf Stream, 1984. (11 pages) |

List of Research Documents (SCR) (continued)

85/21 N962 JOSSI, J. W. Surface temperature and salinities: Massachusetts to Cape Sable, Nova Scotia, and New York to the Gulf Stream, 1984. (8 pages)

85/22 N963 ARMSTRONG, R. S. Variation in the shelf water front position in 1984 from Georges Bank to Cape Romain. (8 pages)

85/23 N964 INGHAM, M. C., and D. R. McLAIN. Sea-surface temperatures in the northwestern Atlantic in 1984. (9 pages)

85/24 N965 BENWAY, R. L. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1984. (6 pages)

85/25 N975 DREW, H. J., E. G. DAWE, and P. C. BECK. The 1984 fishery for short-finned squid (Illex illecebrosus) in the Newfoundland area. (7 pages)

85/26 N976 ROWELL, T. W., and F. BUDDEN. The 1984 fishery for Illex illecebrosus in SA 4 and biological characteristics of the stocks. (11 pages)

85/27 N977 ROWELL, T. W., J. H. YOUNG, J. C. POULARD, and J. P. ROBIN.. Biological characteristics and biomass estimates of the squid (Illex illecebrosus) on the Scotian Shelf (Div. 4VWX) in 1984. (20 pages)

85/28 N978 VAZQUEZ, J., and A. VAZQUEZ. Status of the cod sotck in Divisions 3L, 3M and 3N in 1984. (6 pages)

85/29 N979 STEIN, M., and E. BUCH. Mean temperature conditions off Fyllas Bank/West Greenland. (3 pages)

85/30 N980 STEIN, M., and E. BUCH. Short time variability off Fyllas Bank/West Greenland. (7 pages)

85/31 N981 STEIN, M. On the distribution of Labrador sea water. (7 pages)

85/32 N982 MAUCORPS, A., and J. C. POULARD. Contribution to the assessment of the cod stock in Subdivision 3Ps. (6 pages)

85/33 N983 RIKHTER, V. A., and V. F. TUROK. Distribution of some groundfish species on the Scotian Shelf during the 1984 fishing season from the data of Soviet observers. (11 pages)

85/34 N984 RIKHTER, V. A., and E. I. KONOVALOV. On the question of relationship of growth rate of gonads, abundance and timing of silver hake migration from the Scotian Shelf in summer. (8 pages)

85/35 N985 RIKHTER, V. A. Comparative estimating of total instantaneous mortality rate for the Scotian Shelf silver hake (Divisions 4VWX) from the data of Canadian groundfish surveys and commercial catches per unit effort. (7 pages)

85/36 N986 NOSKOV, A. S. Assessment of the Scotian silver hake (Merluccius bilinearis) stocks and allowable catch in 1986. (13 pages)

85/37 N987 BAIRD, J. W., and C. A. BISHOP. Assessment of the cod stock in NAFO Divisions 2J+3KL. (31 pages)

85/38 N988 BISHOP, C. A., and J. W. BAIRD. An assessment of the cod sotck in Subdivision 3Ps. (20 pages)

85/39 N989 BISHOP, C. A., and J. W. BAIRD. Assessment of the cod stock in NAFO Divisions 3NO. (16 pages)

85/40 N990 LEAR, W. H. Migration of intermingling of cod in relation to the Canadian 200-mile limit around the nose (NAFO Division 3L) and the tail (NAFO Division 3N) of the Grand Bank. (14 pages)

List of Research Documents (SCR) (continued)

85/41 N991 LEAR, W. H., and W. R. BOWERING. Minimum trawlable biomass estimates of Arctic cod (Boreogadus saida) in NAFO Divisions 2G and 2H from post-stratified groundfish surveys. (8 pages)

85/42 N992 LEAR, W. H., and J. W. BAIRD. Minimum estimates of abundance of Arctic cod (Boreogadus saida) in NAFO Divisions 2J, 3K and 3L from research vessel surveys. (14 pages)

85/43 N993 BOWERING, W. R., and W. B. BRODIE. The status of the Greenland halibut (Reinhardtius hippoglossoides) stock in NAFO Subarea 2 and Divisions 3KL. (21 pages)

85/44 N994 BOWERING, W. R. The witch flounder fishery in NAFO Divisions 3NO. (4 pages)

85/45 N1006 AKHTARINA, T. A., and S. V. CHECHENIN. Results of ichthyoplankton survey on Flemish Cap Bank in March-April 1984. (5 pages)

85/46 N995 ATKINSON, D. B. The roundnose grenadier of Subareas 0+1 and 2+3. (12 pages)

85/47 N996 HATANAKA, H. Some morphological features and body size of early stage short-finned squid (Illex illecebrosus) in the Northwest Atlantic. (11 pages)

85/48 N997 ATKINSON, D. B. The redfish of NAFO Div. 3M. (10 pages)

85/49 N998 ATKINSON, D. B. The redfish of NAFO Div. 3LN. (9 pages)

85/50 N999 BRODIE, W. An assessment of the yellowtail flounder stock in NAFO Div. 3L, 3N, and 3O. (19 pages)

85/51 N1000 BRODIE, W. An assessment update of the American plaice stock in NAFO Divisions 3LNO. (24 pages)

85/52 N1001 BAKANEV, V. S., and K. V. GORCHINSKY. Hydroacoustic survey of capelin stocks in Divisions 2J+3K and trawl survey of capelin prerecruits in Divisions 3KLNO in November 1984-January 1985. (11 pages)

85/53 N1002 NIKOLSKAYA, T. L., A. N. SAVATEEVA, and V. L. TRETYAK. Estimation of the stock abundance and TAC for beaked redfish in Div. 3LN and 3M for 1985. (22 pages)

85/54 N1003 BAKANEV, V. S., L. S. LUGOVAYA, and V. L. TRETYAK. Estimation of the stock abundance and TAC for capelin in Div. 2J+3K and 3LNO for 1985-1986. (13 pages)

85/55 N1004 MAMYLOV, V. S., and V. S. BAKANEV. Soviet investigations of capelin stocks in Divisions 3LNO in May-June 1984. (12 pages)

85/56 N1005 PERLYUKM, M. F., A. K. CHUMAKOV, and A. Yu. BULATOVA. Dissolved organic matter - index of increased biological productivity zones. (7 pages)

85/57 N1007 ALBIKOVSKAYA, L. K.. Length-age composition of Benthosema glaciale (Myctophidae) from the southern slope of the Grand Bank. (6 pages)

85/58 N1008 ZUBCHENKO, A. V. Characteristics of parasitofauna and some comments on intra-specific structure of American plaice (Hippoglossoides platessoides platessoides (Febricius). (11 pages)

85/59 N1009 BOROVKOV, V. A., and V. V. BURMAKIN. Hydrographic conditions off the Labrador and Newfoundland in 1983-1984. (17 pages)

85/60 N1010 SIGAEV, I. K. Year to year variability of water temperatures on the Scotian Shelf in summer 1978-1981 and Fall 1977-1984. (11 pages)

85/61 N1011 ROSENØRN, S., J. FABRICIUS, E. BUCH, and Sv. Aa. HORSTED. Record-hard winters at West Greenland. (17 pages)

List of Research Documents (SCR)' (continued)

85/62 N1014 HANSEN, H. H., and E. BUCH. Prediction of year-class strength of cod off West Greenland. (9 pages)

85/63 N1015 CORNUS, H. P., H. H. HANSEN, Sv. Aa. HORSTED, J. MØLLER JENSEN, K. M. LEHMANN, J. MEBTORFF, and SCHUMACHER. Status of the West Greenland cod stock and management considerations. (25 pages)

85/64 N1016 FANNING, P. Interclibration of silver hake abundance estimates from research vessel surveys by different vessels. (3 pages + addendum)

85/65 N1017 WELLS, R., and J. BAIRD. Age compositions of cod in longline samples in 1984 and an abundance estimate from a research vessel survey in 1985 on the Flemish Cap. (5 pages)

85/66 N1018 HUNT, J. J. Comparison of USSR and Canadian estimates of silver hake ageing. (3 pages)

85/67 N1019 HUNT, J. J. Assessment of the historical consistency of Canadian research vessel surveys as an indicator of silver hake abundance. (25 pages)

85/68 N1020 WALDRON, D. E., and L. P. FANNING. Status of the Scotian Shelf silver hake population in 1984. (35 pages)

85/69 N1021 TRITES, R. W., and T. W. ROWELL. Larval and juvenile distribution of the short-finned squid (Illex illecebrosus) in the Cape Hatteras-Florida Straits area in the December-January perio, 1984-1985. (36 pages)

85/70 N1023 CARSCADDEN, J. E., and V. M. HODDER. Preliminary list of studies related to environmentally-induced variation in availability of marine species. (8 pages)

85/71 N1026 KEELEY, J. R. Marine Environmental Data Service report for 1984/85. (60 pages)

85/72 N1027 LILLY, G. R.. Cod (Gadus morhua) on the Flemish Cap fed primarily on redfish (Sebastes sp.) in winter 1984. (7 pages)

85/73 N1028 MILLER, D. S. Capelin (Mallotus villosus) hydroacoustic surveys in NAFO Divisions 3L and 3LNO in 1984. (6 pages + addendum)

85/74 N1029 TRITES, R. W., and K. F. DRINKWATER. Overview of environmental conditions in the Northwest Atlantic in 1984. (36 pages)

85/75 N1033 KULKA, D. W. Estimates of discarding by the Newfoundland offshore fleet in 1983. (19 pages)

85/76 N1034 NAKASHIMA, B. S., and R. W. HARNUM. The 1984 inshore capelin fishery in Div. 3L. (11 pages)

85/77 N1035 CLAY, D., and G. NIELSEN. Age specific M and its effect on VPA: Div. 4VWX silver hake. (11 pages)

85/78 N1036 WOOD, B. M. Early entry in the Scotian Shelf silver hake fishery: activity of Cuban vessels in April 1984 and April 1985. (9 pages)

SUMMARY DOCUMENTS (SCS)

A. SCIENTIFIC COUNCIL MEETING - JANUARY 1985

85/1 N950 NAFO SECRETARIAT. Provisional sealing statistics for 1984. (2 pages)

85/2 N951 NAFO. Provisional report of Scientific Council Meeting, January 1985. (35 pages)

List of Summary Documents (SCS) (continued)

B. SCIENTIFIC COUNCIL MEETING - JUNE 1985

85/3 N957 CWP Secretary. Report of the Twelfth Session of the Coordinating Party on Atlantic Fishery Statistics (CWP), July 1984. (1 page)

85/4 N966 NAFO SECRETARIAT. Tagging activities reported for the Northwest Atlantic in 1984.

85/5 N967 GALLAGHER, E. EEC request for scientific advice on management in 1986 of the cod stock in Subdivision 3Ps. (1 page)

85/6 N968 PARSONS, L. S. Canadian request for scientific advice on management in 1986 of certain stocks in Subareas 0 to 4. (1 page)

85/7 N969 TROLLE, K. Denmark (Greenland) request for scientific advice on management in 1986 of certain stocks in Subarea 1. (2 pages)

85/8 N970 VIA MINISTRY OF FISHERIES AND TRADE. Denmark (Greenland) request for further advice on the shrimp fishery in Subarea 1. (1 page)

85/9 N971 NAFO SECRETARIAT. Historical catches of selected species by stock areas and country for the period 1973-83. (38 pages)

85/10 N972 COADY, L. W.. Canadian (Newfoundland Region) research report, 1984. (9 pages)
Part I
Part II (not yet received)
Part III HARE, G. M.. Canadian (Gulf Region) research report, 1984. (3 pages)
Part IV MAGUIRE, J. J.. Canadian (Quebec Region) research report, 1984 (4 pages)

85/11 N973 GROSSLEIN, M. D., and E. D. ANDERSON. United States research report for 1984. (8 pages)

85/12 N974 LARRANETA, M. G. Spanish research report, 1984. (2 pages)

85/13 N1012 KAWAHARA, S. Japanese research report for 1984. (3 pages)

85/14 N1013 CHUMAKOV, A. K., and V. A. POLETAEV. USSR research report for 1984 (Subareas 0, 2, and 3) (Part I) (22 pages)

NOSKOV, A. S. USSR research report for 1984 (Subarea 4) (Part II) (4 pages)

85/15 N1022 GODINHO, M. L. Portuguese research report, 1984. (9 pages)

85/16 N1024 POULARD, J. C. France research report for 1984. (6 pages)

85/17 N1025 SMIDT, E. Denmark (Greenland) research report for 1984. (15 pages)

85/18 N1037 NAFO SECRETARIAT. Provisional lists of sampling data, 1979-83. (72 pages)

85/19 N1041 NAFO SECRETARIAT. Preliminary lists of sampling data, 1984. (25 pages)

85/20 N1039 NOË, R. On the formulation of scientific advice by the NAFO Scientific Council for stocks in the Regulatory Area (exclusive or overlapping) (2 pages)

85/21 N1040 ASSISTANT EXECUTIVE SECRETARY. Notes on statistical activities and related publications, 1983/84. (3 pages)

Northwest Atlantic Fisheries Organization

Serial No. N1048

NAFO SCS Doc. 85/22
(Addendum)

SCIENTIFIC COUNCIL MEETING - JUNE 1985

Addenda

to

Provisional Report of Scientific Council

Dartmouth, Canada, 5-20 June 1985

A. The following addendum pertains to the omission noted on page 3 of SCS Doc. 85/22.

## I. FISHERY SCIENCE (APP. I)

1. General Fishery Trends

From near-final statistics for 1983 and provisional data for 1984, the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) decreased (7%) from 2.79 million (metric) tons in 1983 to 2.60 million tons in 1984 (see Appendix I, Table 1). The total catch of groundfish species decreased (9%) from 1.25 million tons in 1983 to 1.18 million tons in 1984, due mainly to decreased catches of cod, haddock, yellowtail flounder, Greenland halibut, and winter flounder, although increases were noted for redfish, silver hake, pollock, witch flounder and white hake. The catch of pelagic fish declined (17%) from 562,000 tons in 1983 to 469,000 tons in 1984, due mainly to a large decrease for menhaden (28%) although increases were noted for mackerel and butterfish. For the other finfish group of species, the 1984 catch of 112,000 tons was 27% higher than the 1983 catch of 89,000 tons, due almost entirely to the increase catch of capelin. The total catch of invertebrate species decreased (6%) from 890,000 tons in 1983 to 836,000 tons in 1984, due mainly to decreased catches of squids, scallops, oyster, and various crustaceans.

With respect to the total nominal catches by subarea, an increase from 1983 to 1984 was recorded only for Subarea 3 (489,000 to 516,000 tons), and decreases were noted for Subarea 0 (10,000 to 1,000 tons), Subarea 1 (121,000 to 90,000 tons), Subarea 2 (83,000 to 53,000 tons), Subarea 4 (688,000 to 685,000 tons), Subarea 5 (456,000 to 427,000 tons) and Subarea 6 (940,000 to 824,000 tons).

B. The following addendum pertains to the omission noted on page 11 of SCS Doc. 85/22.

## I. FISHERY TRENDS

1. General Trends for the Northwest Atlantic

In Table 1, the nominal catches for 1983 are still provisional to the extent that final data have not been received from France, and the provisional data for 1984 are those reported on STATLANT 21A forms by all national statistical agencies except France.

The overall reported catch (round fresh weight) of all finfish and invertebrates at 2.60 million tons in 1984 was 7% lower than the 1983 provisional catch of 2.79 million tons. The total groundfish catch, which represented about 46% of the overall catch in 1984, decreased (5%) from 1.25 million tons in 1983 to 1.18 million tons in 1984, due mainly to decreased catches of cod (14%), haddock (18%), yellowtail flounder (27%) and Greenland halibut (18%), which were partly offset by increased catches of redfish (11%), silver hake (81%) and pollock (8%). The total pelagic fish catch, which represented 18% of the overall catch in 1984, decreased (17%) from 562,000 tons in 1983 to 469,000 tons in 1984, due mainly to decreases for herring (5%) and menhaden (28%) although the catch of mackerel increased by 23%. The total "other finfish" catch, which represented only 4% of the overall catch in 1984, increased from 89,000 tons in 1983 to 112,000 tons in 1984, due almost entirely to an increase in the capelin catch from 41,000 tons in 1983 to 61,000 tons in 1984. The total catch of invertebrates, which represented 32% of the overall catch in 1984, decreased (6%) from 890,000 tons in 1983 to 836,000 tons in 1984, due mainly to decreased catches of squids (17%), scallops (17%), shrimps (22%) and crabs (17%), although an increase was noted for the catch of clams (14%).

2. Fishery Trends by Subarea

a) Subarea 0

The unusually low catch of 1,000 tons in 1984 was considerably lower than the 1983 catch of about 10,000, due to greatly reduced catches of Greenland halibut (480 tons) and shrimp (560 tons) which were the dominant species.

b) Subarea 1

The total nominal catch of all species declined significantly (26%) from 121,000 tons in 1983 to 90,000 tons in 1984, due almost entirely to the decreased catches of cod (47%) and shrimp (17%). These species represented 82% of the total catch in 1983 and 72% in 1984.

c) Subarea 2

The total nominal catch of all species declined (36%) from 83,000 tons in 1983 to 53,000 tons in 1984, this being the lowest recorded catch in this subarea. The decline was due mainly to decreased catches of cod (55%) and Greenland halibut (25%), although the capelin catch increased by 50%.

d) Subarea 3

The total nominal catch of all species increased slightly (6%) from 489,000 tons in 1983 to 516,000 tons in 1984, due mainly to increases for redfish (9%), yellowtail flounder (44%) and capelin (43%). These were partly offset by decreased catches of Greenland halibut (12%) and mackerel (37%). The cod catch, which represents about 55% of the overall total catch in the subarea, was approximately the same in 1984 as in 1983 (275,000 tons).

e) Subarea 4

The total nominal catch of all species was essentially the same in 1984 (685,000 tons) as in 1983 (688,000 tons). While increased catches were noted for redfish (24%), silver hake (106%) and American plaice (29%), decreases were recorded for cod (12%), haddock (20%), herring (13%) and scallops (27%).

f) Subarea 5

The total nominal catch of all species declined (6%) from 456,000 tons in 1983 to 427,000 tons in 1984. This was due mainly to decreased catches of cod (20%), haddock (26%), American plaice (23%), yellowtail flounder (53%), menhaden (12%) and scallops (27%), although increases were noted for pollock (11%), herring (43%), clams (30%) and lobsters (29%).

g) Subarea 6

The total nominal catch of all species declined significantly (12%) from 940,000 tons in 1983 to 824,000 tons in 1984, due largely to decreased catches of menhaden (30%), squids (14%), oysters (27%) and crabs (29%), although increases were noted for mackerel (125%) clams (11%) and scallops (18%).

Table 1. Provisional nominal catches (000 tons) by subarea for 1983 and 1984 (+ indicates less than 500 tons.)

| Species | SA 0 | | SA 1 | | SA 2 | | SA 3 | | SA 4 | | SA 5 | | SA 6 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| Atlantic cod | - | - | 58 | 31 | 55 | 25 | 274 | 276 | 242 | 214 | 65 | 52 | + | + | 694 | 598 |
| Haddock | - | - | + | - | - | - | 1 | 4 | 35 | 28 | 19 | 14 | - | + | 56 | 46 |
| Atlantic redfishes | + | - | 7 | 6 | 2 | 2 | 65 | 71 | 37 | 46 | 5 | 5 | - | - | 117 | 130 |
| Silver hake | - | - | - | - | - | - | - | + | 36 | 74 | 12 | 14 | 6 | 7 | 53 | 96 |
| Red hake | - | - | - | - | + | - | + | + | 1 | + | 2 | 2 | 1 | 1 | 3 | 3 |
| Pollock | - | - | - | - | + | - | 1 | 2 | 30 | 31 | 18 | 20 | + | + | 49 | 53 |
| American plaice | - | - | + | + | + | + | 43 | 41 | 14 | 18 | 13 | 10 | + | + | 71 | 69 |
| Witch flounder | - | - | - | - | + | + | 7 | 8 | 3 | 3 | 6 | 6 | + | + | 16 | 18 |
| Yellowtail flounder | - | - | - | - | - | - | 9 | 13 | 2 | 3 | 32 | 15 | 2 | 3 | 45 | 33 |
| Greenland halibut | 5 | + | 4 | 7 | 12 | 9 | 16 | 14 | 1 | 2 | - | - | - | - | 38 | 31 |
| Other flounders | - | - | 1 | + | + | + | 3 | 5 | 8 | 5 | 19 | 18 | 10 | 13 | 40 | 42 |
| Roundnose grenadier | + | + | + | + | 2 | + | 2 | 3 | - | - | - | - | - | - | 4 | 4 |
| White hake | - | - | - | - | + | - | 3 | 5 | 11 | 11 | 7 | 7 | + | + | 22 | 24 |
| Wolffishes | + | - | 3 | 2 | + | + | 4 | 2 | 3 | 2 | 1 | 1 | - | - | 11 | 7 |
| Other groundfish | - | - | 6 | 7 | + | + | + | + | 6 | 4 | 10 | 11 | 6 | 6 | 28 | 28 |
| Atlantic herring | - | - | + | + | + | + | 1 | 2 | 142 | 123 | 23 | 33 | + | + | 166 | 158 |
| Atlantic mackerel | - | - | - | - | - | - | 8 | 5 | 12 | 13 | 2 | 2 | 8 | 18 | 30 | 37 |
| Atlantic menhaden | - | - | - | - | - | - | - | - | - | - | 40 | 35 | 309 | 217 | 350 | 252 |
| Other pelagics | - | - | - | - | - | - | 1 | 1 | 1 | 1 | 7 | 12 | 8 | 8 | 17 | 22 |
| Capelin | - | - | + | 1 | 10 | 15 | 30 | 43 | 1 | 2 | - | - | - | - | 41 | 61 |
| Other finfish | + | + | 1 | 2 | 1 | 1 | 4 | 6 | 7 | 9 | 11 | 11 | 24 | 22 | 48 | 50 |
| Squids | - | - | - | - | - | - | - | + | + | + | 11 | 7 | 29 | 25 | 40 | 33 |
| Clams | - | - | - | - | - | - | - | + | 5 | 7 | 43 | 56 | 276 | 307 | 324 | 369 |
| Scallops | - | - | - | - | + | + | 5 | 4 | 22 | 16 | 75 | 55 | 28 | 33 | 130 | 108 |
| Other molluscs | - | - | - | - | - | - | - | + | 2 | 3 | 15 | 16 | 151 | 107 | 168 | 127 |
| Shrimps | 5 | 1 | 41 | 34 | 1 | 1 | - | - | 10 | 9 | 2 | 3 | + | + | 60 | 47 |
| Crabs | - | - | - | - | - | - | 11 | 10 | 31 | 34 | 3 | 3 | 78 | 55 | 123 | 102 |
| Lobsters | - | - | - | - | - | - | 1 | 1 | 26 | 27 | 14 | 18 | 2 | 2 | 43 | 49 |
| Other invertebrates | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 2 | + | 2 | 1 |
| Total | 10 | 1 | 121 | 90 | 83 | 53 | 489 | 516 | 688 | 685 | 456 | 427 | 940 | 824 | 2789 | 2598 |

Northwest Atlantic Fisheries Organization

Serial No. N1048

NAFO SCS Doc. 85/22
(Corrigenda)

SCIENTIFIC COUNCIL MEETING - JUNE 1985

Provisional Report of Scientific Council

Dartmouth, Canada, 5-20 June 1985

## Corrigenda

To avoid significant delay in the distribution of the Provisional Report of Scientific Council after the 1985 Meeting, it was dispatched without detailed proofreading of the text. Subsequent reading has revealed a number of minor corrections and omissions which are listed below:

| | |
|---|---|
| Page 3, para. 1, line 8: | managmenet = management |
| para. 2, line 3: | insert after "USA" the words " and Food and Agriculture Organization (FAO)" |
| 4 lines from bottom: | lsited = listed |
| Page 5, para 2, line 2: | that meeting = this meeting |
| Page 6, sect. 1(b), line 8: | time submission = time of submission |
| sect. 2(b), line 1: | "...proposal that time series of survey data be ..." |
| Page 8, sect. 4, line 2: | met = meet |
| Page 9, Adjournment: | Insert the following paragraph between the third and fourth paragraphs. |
| | "Sv. Aa. Horsted noted that Dr. T. K. Pitt (Canada), who had served as as valuable member of STACRES (ICNAF) and STACFIS (NAFO) as well as Chairman of STACREC, would be retiring in a few months and that this meeting would be his last. On behalf of the Council, he expressed gratitude for Dr. Pitt's contributions over the years and wished him well during his retirement". |
| Page 13, sect. (v), line 7: | change "to spread" to "from spreading" |
| Page 14, para. 4, line 2: | tempeature = temperature |
| Page 18, sect. b(i), line 13: | to both periods = in both periods |
| Page 21, sect. b(i), line 10: | only a small portion = only small portions |
| Page 22, sect. (e), line 4: | 1981 year-clasaes = 1981 year-classes |
| Page 28, sect. 6(a), line 11: | comercial = commercial |
| sect. 6(b), line 7: | farily = fairly |
| sect. 7(a), line 2: | fishing = fishery |
| line 3: | (000) = (000 tons) |
| Page 29, sect. (d), line 7: | model length = modal length |
| Page 31, sect. (b)(i), line 1: | tonnage class 7 trawlers |
| Page 33, sect. 11(b)(i), line 1: | Catches rates = Catch rates |
| Page 35, sect. (e), line 13: | at TAC = a TAC |
| Page 37, sect. c(i), line 9: | average = averaging |
| Page 38, sect. 14(a), line 3: | delete in 1984 |

| | |
|---|---|
| Page 39, sect. (d), line 1: | recently = recent |
| Page 41, sect. (b), line 2: | "from the Canadian observer ..." |
| Page 44, line 4: | underestimated = underestimate<br>larger variation = large variance |
| Page 46, sect. (ii), line 6: | throughtout = throughout |
| Page 47, sect. 21, line 2: | were given = was given |
| Page 48, sect. (e), line 1: | in position = in a position |
| para. below (f), line 6: | so far for = as far as |
| sect. 2 heading: | Environmetnal = Environmental |
| Page 51, sect 1, line 6: | achevied = achieved |
| Page 54, top, line 5: | "or spawning stock and year-class ..." |
| Page 57, sect. (b), line 1: | Council = Committee<br>and its brief = and a brief |
| Page 60, sect. 4(mid page): | Jnauary = January |