Northwest Atlantic Fisheries Organization

Serial No. N1216

NAFO SCS Doc. 86/24
(Corrigenda)

SCIENTIFIC COUNCIL MEETING - JUNE 1986

Provisional Report of Scientific Council
Dartmouth, Canada, 4-19 June 1986

The following corrigenda was noted after distribution of the report in July 1986.

Page 5. Para. 1, line 4: requirements

Page 9. Line 2 (top of page): insert the following sentence "In making these proposals for NAFO representation the Council points out that participation by the Chairman of STACREC and the country representatives would be, as traditionally, at national expense."

Page 9. Section 1(b), line 10: ... and effort statistics....

Page 15. Section 1, line 4: ...1985 were not available....

Page 32. Section 4(b)(ii), line 3: ...was incomplete and...

Page 34. Section 5(b)(ii), line 9: ...calibration of cohort analyses.....

Page 58. Section (c), line 3: ...TAC for 1987 should....

Page 61. Section 3(c): replace 4 lines after the question by the following:

"Estimates of Greenland halibut biomass in Div. 3L were available from Canadian seasonal surveys in 1984-86. The lowest estimate of biomass was 1,773 tons in the Regulatory Area during a winter survey which amounted to 78.1% of total estimate for the division. The highest estimate of biomass in the Regulatory Area was 7,005 tons during the summer survey which amounted to 32.3% of the total biomass estimate for the divison.

Page 67. Section 1, line 3: ...The estimates from...

Table 16 caption: Cod, flatfishes and redfish catches in 1985 (provisional).

Table 16 footnote: add "E Sum of columns B and D".

Page 70. Section 2(c), heading: insert document 86/56.

Page 72. Section 8, line 5: Oceanographers

Section 9, line 3: W. Thiele

Page 73; Section 10(d), line 5: Participants agreed that data from these areas were extremely useful in monitoring....

Section 10(d), line 6: The Subcommittee.....

Section 10(d), line 9: ...50°N and 44°W.

Page 78. Table 2, DEU (left column): reverse the dates of the surveys.

Page 83. Acknowledgements: insert the following:

"The Chairman expressed his thanks to the Committee members for their participation and to the Rapporteur and the Secretariat for their support of the Committee's work.

Northwest Atlantic Fisheries Organization

Serial No. N1216

NAFO SCS Doc. 86/24

SCIENTIFIC COUNCIL MEETING - JUNE 1986

Provisional Report of Scientific Council

Dartmouth, Canada, 4-19 June 1986

CONTENTS

		Page
I.	Fishery Science	5
1.	General Fishery Trends	5
2.	Assessment of Finfish and Invertebrate Stocks	6
3.	Environmental Research	7
4.	Ageing Techniques	8
5.	Other Matters	8
II.	Research Coordination	8
1.	Statistics and Sampling	8
2.	Biological Surveys	9
3.	Other Matters	10
III.	Publications	10
1.	Review of Publications	10
2.	Editorial Policy Concerning Publications	10
3.	Promotion and Distribution of Scientific Publications	10
4.	Production of Microfiche Copies of Meeting Documents	10
5.	Papers for Possible Publication	11
6.	Title and Scope of the Journal	11
IV.	Amendment to Rules of Procedure	11
1.	Report of Executive Secretary on Results of Vote by Mail	11
V.	Collaboration With Other Organizations	11
1.	NAFO/ICES Study Group on Redfish off Greenland	11
2.	Assessment of West and East Greenland Cod Stocks	12
3.	Proposal for Joint ICES/NAFO Working Group on Seals	12
4.	Coordinating Working Party on Atlantic Fishery Statistics (CWP)	12
VI.	Future Scientific Meetings	12
1.	Annual Meeting in September 1986	12
2.	Mid-term Meeting for Shrimp	12
3.	Scientific Council Meeting, June 1987	12
4.	Special Session in September 1987	13
VII.	Other Matters	13
1.	Provisional Report of January 1986 Meeting	13
2.	Theme for Special Session in September 1988	13
VIII.	Adjournment	13
Appendix I.	Report of Standing Committee on Fishery Science (STACFIS)	15
I.	Fishery Trends	15
II.	Stock Assessments	17
1.	Cod in Subarea 1	17
2.	Cod in Divisions 2J, 3K and 3L	24
3.	Cod in Division 3M	30

4. Cod in Divisions 3N and 3O 32
5. Cod in Subdivision 3Ps 34
6. Redfish in Subarea 1 36
7. Redfish in Division 3M 37
8. Redfish in Divisions 3L and 3N 37
9. Silver Hake in Divisions 4V, 4W and 4X 39
10. American Plaice in Division 3M 42
11. American Plaice in Divisions 3L, 3N and 3O 43
12. Witch Flounder in Divisions 3N and 3O 48
13. Yellowtail Flounder in Divisions 3L, 3N and 3O 48
14. Greenland Halibut in Subareas 0 and 1 50
15. Greenland Halibut in Subarea 2 and Divisions 3K and 3L 50
16. Roundnose Grenadier in Subareas 0 and 1 52
17. Roundnose Grenadier in Subareas 2 and 3 52
18. Wolffish in Subarea 1 53
19. Capelin in Divisions 3L, 3N and 3O 54
20. Squid-Illex in Subareas 2 to 6 57
21. Shrimp in Subareas 0 and 1 and in Denmark Strait 59

III. Response to Fisheries Commission Request 59

1. Cod in Divisions 2J, 3K and 3L 59
2. Cod in Division 3M 60
3. Greenland Halibut in Subarea 2 and Divisions 3K and 3L 60
4. Roundnose Grenadier in Subareas 2 and 3 61
5. Capelin in Division 3L 61
6. Squid in Subareas 3 and 4 62

IV. Environmental Research 63

1. Introduction 63
2. Review of Environmental Studies in 1985 63
3. Overview of Environmental Conditions in 1985 63
4. Environmentally-induced Variations in Stock Assessment Parameters 63

V. Ageing Techniques and Validation Studies 63

1. Validation of Age Determinations for Flemish Cap Cod 63
2. Redfish on Flemish Cap 64
3. Proposal for Second Workshop on Ageing Shrimp 64
4. Ageing Studies of Silver Hake 64

VI. Review of Scientific Papers 64

1. Variable Rates of Natural Mortality for Fish of Different Ages 64
2. Horizontal Distribution of Capelin During the Spawning Season at West Greenland 65
3. Fishing Grounds of Canadian Longliners in Subarea 5 65
4. Study of Ichthyoplankton on Flemish Cap, 1985 65
5. Redfish in the Irminger Sea 66
6. Egg and Larval Silver Hake Surveys on the Scotian Shelf 66
7. Ichthyoplankton Studies in the Western Atlantic Ocean 66
8. Comparative Studies of Trawl Gear Used for the Study of Juvenile Silver Hake 66
9. Acoustic Surveys of Capelin in Divisions 2J and 3K 66
10. Biology of Benthosema glaciale 66
11. Food of Greenland Halibut in Divisions 2J and 3K 66
12. Food of Cod in Divisions 2J and 3K 66
13. Newfoundland Fleet Discarding Practices 67
14. Changes in Weight-at-Age of Cod During 1980-85 67

VII. Other Matters 67

1. Reporting Problems with Catch Statistics 67
2. Progress Report on Contributions for the Special Session on Recruitment Studies in September 1986 68
3. Acknowledgements 68

Annex 1. Report of Subcommittee on Environmental Research 69

1. Marine Environmental Data Service (MEDS) Report for 1985/86 ... 69
2. Review of Environmental Studies in 1985 69
3. Overview of Environmental Conditions in 1985 71
4. Remote Sensing Activities at the Bedford Institute of Oceanography 71
5. Distribution of Squid Larvae and Juveniles in Relation to Oceanography 71
6. Marine Environment and Ecosystems Subcommittee (MEES) 72
7. Environmentally-induced Variations to Stock Assessments 72
8. Environmentally-related Aspects of Special Session in September 1987 72
9. National Representatives 72
10. Other Matters 72
11. Acknowledgements 73

Appendix II. Report of Standing Committee on Research Coordination (STACREC) ... 75

I. Statistics and Sampling 75

1. Fishery statistics 75
2. Biological sampling 76

II. Biological Surveys 76

1. Review of Survey Activities in 1985 76
2. Survey Plans for 1986 and Early 1987 76
3. Review of Stratification Schemes 76
4. Coordination of Surveys in 1986 and 1987 77
5. Documentation of Survey Design and Procedures 79

III. Other Matters 79

1. Review of Scientific Observer Program 79
2. List of Fishing Vessels 79
3. Tagging Activities Reported for 1985 79
4. Review of Relevant Documents 79
5. Modification of the Subarea 4/5 Boundary 79
6. Acknowledgements 79

Appendix III. Report of Standing Committee on Publications (STACPUB) 81

1. Review of Scientific Publications Since June 1985 81
2. Editorial Matters Regarding Scientific Publications 81
3. Promotion and Distribution of Scientific Publications 82
4. Progress Report on Microfiche Project 83
5. Papers for Possible Publication 83
6. Acknowledgements 83

Appendix IV. Agenda for the June 1986 Meeting 85

Annex 1. Fisheries Commission Request for Scientific Advice on Management in 1987 of Certain Stocks in Subareas 2 to 4 88

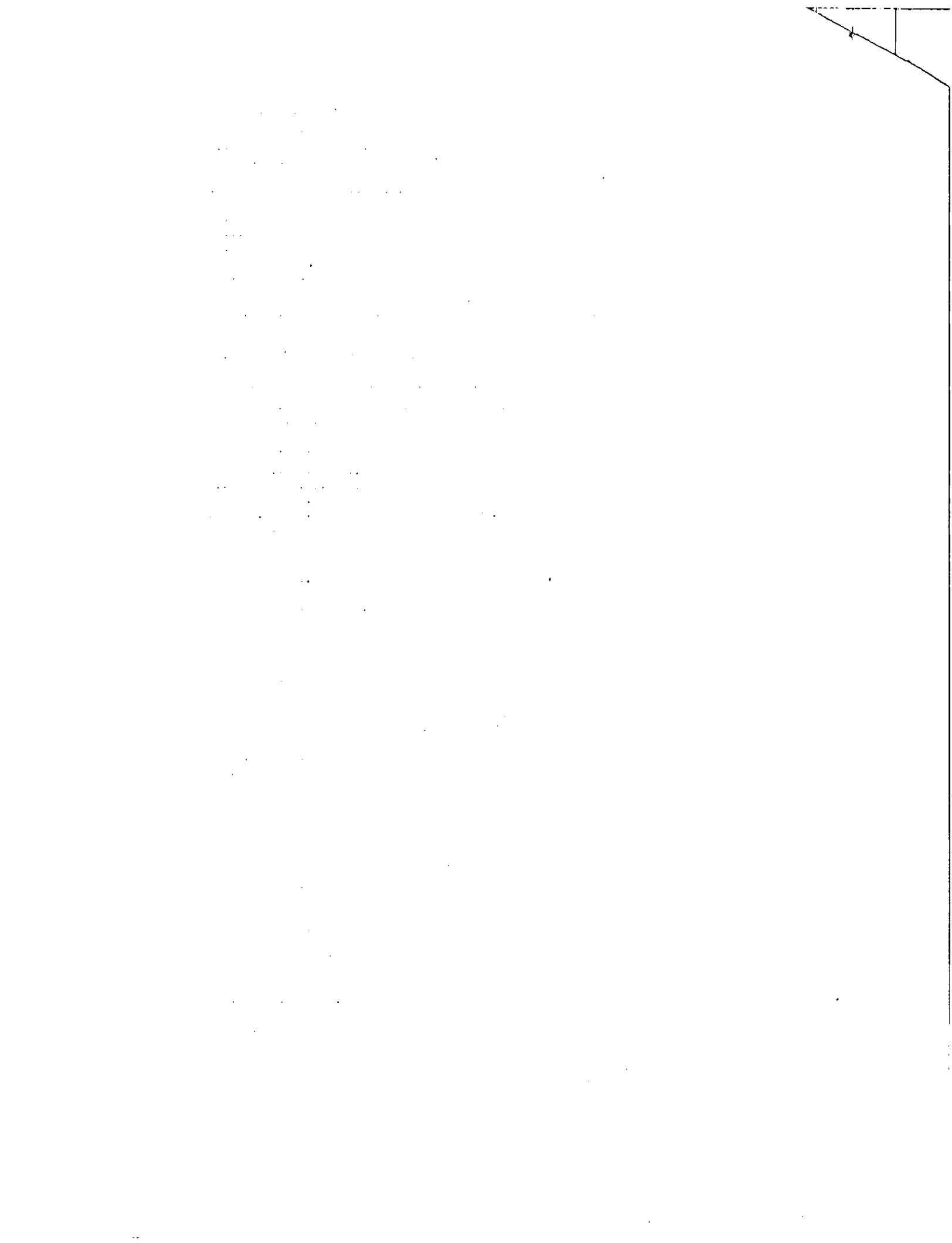
Annex 2. Canadian Request for Scientific Advice on Management in 1987 of Certain Stocks in Subareas 0 to 4 90

Annex 3. EEC Request for Scientific Advice on Management in 1987 of Cod Stock in Subdivision 3Ps 90

Annex 4. Denmark (Greenland) Request for Scientific Advice for Management of Certain Stocks in 1987 91

Appendix V. List of Participants 93

Appendix VI. Lists of Research and Summary Documents 95



PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

June 1986 Meeting

Chairman: J. Messtorff Rapporteur: V. M. Hodder

The Council, with its Standing Committees and associated subcommittees and working groups, met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 4-19 June 1986 to consider and report on various matters listed in its agenda (Appendix IV). In addition to matters of general scientific interest, the Council considered the requirments 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 1987 of a number of stocks in Subareas 0 to 4 (Appendix IV, Annexes 1-4). The Council noted that, although the offical request of Denmark on behalf of Greenland was not available when the provisional agenda was distributed in early April 1986, the relevant stocks had been included , and it was agreed unamimously that STACFIS should deal with the request in the usual way. The Executive Committee met briefly prior to the opening session and recommended a plan of work for the three Standing Committees which was adopted by the Council.

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

The reports of the Standing Committees 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 follow.

I. FISHERY SCIENCE (APP. I)

1. General Fishery Trends

From near-final statistics for 1984 and provisional data for all member countries except Faroe Islands in 1985, the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) increased (2.6%) from 2.63 million (metric) tons in 1984 to 2.70 million tons in 1985 (see Appendix I, Table 1). The total catch of "groundfish" species was approximately the same in 1984 and 1985 at 1.22 million tons. The total catch of "pelagic fish" increased (30%) from 469,000 tons in 1984 to 610,000 tons in 1985. For the "other finfish" group of species, the catch decreased (13%) from 112,000 tons in 1984 to 97,000 tons in 1985. The total catch of "invertebrate" species decreased (8%) from 836,000 tons in 1984 to 773,000 tons in 1985.

With respect to the total catches by subarea, increases from 1984 to 1985 were recorded for Subarea 0 (1,000 to 3,000 tons), Subarea 3 (533,000 to 605,000 tons) and Subarea 4 (703,000 to 766,000 tons), and decreases were noted for Subarea 1 (90,000 to 81,000 tons), Subarea 2 (53,000 to 41,000 tons), Subarea 5 (427,000 to 399,000 tons) and Subarea 6 (824,000 to 803,000 tons).

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), EEC and 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. Advice on other levels of fishing mortality was provided for certain stocks, as requested specifically by the Fisheries Commission. Management advice, based on the reference levels, could not be provided for some stocks due to insufficient data. For the capelin and squid stocks, different management criteria were used. In cases where specific total allowable catches (TACs) were advised, these are listed 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, but there are indications that the 1984 and 1985 year-classes are stronger than average. Management options for various levels of fishing mortality are presented (see relevant section of Appendix I for details).

b) For the cod stock in Div. 3M, the biomass (age 3+) continues to be at a low level (30,000-35,000 tons) relative to the target biomass (85,000 tons) which was set by the Fisheries Commission. This target biomass could most quickly be achieved through cessation of fishing.

Table 1. Summary of recent catches (1980-85) and TACs (1980-86) for stocks reviewed at the June 1986 Meeting of STACFIS, with advised TACs for 1987.

Species	Stock area	Nominal catches (000 tons)						TACs (000 tons)							
		1980	1981	1982	1983	1984[1]	1985[1]	1980	1981	1982	1983	1984	1985	1986	1987
Cod	1	54	53	56	63	30	15	...	50	62	62	68	28.3	12.5	( )[2]
	2J+3KL	176	171	230	232	230	227	180	200	237	260	266	266	266	(266)
	3M	10	14	13	10	12	14	13	12.7	12.4[6]	12.4[6]	13	13	13	(0)[3]
	3NO	20	24	32	32	27	41	26	26	17[6]	17[6]	26	33	33	( )[4]
	3Ps	38	39	34	38	37	51	28	30	33	33	35.8	44.6	...	( )[2]
Redfish	1	8	6	8	8	4	2	...	...	...	...	...	...	...	(9)
	3M	16	14	15	20	20	20	20	20	20	20	20	20	20	(20)
	3LN	16	24	22	20	14	21	25	25	25	25	25	25	25	(25)
Silver hake	4VWX	45	45	60	36	74	76	90	80	80	80	100	100	100	(100)
A. plaice	3M	1	1	1	2	1	2	2	2	2	2	2	2	2	(2)
	3LNO	49	50	50	38	40	51	47	55	55	55	55	49	55	(48)
Witch flo.	3NO	2	2	4	4	3	9	7	5	5	5	5	5	5	(5)
Yellowtail	3LNO	12	15	12	9	15	27	18	21	23	19	17	15	15	(15)
G. halibut	0+1	8	10	9	9	6	9	25	25	25	25	25	25	25	(25)
	2+3KL	33	31	26	28	25	17	35[7]	55[7]	55[7]	55[7]	55[7]	75	100	100
R. grenadier	0+1	2	+	+	+	+	+	8	8	8	8	8	8	8	(8)
	2+3	2	7	4	4	4	5	30	27	27	11	11	11	11	(11)
Wolffishes	1	5	4	4	3	2	2	...	...	...	...	5-6	5-6	5-6	(5-6)
Capelin	3LNO	14	24	27	25	33	26	16	30	30	60	38[8]	60[8]	130[8]	(293)[9]
Squid-*Illex*	3+4	70	33	13	+	1	1	150	150	150	150	150	150	150	(150)
Shrimp	0+1	44	46	44	47	45	...	30	35	35	35	35	42	36	( )[5]

[1] Provisional statistics.
[2] See relevant section of STACFIS Report (App. I).
[3] No directed fishery.
[4] Deferred to September 1986.
[5] Deferred to January 1987.
[6] Excludes expected catches by Spain.
[7] TACs pertain to Div. 2J+3KL.
[8] TACs pertain to Div. 3L only.
[9] TAC of 283,000 tons for Div. 3L and 10,000 tons for Div. 3NO.

c) The data available for assessment of the cod stock in Div. 3NO indicated that fishing mortality in 1985 was much higher than the value (0.20) determined last year for 1984, but a precise estimate could not be determined. Because of the serious implications of this and the need to review additional data, further assessment of this stock was deferred to the September 1986 Meeting, when the results from Canadian and USSR surveys in 1986 would be available, together with preliminary data for the 1986 commercial fishery.

d) For the cod stock in Div. 3Ps, no precise estimate of its status in 1984 could be determined at the June 1985 Meeting, and the same situation applies at the present meeting regarding the status of the stock in 1985. Practical upper and lower values of fishing mortality in 1985, when projected to 1987 at $F_{0.1}$, indicated a range of catches that encompassed the effective TAC (44,600 tons) for 1985.

e) For American plaice in Div. 3LNO, the TAC advised for 1987 is 48,000 tons, which is 7,000 tons less than the 1986 TAC of 55,000 tons but similar to the 1985 TAC of 49,000 tons.

f) For witch flounder in Div. 3NO, the 1985 catch was three times the catch in 1984 and nearly twice the 1985 TAC of 5,000 tons. It is unlikely that the stock can sustain such high catches without a decline in abundance.

g) For yellowtail flounder in Div. 3LNO, the catch in 1985 was approximately twice that of 1984 and nearly twice the 1985 TAC of 15,000 tons. It is unlikely that the stock can sustain the 1985 catch level without a decline in abundance.

h) For capelin Div. 3L, a catch of 283,000 tons was advised for 1987 which represents more than twice the advised level for 1986. In Div. 3NO, it appears that the stock has recovered sufficiently to permit a fishery, and a TAC of 10,000 tons is therefore advised for 1987.

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

j) No firm assessments of the stocks of redfish and wolffishes in Subarea 1 were possible due to the lack of adequate data.

k) Advice on management in 1987 of the shrimp stocks in Subareas 0+1 and in Denmark Strait could not be provided at this meeting, and it was agreed that a mid-term meeting in January 1987 would be appropriate.

3. Environmental Research

The Council noted that the Environmental Subcommittee (M. Stein as Chairman) had met during 9-10 June 1986 and had considered about 15 research documents which dealt with a variety of environmentally-related topics. The full report of the Subcommittee is Annex 1 to the Report of STACFIS (Appendix I).

The Council noted that there was discussion on environmentally-induced variations in catchability and the effects of such variations on stock assessments. The discussion resulted from the work that was undertaken by an *ad hoc* working group formed at the June 1985 Meeting. Evolving from the discussion was a suggested topic for the Special Session in September 1988. Further discussion of this item was deferred to September 1986.

4. Ageing Techniques

The Council noted that national experts on shrimp had indicated insufficient progress to warrant another workshop on ageing shrimp for at least another 2 years. The Council also noted that STACFIS had reviewed documentation on ageing of redfish in Div. 3M, cod in Div. 3M and silver hake in Div. 4VWX, and concurred with the proposals for continuation of such studies.

5. Other Matters

a) Response to questions by Fisheries Commission

The Council concurred with the advice which STACFIS provided in response to specific questions by the Fisheries Commission regarding certain stocks in Subareas 2, 3 and 4.

b) Irregularities in catch statistics

The Council noted that STACFIS had addressed the problem regarding catch statistics of non-reporting countries as well as the discrepancies between reported catches by some member countries and estimated catches by Canadian surveillance authorities. The Council agreed to seek direction and advice from the Fisheries Commission on how to proceed with addressing the problem in the future.

c) Topics deferred for consideration in September 1986

i) Review of simulation involving combined assessment of West and East Greenland cod stocks.

ii) Outline of topics for Special Session in September 1987, and proposed theme for Specical Session in September 1988.

iii) Reevaluation of the cod stock in Div. 3NO.

iv) Review of arrangements for conducting stock assessments.

II. RESEARCH COORDINATION (APP. II)

1. Statistics and Sampling

a) CWP activities relevant to NAFO (SCS Doc. 86/4)

The Council noted that STACREC had reviewed the Report of the *ad hoc* Interagency Consultation on Atlantic Fishery Statistics, which was held in London, England, on 5-6 October 1985. The report of that meeting was presented by Mr. D. G. Cross (EUROSTAT), who is Deputy Secretary of the CWP (Coordinating Working Party on Atlantic Fishery Statistics).

The Council was informed that the 13th Session of the CWP will be held in Rome, Italy, on 11-18 February 1987 and decided that NAFO be represented at that session by the Assistant Executive Secretary and the Chairman of STACREC. It was further agreed that Canada be invited to be the

participating NAFO Contracting Party and that the EEC be invited to provide a substitute participant should Canadian participation not be forthcoming.

b) Fishery statistics

The Council was pleased to note that there has been an improvement in adherence to the deadlines for submission of data on STATLANT 21A and 21B forms, and that, as a result, the Secretariat was able to prepare the provisional inventory of nominal catches (SCS Doc. 86/22) during the present meeting. The Council hoped that Contracting Parties would maintain this improvement with the timely submission of STATLANT 21B reports.

There was general satisfaction with the format of the STATLANT forms. However, in recognition of the need of national authorities for a complete and precise knowledge of their obligations under the NAFO Convention, the Council requested the Secretariat to prepare a document, for consideration at the June 1987 Meeting, containing complete and precise information on the catch and effect statistics to be submitted by Contracting Parties with respect to their obligations under Article VI(3) of the Convention.

The Council endorsed the proposal that Contracting Parties inform the Secretariat of fishing activities of non-member countries in the Convention Area and that the Executive Secretary contact the authorities in these non-member countries requesting the submission of relevant data for inclusion in the NAFO database.

The Council, noting that information on conversion factors which are used by national authorities to derive live weight equivalents of landings would be desirable, proposed that the Secretariat prepare, for the September 1986 Meeting, a summary document containing all available national conversion factors, including the most recent information available from FAO.

c) Sampling data

The Council welcomed the publication of the inventory of 1967-78 sampling data which was distributed in early 1986.

2. Biological Surveys

a) Stratification schemes

The Council was informed that suitable bathymetric charts for Subareas 0 and 2 have recently become available and that stratification schemes for Div. 0A, 0B, 2G and 2H are in preparation at the Northwest Atlantic Fisheries Centre, St. John's, Newfoundland.

b) Time series of survey data

The Council noted that some materials on methods of conducting bottom-trawl groundfish surveys in Subareas 2 and 3, as recommended at the June 1985 Meeting, are now available and agreed that a working group should be established at the September 1986 Meeting to evaluate the materials in association with past survey results in order to derive the most precise abundance indices for assessment purposes.

3. Other Matters

a) List of fishing vessels

The Council endorsed the proposal that the Secretariat solicit the necessary data and prepare an updated list of fishing vessels for 1986.

b Maritime boundary between Canada and USA

The Council endorsed the proposal (GC Doc. 86/2) that the statistical boundary between Subareas 4 and 5 be modified, and that catches in Subdiv. 5Ze be reported in the future as being from Subdiv. 5Zc (east of the Canada-USA boundary) and Subdiv. 5Zu (west of the Canada-USA boundary).

III. PUBLICATIONS (APP. III)

1. Review of Publications

The Council, in considering 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) had been completed, that Vol. 33 had been published in December 1985, that the Inventory of Sampling Data (for 1967-78) was published in April 1986, that NAFO Scientific Council Studies (No. 9) was published in September 1985, and that Vol. 6 of the Journal was published in two parts in June and December 1985.

2. Editorial Policy Concerning Publications

The Council learned with regret that B. E. Skud (USA) who had been appointed Editor of the Journal of Northwest Atlantic Fishery Science following the June 1985 Meeting had asked to be relieved of the responsibility because of new duties. The Council also noted that G. A. Robinson (United Kingdom) had accepted the role of Associate Editor of the Journal for contributions relating to Biological Oceanography.

The Council accepted STACPUB's recommendation that, while efforts were being made to find an Editor, the Associate Editors be informed that for the next volume of the Journal, which is expected to be only one issue, manuscripts received from them will be treated as being ready for publication. The Associate Editors will be asked, at the same time, whether they would be prepared to continue to operate on this basis in the long term, should no Editor be identified.

3. Promotion and Distribution of Scientific Publications

The Council agreed that the Executive Secretary, subject to General Council approval of the financial aspects, should prepare a brochure publicizing the Journal and undertake advertising of its contents and availability.

4. Production of Microfiche Copies of Meeting Documents

The Council was pleased to note that the production of microfiche copies of all research-related ICNAF meeting documents was expected to be completed by the end of 1986 and that costs are projected to be under the budgeted amount.

5. Papers for Possible Publication

The Council noted that STACPUB had reviewed four outstanding research documents from the September 1985 Meeting and 89 from the January and June 1986 Meetings and had nominated 9 of these for possible publication in the Journal or Studies, together with two papers that were submitted directly to Studies.

6. Title and Scope of the Journal

There was some discussion on this subject, and the Council agreed that it be addressed by STACPUB in September 1986.

IV. AMENDMENT TO RULES OF PROCEDURE

1. Report of Executive Secretary on Results of Vote by Mail

The Executive Secretary reported that the Scientific Council representatives were telexed on 8 May 1986, giving a 26 May deadline for the receipt of responses and indicating that the absence of a response by the given deadline would be taken as agreement with the rule changes. In view of objections to that procedure by two Contracting Parties and because of the uncertainty addressed below, it was simply recorded that there were four positive and no negative votes.

The question arose as to whether there was a quorum, because it was uncertain whether a non-response was due to non-receipt of the telex by the representative authorized to vote or to the representative assuming that a non-response would be counted as a positive vote. Therefore, the Executive Secretary was requested to determine from the non-respondents to the May 8 telex whether the telex has indeed been received. It was agreed that responses be requested by the end of July 1986, in order that the Chairman could judge which countries should be approached for proxy delegations to the Executive Secretary in time for the September meeting.

The Cuban representative at this meeting expressed agreement with the proposed changes to the Rules of Procedure.

V. COLLABORATION WITH OTHER ORGANIZATIONS

1. NAFO/ICES Study Group on Redfish off Greenland

The Council noted that the Group had not met since its second meeting in early 1984. At that meeting, it was proposed that information should be obtained on possible locations along the West Greenland coast for redfish tagging experiments and that a multiship research program (to study the drift of redfish larvae from the Irminger Sea to West Greenland) should be developed by correspondence during 1984 and finalized at a meeting in 1985. Although the Scientific Council endorsed the proposals and urged that the activities of the Study Group be continued (NAFO Sci. Coun. Rep., 1984, page 25), there was no meeting in 1985 and none was scheduled for 1986. The Council considered that little could be achieved until ICES shows some interest to continuing the project.

2. Assessment of West and East Greenland Cod Stocks

The ICES Working Group on Cod off East Greenland met in early 1986 and undertook a combined assessment of the cod stocks (without management advice for the West Greenland stock). Relevant sections of the report of the ICES Working Group were extracted and issued as NAFO SCR Doc. 86/55. This material formed the basis for developing management advice for Subarea 1 cod at this meeting.

3. Proposal for Joint ICES/NAFO Working Group on Seals (SCS Doc. 86/10)

The Council reviewed the relevant information on the ICES proposal for establishment of a joint working group, noting particularly its decision in September 1985 to defer any formal relationship with ICES on this matter until there is some clear indication of what advice will be required by the coastal states. The Canadian representative indicated that the report of the Royal Commission on Sealing was not yet available and that some time would be needed to study the report after it became available before advice, if any, would be sought. The Denmark (Greenland) representative indicated that Greenland was keenly interested in establishment of a joint ICES/NAFO working group and hoped that the matter will be considered again next year. The Council, in declining the ICES invitation at this time, expressed an interest in the work of the ICES Working Group on Seals and agreed to keep the matter under review.

4. Coordinating Working Party on Atlantic Fishery Statistics (CWP)

The Council noted that an *ad hoc* interagency consultation on Atlantic fishery statistics was held in early October 1985, when arrangements were made for the 13th Session of the CWP to be held at FAO in Rome, Italy, during 11-18 February 1987.

VI. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting in September 1986

The Scientific Council will meet in conjunction with the Annual Meeting of NAFO during 8-12 September 1986 in the Lord Nelson Hotel, Halifax, Nova Scotia. That meeting will be preceded by the Special Session on "Recent Advances in Understanding Recruitment in Marine Fishes of the Northwest Atlantic, with Particular Emphasis on Georges Bank Herring and Flemish Cap Cod and Redfish" during 3-5 September 1986 at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, with Dr. M. D. Grosslein as Convener. Approximately 25 papers will be presented.

2. Mid-term Meeting for Shrimp

The Council concurred with the view of STACFIS regarding the provision of advice on management of shrimp stocks in 1987, and agreed to meet in January 1987. The unoffical invitation for the meeting to be held in Copenhagen at the Greenland Fisheries and Environment Research Institute was tentatively accepted, with the time to be decided at the Setpember 1986 Meeting.

3. Scientific Council Meeting, June 1987

The Scientific Council and its Standing Committees, including the Environmental Subcommittee, will meet at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 3-18 June 1987.

4. Special Session in September 1987

The 1987 Annual Meeting of the Scientific Council on 14-18 September 1987 will be preceded on 9-11 September by the Special Session on "Biology of Demersal Resources of the North Atlantic Continental Slopes, with Emphasis on Greenland Halibut and Grenadiers". W. R. Bowering (Canada) was unanimously nominated as Convener for the Session. A preliminary outline of the agenda for the Session could not be provided at this time because the Convener, being Chairman of STACFIS, was too involved with other business of the Council. However, he assured the Council that the outline would be provided for consideration at the September 1986 Meeting.

VII. OTHER MATTERS

1. Provisional Report of January 1986 Meeting

The Council formally approved, with minor amendments, the report of its meeting on 14-18 January 1986 (SCS Doc. 86/1).

2. Theme for Special Session in September 1988

The Council agreed to defer consideration of this item to September 1986.

VIII. ADJOURNMENT

There being no further business, the Chairman expressed his appreciation to the chairmen of the Standing Committees (W. R. Bowering, R. Dominguez and J. S. Beckett) and Environmental Subcommittee (M. Stein), the conveners of the *ad hoc* working groups (B. Atkinson and A. Sinclair), the rapporteurs who were responsible for preparing the initial drafts of material for consideration, all other participants for their cooperation and contribution to the success of the meeting, and the Secretariat staff for their usual efficient work in organizing and servicing the meeting.

The final session was adjourned at 1415 hours on 19 June 1986.

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

Chairman: W. R. Bowering Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 4-18 June 1986 to consider and report on various matters that were 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). Representatives attended from Canada, Cuba, Denmark (Greenland), EEC, German Democratic Republic, Japan and USSR, and observers were present from the USA.

Meetings of the *ad hoc* Working Group on Cod (covened by B. Atkinson) and the *ad hoc* Working Group on Species except Cod (convened by A. Sinclair) were held concurrently. Various scientists, designated by the Conveners of the Working Groups and the Chairman of STACFIS, assisted in the initial preparation of the draft reports on the various topics considered by the Committee (Sections I to III below). The report of the Subcommittee on Environmental Research (Chairman: M. Stein) is introduced in Section IV of this report and given in detail in Annex 1. The remaining sections deal with other matters that were considered by the Committee.

I. FISHERY TRENDS

1. Introduction

Unlike the past several years, when this section of the report could not be completed due to the absence of data at the time of the June meetings, sufficient 1985 STATLANT 21A reports were available for the Secretariat to compile provisional nominal catches for 1985 (SCS Doc. 86/22). Faroese data for 1984 and 1985 are not available. Much of the data that were used to obtain the 1984 summaries in Table 1 are final statistics, but the 1985 figures are based on provisional STATLANT 21A reports.

Table 1. Nominal catches (000 tons) by subarea for 1984 and provisional data for 1985 (+ indicates less than 500 tons).

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985
Atlantic cod	-	-	31	15	25	12	289	341	232	219	52	49	+	+	629	636
Haddock	-	-	-	-	-	-	6	12	28	27	14	11	+	+	48	50
Atlantic redfishes	-	+	6	4	2	1	71	78	46	41	5	4	-	-	130	128
Silver hake	-	-	-	-	-	-	+	+	74	75	14	14	7	8	96	97
Red hake	-	-	-	-	-	-	+	+	+	+	2	1	1	+	3	2
Pollock	-	-	-	-	-	-	2	2	31	42	20	21	+	+	54	66
American plaice	-	-	+	-	+	+	42	49	18	16	10	7	+	+	70	72
Witch flounder	-	-	-	-	+	+	8	9	3	4	6	6	+	+	18	19
Yellowtail flounder	-	-	-	-	-	-	13	17	3	1	15	6	3	1	33	26
Greenland halibut	+	1	7	9	9	9	14	10	2	2	-	-	-	-	31	30
Other flounders	-	-	+	+	+	+	5	2	5	7	18	18	13	8	42	36
Roundnose grenadier	+	+	+	+	+	+	3	5	-	-	-	-	-	-	4	5
White hake	-	-	-	-	-	-	5	5	11	12	7	7	+	+	24	24
Wolffishes	-	-	2	2	+	+	2	2	2	2	1	1	-	-	7	7
Other groundfish	-	-	7	+	+	+	+	+	4	3	11	13	6	5	28	21
Atlantic herring	-	-	+	-	+	+	2	3	123	186	33	26	+	+	158	215
Atlantic mackerel	-	-	-	-	-	-	5	16	13	15	2	3	18	37	37	70
Atlantic menhaden	-	-	-	-	-	-	-	-	-	-	35	20	217	291	252	312
Other pelagics	-	-	-	-	-	-	1	1	1	1	12	6	8	5	22	13
Capelin	-	-	1	-	15	17	43	32	2	3	-	-	-	-	61	52
Other finfish	+	+	2	1	1	+	7	11	9	12	11	10	22	11	51	45
Squids	-	-	-	-	-	-	+	+	+	+	7	6	25	17	33	23
Clams	-	-	-	-	-	-	+	-	7	5	56	59	307	338	369	402
Scallops	-	-	-	-	+	+	4	1	16	15	55	64	33	28	108	107
Other molluscs	-	-	-	-	-	-	+	-	3	2	16	20	107	29	127	51
Shrimp	1	2	34	50	1	2	-	+	9	9	3	4	+	+	47	67
Crabs	-	-	-	-	-	+	10	7	34	36	3	3	55	23	102	69
Lobsters	-	-	-	-	-	-	1	2	27	31	18	19	2	2	49	53
Other invertebrates	-	-	-	-	-	-	-	-	-	-	1	1	+	+	1	1
Total	1	3	90	81	53	41	533	605	703	766	427	399	824	803	2634	2699

2. General Trends for the Northwest Atlantic

The overall reported catch (round fresh weight) of all finfish and invertebrates was 2.70 million (metric) tons in 1985, a 2.6% increase over the 1984 catch of 2.63 million tons. The total "groundfish" catch, which represented 45% of the overall catch in 1985, was essentially the same in 1984 and 1985 (1,217 and 1,219 respectively), with increases for pollock (22%) being offset by decreased catches of yellowtail flounder (21%) and unspecified groundfish (25%). The total "pelagic fish" catch, which represented 23% of the overall catch in 1985, increased significantly (30%) from 469,000 tons in 1984 to 610,000 tons in 1985, due to increased catches of herring (36%), menhaden (24%) and mackerel (89%). The total "other finfish" catch, which represented less than 4% of the overall catch in 1985, decreased (23%) from 112,000 tons in 1984 to 97,000 tons in 1985, due mainly to a decrease in the catch of capelin. The total catch of "invertebrates", which represented 29% of the overall catch in 1984, decreased (8%) from 836,000 tons in 1984 to 773,000 tons in 1985, due mainly to decreased catches of squids (30%), crabs (32%) and oysters (73%), although increases were noted for clams (9%), shrimp (42%) and lobsters (8%).

3. Fishery Trends by Subarea

a) Subarea 0

The increase in total catch from 1,000 tons in 1984 to 3,000 tons in 1985 was due mainly to increased catches of Greenland halibut and shrimp, which were the dominant species.

b) Subarea 1

The total catch of all species declined (10%) from 90,000 tons in 1984 to 81,000 tons in 1985, continuing the decline from a nominal catch of 121,000 tons in 1983. The decline, due almost entirely to the decreased catch of cod (52%), was partially offset by an increase for shrimp (47%). These species represented about 80% of the total catch in 1984 and 1985.

c) Subarea 2

The total nominal catch of all species declined (23%) from 53,000 tons in 1984 to 41,000 tons in 1985, the latter being the lowest recorded catch for this subarea. The decline was due entirely to the decreased catch of cod (52%) from 25,000 to 12,000 tons. The capelin catch increased slightly from 15,000 to 17,000 tons.

d) Subarea 3

The total nominal catch of all species increased (14%) from 533,000 tons in 1984 to 605,000 tons in 1985, due mainly to increased catches of cod (18%), haddock (100%), redfish (10%) and flounders (6%), although declines were noted for capelin (26%) and crabs (30%). In 1985, the cod catch represented 56% of the overall catch in this subarea, followed by redfish (12%), American plaice (8%) and capelin (5%).

e) Subarea 4

The total nominal catch of all species increased (9%) from 703,000 tons in 1984 to 766,000 tons in 1985, due mainly to increased catches of pollock (35%) and herring (50%), although declines were noted for cod (6%), redfish (9%) and American plaice (11%). Cod (29%) and herring (24%) were the most significant components of the overall catch in this subarea, followed by silver hake (10%), pollock (5%), redfish (5%) and crabs (5%).

f) Subarea 5

The total nominal catch of all species declined slightly (7%) from 427,000 tons in 1984 to 399,000 tons in 1985, following a decline of 6% from 1983 to 1984. Significant changes in catches from 1984 to 1985 were declines for cod (9%), haddock (21%), flounders (24%), herring (21%) and menhaden (43%), which were partly offset by increases for scallops (16%), clams (5%) and other molluscs (25%). In 1985, "invertebrate" species made up 44% of the overall catch, followed by "groundfish" at 40% and "pelagic fish" at 14%.

g) Subarea 6

The total nominal catch of all species decreased slightly (3%) from 824,000 tons in 1984 to 803,000 tons in 1985. Significant changes in catches from 1984 to 1985 were increases for menhaden (34%), mackerel (105%) and clams (10%) and decreases for flounders (44%), squid (32%), scallops (15%), oysters (73%) and crabs (58%). Invertebrates and pelagic species comprised 54% and 41% respectively of the overall catch in 1985.

II. STOCK ASSESSMENTS

1. Cod Subarea 1 (SCR Doc. 86/20, 42, 43, 46, 48, 55, 86; SCS Doc. 86/12, 16)

a) Introduction

The fishery for cod in Subarea 1 is partly an offshore fishery, mainly undertaken by large trawlers using bottom otter trawls, and partly a coastal and fjord fishery. In the latter fishery, the major part of the catch is usually by pound nets (mainly during the period May-September), other gears being handlines and gillnets. The trawlers' catch accounted for 44% of the total Subarea 1 catch of cod in 1985, compared to about 60% in 1984 (Table 2). Their catch was taken almost exclusively in Div. 1E and 1F while inshore catches were highest in Div. 1D and 1B.

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.

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Trawlers	19	46	53	57	16	14	29	42	18[1]	7[1]	
Other vessels	14	27	20	42	38	39	27	21	12[1]	8[1]	
Total (000 tons)	33	73	73[2]	99[2]	54[2]	53	56	63	30[1]	15[1]	
TAC (000 tons)	45[3]	31[3]	-[4]	-[4]	20[3]	50	62	62	68		
CPUE (tons/hr)	0.63	1.29	3.33	2.38	1.24	3.26	2.21	1.36	0.99	28.3	12.5

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

Information on fishing effort was available for some of the trawlers only. Their catch-per-unit-effort for the two most important divisions combined (Div. 1D and 1E) decreased from 3.3 tons in 1981 to 0.7 tons in 1985, the lowest since 1976 (Table 2 and Fig. 1).

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. Recruitment of the relatively good 1973 year-class in 1976-77 resulted in increased catches up to 1979. During 1980-83, catches fluctuated between 53,000 and 63,000 tons (close to the TAC level) but decreased sharply in 1984 to 30,000 tons and fell again in 1985 to only 15,000 tons (half the TAC level). The TAC for 1986 has been set at 12,500 tons, with no direct trawl fishery allowed.

b) Commerical fishery data

i) Age composition

The commercial catches of the Federal Republic of Germany were well sampled in 1985, whereas commercial Greenland catches were very poorly sampled, especially catches by small vessels (<80 GRT), including all inshore catches. Bearing in mind that the catch statistics also have some deficiencies, especially so far as information on gear is concerned, the figures for catch in numbers by age-group are very rough estimates. However, there is no doubt that the overwhelming part of the catches by both Greenland and the Federal Republic of Germany was of age-group 6 (the 1979 year-class), as expected. This year-class made up about 60% of the total catch in number as well as in weight.

The 1977 year-class, which accounted for 20% by number of the 1984 catch, was still a predominating year-class in the trawl fisheries of Div. 1F during the first quarter of the year (42% by number in a Greenland sample) and made up 24% by number of the trawl catches by the Federal Republic of Germany. However, of the total catch for Subarea 1, the 1977 year-class accounted for about 9%, while the incoming 1980 and 1981 year-classes accounted for 15 and 8% respectively.

ii) Weight-at-age data

Mean length-at-age, and thereby also mean weight-at-age, of fish caught by Greenland trawlers has decreased substantially over the 1979-84 period. The decrease which was about 45% over that period seems to have continued in 1985. A decrease in weight-at-age from 1984 to 1985 also was evident for the inshore catches.

The overall mean weight (nominal catch/numbers caught) was 1.60 kg in 1985, slightly less than in 1984 (1.65 kg).

c) Data from research surveys

i) Stock size and distribution

Stratified-random bottom-trawl surveys off West Greenland were conducted in November-December 1982, 1983 and 1985 by R/V *Walther Herwig* and in October-November 1984 by R/V *Anton Dohrn*. The number of randomly distributed fishing stations occupied during the 1982-85 surveys amounted to 111, 153, 162 and 133 respectively. The results were based on 98, 142, 158 and 114 valid sets. The reduction in 1985 was caused by an unexpected loss of survey time. In order to compensate for this without diminishing the reliability of the survey results, the necessary reduction in coverage of the survey area was restricted to Div. 1B and 1C where cod biomass and abundance were extremely low in 1983 and 1984. In Div. 1D and 1E, however, the coverage was improved compared with all previous years. Cod biomass and abundance estimates for the total survey area off West Greenland of 19,864 nm^2 in 1982 and 1983 and of 20,133 nm^2 since inclusion of stratum 4 in 1984 and 1985 were as follows:

Year	Biomass (tons)	Abundance
1982	179,934 ± 37.0%	109,039 ± 36.1%
1983	98,843 ± 28.5%	59,375 ± 26.5%
1984	24,945 ± 39.7%	16,110 ± 39.1%
1985	35,213 ± 68.7%	55,886 ± 34.7%

The confidence intervals are given at the 95% level of significance. From 1982 to 1984, the survey results revealed a drastic decline in cod biomass and abundance which was observed not only for the whole survey area but also for each division. Confirmation of the reduced stock size in 1983 and 1984 was also obtained by continuous echo-sounder recordings throughout the survey area and by the trends in commercial catch and effort (Fig. 1). Although the commercial catch-per-unit-effort continued to decline in 1985, the survey results obtained at the end of 1985 indicate a slight increase in biomass by a factor of 1.4 but a considerable increase in abundance by a factor of 3.5. The latter was mainly due to the extremely high abundance of 1-year-old cod (1984 year-class) and even younger fish (1985 year-class) that were never observed to this extent in previous surveys. These two year-classes accounted for 67% of the total abundance. As previously, the results of the trawl surveys have been taken under the assumption of a catchability factor of 1.0, (i.e. that all cod in and above the area swept are caught). Clearly this assumption could well mean that the true stock size differs from that achieved from the surveys. The ICES Working Group on Cod Stocks of East Greenland at its meeting in January 1986 discussed this problem (see NAFO SCR Doc. 86/55, page 4). The assumption of the catchability factor of 1.0 was made to avoid overestimates of the true stock size. However, catchability can be both higher and lower than 1.0, because it is related to a number of factors which affect it in both directions. Since, however, no quantitative estimate of the catchability coefficient is available at present, the ICES Working Group and STACFIS continued to use the survey estimates without adjustments. The possibility that the true catchability is different from 1.0 should be kept in mind for the evaluation of the assessment.

ii) Age composition

According to the 1985 survey results, the year-classes which predominated in numbers among age 4 and older cod were those of 1981 (43%) and 1979 (36%). The drastic decline of the 1977 year-class continued throughout 1985, and, at the time of the survey, this year-class amounted to less than 4% of age 4+ cod. The once good 1973 year-class has now disappeared completely from West Greenland waters. The noteworthy high abundance of age-groups 0 and 1 (1985 and 1984 year-classes) in the 1985 trawl survey was mentioned above.

iii) Maturity-at-age

Data on maturity-at-age were obtained from the trawl-survey catches. The results differ only very slightly from those found in 1983 and used for the 1983 and 1984 assessments. The figures for 1985 are listed in Table 3.

iv) Environmental data

The hydrographical conditions in the West Greenland area in 1985 were influenced by a

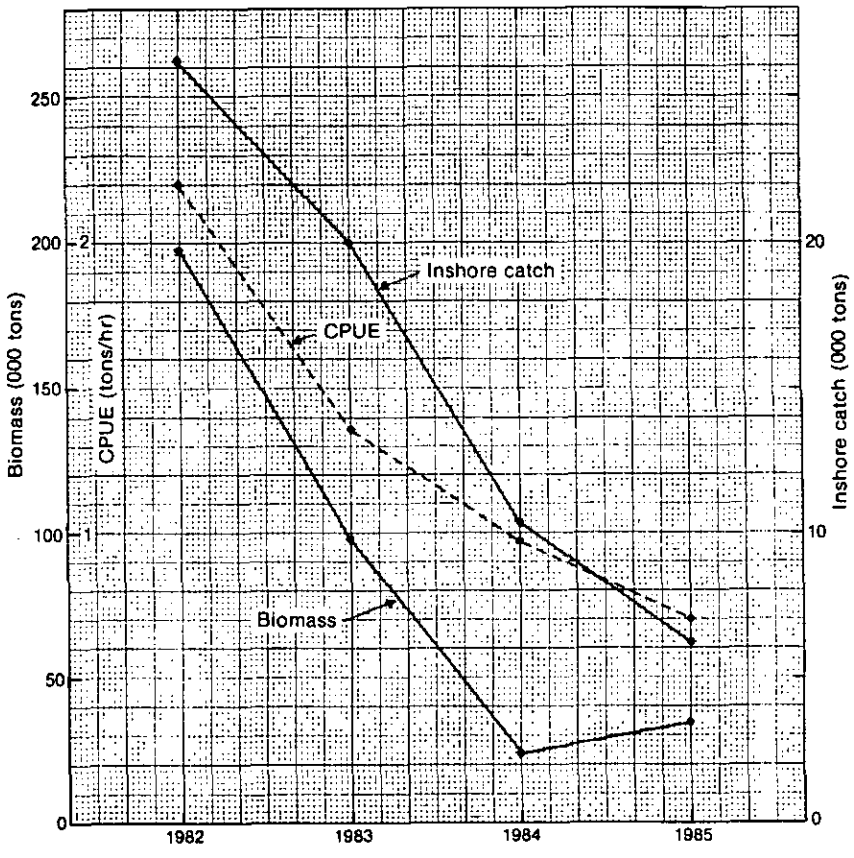


Fig. 1. Cod in Subarea 1: trends in total survey biomass, catch-per-unit-effort of Greenland trawlers and inshore catches, 1982-85.

change in the meteorological situation over Greenland which took place in the winter of 1984/85, when the air temperature shifted from a 3-year period of strong negative anomalies to slightly positive anomalies for all months in 1985. As a result of this climatic change, the surface-water temperatures off West Greenland increased to about-normal values. By mid-June, the mean temperature of the water mass over the top of Fylla Bank was 2.07°C, which is a little above average. The deeper layers on the western slope of the bank also showed positive temperature anomalies, expecially during the last half of 1985, when there was a greater-than-normal inflow of warm Irminger water. The intensity of this current was so strong that, in November, the effects of it could be traced to the tops of the fishing banks as far north as 68°N.

Table 3. Cod in Subarea 1: stock size by 1 January 1986 and parameters used in stock and catch projections. Estimated mortality due to discards of age 3 fish and loss due to emigration of age 6 and older fish are accounted for by the relative M values (M = 0.20).

Age	Stock size 1 Jan 1986 (000)	Relative M (M = 0.20)	Mean weight (kg)	Percent maturity	Relative F
3	20,000	1.5	0.50	1	0.039
4	14,367	1.0	0.76	3	0.52
5	7,137	1.0	1.04	15	1.0
6	2,360	1.25	1.60	48	1.0
7	5,845	1.25	2.22	83	1.0
8	281	1.25	3.03	96	1.0
9	606	1.25	3.96	99	1.0
10	20	1.25	4.39	100	1.0
11	1	1.25	4.75	100	1.0
12+	1	1.25	6.00	100	1.0

d) Assessment results (SCR Doc. 86/86)

The results of the most recent stock assessments are presented in Table 4. The stock size (number-at-age) at the end of 1985 was calculated from the abundance estimate derived from the November-December trawl survey. Total mortality (Z) for 1985 was calculated from this estimate and the corresponding one from the 1984 survey to be as low as 0.27 for age 5 and older cod. Taking the natural mortality coefficient M to be 0.20 for all cod of 4 years and older, the actual catches in 1985 can only be explained by assuming an overall net immigration to the area, probably from southeastern Greenland. This accounts specifically for age-groups 5 and 6, whereas, for older age-groups, the assessment is consistent with a net (spawning) emigration in the assessment.

Table 4. Cod in Subarea 1: assessment table for 1985.

Age (yr)	Year-class	Stock size (000) 1 Jan	31 Dec	Z	F	Catch 1985	M	E	Losses due to M	E
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
5	1980	1,286	2,360	-0.607	0.736	1,303	0.2	-1.543	354	-2,731
6	1979	7,994	5,845	0.313	0.716	4,915	0.2	-0.603	1,373	-4,139
7	1978	716	281	0.940	0.348	161	0.2	0.391	93	181
8	1977	1,901	606	1.143	0.662	750	0.2	0.281	227	318
9	1976	80	20	1.386	0.970	42	0.2	0.208	9	9
10+	<1976	242	2	4.796	3.537	177	0.2	1.059	10	53
Total	5-9	11,977	9,112	0.273	0.683	7,171	0.2	-0.606	2,056	-6,362
Total	6-9	10,691	6,752	0.460	0.685	5,868	0.2	-0.424	1,702	-3,631

Calculation steps:
1. Calculation of col. (B) from November 1985 survey estimate, reduced by natural mortality and catches in December 1985.
2. Calculation of col. (C): $Z = \ln [(A)/(B)]$
3. Calculation of col. (H): $(A) \times M/Z(1.- \exp(-Z))$.
4. Calculation of col. (I): $(A) - (B) + (E) + (H)$.
5. Calculation of col. (D) and col. (G): allocation of Z proportionally to col. (E), col. (H) and col. (I).

It must, however, be borne in mind that, in the present assessment, the stock estimates for the two consecutive years are each taken at their mid-value, and, although there is a rather high variability connected with each of these estimates, the variability as not been taken into account in the assessments. The estimates of emigration-immigration are, therefore, also connected with a high degree of uncertainty. However, anecdotal information from fishermen and the shift in environmental conditions from 1984 to 1985 point to the possibility that at least some of the immature cod, thought to have left the subarea in cold years (1982-84), may have returned. However, there is a continued emigration of mature fish (spawning migration) from West Greenland to East Greenland waters and to Iceland. This migration seems now to be at a lower level from this assessment, and the emigration rate for age 6+ fish has been taken to be E = 0.05 for the projections. It is pointed out, however, that emigration rates will vary much between year-classes and years and should be reviewed annually.

e) Recruitment prospects

The 1982 year-class. Mainly on the basis of the high abundance of cod larvae in plankton catches, the 1982 year-class was considered to be a relatively good one and was initially set at a value of 200 million fish at age 3. However, all subsequent information (trawl surveys, pound-net catches, gillnet survey, anecdotal information) point to a very small year-class, and, for the 1985 assessment, the estimate was reduced to 20 million fish, the conventional level of poor year-classes. This value has been maintained in current analyses.

The 1983 year-class. There is no new information to indicate a change of the initial estimate of a poor year-class, set at 20 million fish at age 3.

The 1984 year-class. Icelandic 0-group surveys off East Greenland in August 1984 gave a very high abundance index of 0-group cod, about 3 times that for the good 1973 year-class. This year-class was also very abundant at age 1 at West Greenland, based on offshore trawl surveys and inshore gillnet surveys, and this year-class may therefore be of great importance for the future stock and the fisheries. It was, however, felt that a more precise quantification of its actual size could better be done after it has been observed by offshore and inshore surveys in 1986. Projections have, however, been made with a size of this year-class set at 200 million fish at age 3 (the same level as estimated for the 1973 year-class), but it is stressed that this is only meant as a figure to illustrate changes in a depleted stock should a good year-class occur.

The 1985 year-class. This year-class also seems to be a promising one, expecially on the basis of its occurrence in the 1985 trawl survey off West Greenland and in the Icelandic 0-group survey off East Greenland. The latter survey conducted in August 1985 gave the third highest index for 0-group cod since 1973 although considerably lower than those of 1973 and 1984. However, preliminary analyses of the Danish plankton samples from West Greenland show a very low abundance of cod larvae in 1985. Projections have been made with this year-class set at 100 million fish at age 3, but, as for the 1984 year-class, the value used is meant to be no more than an illustrative example of change in stock composition.

The 1986 year-class. This year-class has arbitrarily been set as a poor one, i.e. 20 million fish at age 3.

f) Projections of catch and stock size for 1987-89

The parameters used to project catch and biomass of the cod stock (age 3+) as well as the spawning stock biomass, are given in Table 3. The numbers by age-group at the beginning of 1986 were derived from results of the 1985 groundfish trawl survey. The relative fishing mortalities at ages 3 and 4, being those used in recent years, were derived from catch-curve analyses (NAFO SCR Doc. 83/60). Mean weight-at-age values for the projections were obtained from data for the inshore Greenland fisheries and from survey data with a 5:1 weighting taking present regulation into account.

Projections were carried out for a catch level in 1986 equal to the TAC (12,500 tons) and for five different management options (Table 5, left part), and for a catch level in 1986 different from the TAC (Table 5, right part). Figure 2 illustrates the yield-per-recruit curve for the present values of mean weight-at-age and assumption of emigration rate, and the projected spawning stock biomass implied by catches in 1987 corresponding to fishing mortality values between 0 and 1.0.

The rate of stock rebuilding will depend much upon the actual size of the 1984 and 1985 year-classes but also upon the extent to which these will be fished. The maximum potential in the illustrative examples (Table 5) would be realized by an immediate closure of the fishery in 1986 and a continued closure in 1987 and 1988, but the differences, from 1986 onwards, between the projected stock biomasses from such closures and those from the options with small annual catches (fishing at $F_{0.1}$) are marginal.

The catches in 1987 will remain low regardless of the size of the 1984 year-class, because thse fish will be age 3 and only partially recruited to the fishery. At constant F, catches in 1988 could be higher because of increased recruitment of that year-class to the fishery. This would, however, result in a decrease in the rate of stock rebuilding. If the 1984 year-class is left unfished, a catch of about 12,000 tons in 1988 represents a standing stock (age 3+) of about 22,000 tons in 1989.

Table 5. Cod in Subarea 1: projections of age 3+ biomass and spawning stock biomass (000 tons) at beginning of year and catch during the year for different management strategies.

		1986 Catch = TAC (12,500 t)					C(87-88)=0	C(87-88) at 1986 level		
Year		TAC= 12.5	F = 0	$F_{0.1}$	F_{max}	F(85)	C(86)= 6000 t	F(86) =$F_{0.1}$	F(86) =F_{max}	F(86) =F(85)
1986	B(3+)	48	48	48	48	48	48	48	48	48
	SSB	17	17	17	17	17	17	17	17	17
	F(6-9)	0.517	0.517	0.517	0.517	0.517	0.220	0.190	0.380	0.685
	Catch(C)	12.5	12.5	12.5	12.5	12.5	6.0	5.3	9.7	15.5
1987	B(3+)	138	138	138	138	138	146	147	142	135
	SSB	17	17	17	17	17	22	23	19	15
	F(6-9)	0.449	0	0.190	0.380	0.685	0	0.137	0.304	0.660
	Catch(C)	12.5	0	5.8	10.9	17.6	0	5.3	9.7	15.5
1988	B(3+)	190	205	198	192	184	214	208	197	182
	SSB	20	29	25	21	17	36	32	25	15
	F(6-9)	0.165	0	0.190	0.380	0.685	0	0.057	0.117	0.226
	Catch	12.5	0	15.5	27.5	41.8	0	5.3	9.7	15.5
1989	B(3+)	207	238	212	190	164	247	235	218	195
	SSB	39	56	44	34	24	64	57	46	32

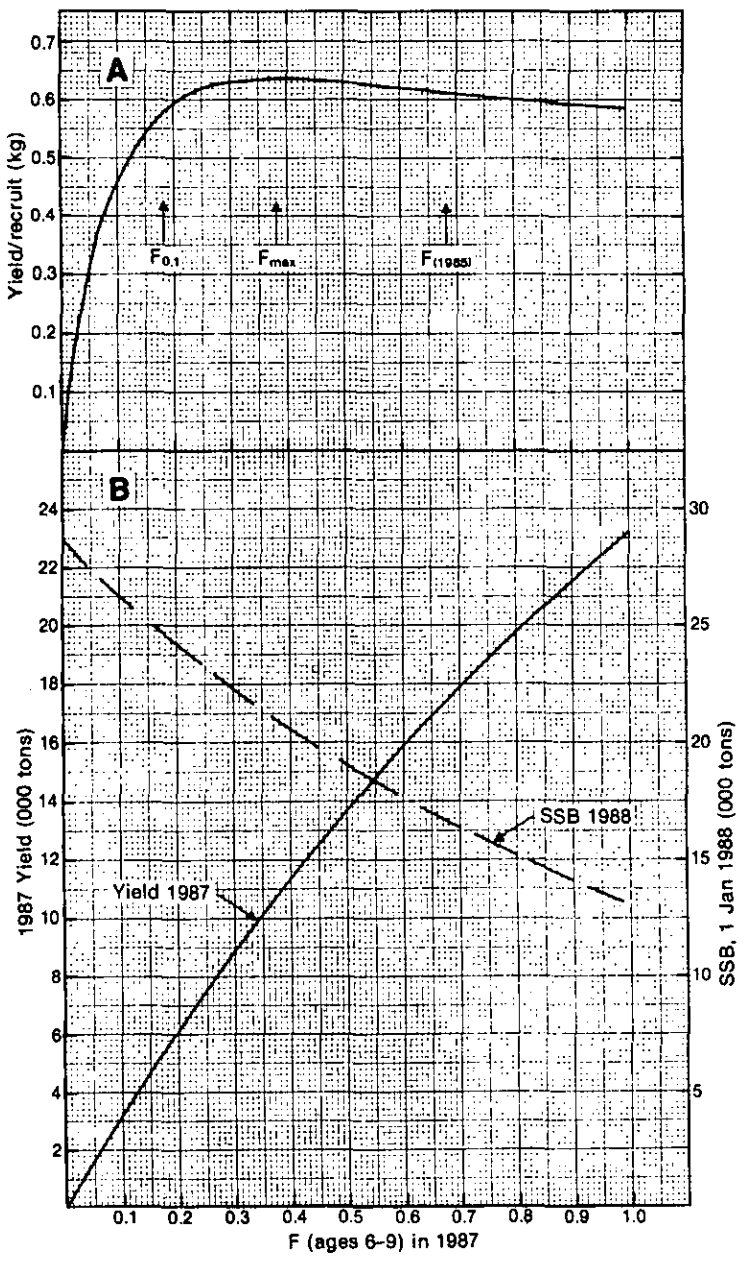


Fig. 2. Cod in Subarea 1: (A) yield-per-recruit curve, and (B) calculated yield in 1989 and spawning stock biomass (SSB) in January 1988 for various levels of fishing mortality in 1987.

Table 6 shows that 3-year-old fish will dominate the stock by 1987. If the year-class achieves the size used for illustration, 3-year-olds will account for 72% of the stock biomass but only 11% of the catch ($F_{0.1}$ level). However, by 1988, the year-class could account for more than 62% of the catch (by weight). This clearly illustrates that the actual catch level in the projections depends heavily on a more precise estimate of recruitment of the 1984 and 1985 year-classes.

g) Expected distribution of the 1984 and 1985 year-classes in 1987 and 1988

Denmark, on behalf of Greenland, has requested that the expected spatial distribution of the 1984 and 1985 year-classes in 1987 and 1988 be described, and that the expected length and weight distributions of the catches in 1987 and 1988 should be given, if possible, by gear types (SCS Doc. 86/12). STACFIS offers the following comments on the expected spatial distribution of year-classes 1984 and 1985:

Table 6. Cod in Subarea 1: calculated yield and biomass (000 tons) for various management strategies in 1987-91 and % contribution of the 1984 and 1985 year-classes. (All strategies assume that the 1986 TAC will be taken.)

			% of YC			% of YC			% of YC			% of YC	
		F=0	84	85	$F_{0.1}$	84	85	F_{max}	84	85	F(85)	84	85
1987	B(3+)	138	72	-	138	72	-	138	72	-	138	72	-
	SSB	17	6	-	17	6	-	17	6	-	17	6	-
	F(6-9)	0			0.190			0.380			0.685		
	Catch	0	-	-	5.8	11	-	10.9	12	-	17.6	13	-
1988	B(3+)	205	55	24	198	56	25	192	58	26	184	60	27
	SSB	29	12	2	25	14	2	21	16	2	17	20	3
	F(6-9)	0			0.190			0.380			0.685		
	Catch	0	-	-	15.5	62	2	27.5	66	2	41.8	72	3
1989	B(3+)	238	53	24	212	54	26	190	54	29	164	52	33
	SSB	56	34	3	44	39	4	34	45	5	24	53	7
	F(6-9)	0.190			0.190			0.380			0.685		
	Catch	31.8	62	15	27.7	65	17	45.1	65	20	60.2	65	25
1990	B(3+)	248	53	23	213	55	27	176	50	29	125	44	34
	SSB	108	59	8	91	63	9	65	65	12	39	67	16
	F(6-9)	0.190			0.190			0.380			0.685		
	Catch	36.0	56	25	32.2	56	28	45.8	54	32	50.1	49	39
1991	B(3+)	241	49	25	219	48	27	151	43	29	90	29	30
	SSB	159	61	18	140	63	20	87	62	24	43	58	30

i) Offshore distribution

The trawl survey in 1985 by the Federal Republic of Germany showed that approximately 50% of the estimated number of cod of the 1984 year-class were found in Div. 1C and that part of Div. 1B covered by the survey, (i.e. south of 67°N). In terms of numbers, the year-class was also the predominant one in Div. 1D-1F. It thus seems important throughout the offshore areas, at least from the southern part of Div. 1B to Div. 1F. If the usual southward migration takes place as the individuals grow, Div. 1C and 1D would be expected to be those showing the highest percentage of this year-class in 1987 and 1988, but it seems likely that it will be predominant in all divisions in these years. The 1985 year-class was also found in relatively high numbers in all divisions in the survey mentioned, the highest numbers being taken in Div. 1F. Due to the selectivity of the gear and the small size of the 0-group fish, it is premature to advise further on the spatial distribution of this year-class before its distribution as 1-year-old fish has been observed in the 1986 survey.

ii) Inshore distribution

An inshore young-fish survey was carried out with gillnets in 1985. As the gillnets do not catch fish of the 0-group size, information is available only for the 1984 year-class. The major part of the fishing was done in Div. 1D-1F but with some effort also in Div. 1A-1C as far north as Umanak in Div. 1A. Although the highest catch rates were obtained in shallow waters in Div. 1F, they generally indicated a rather even distribution in Div. 1B-1F. Catches in Div. 1A were insignificant. The 1984 year-class is thus expected to be a major contributor to inshore catches in 1988, at least from Holsteinsborg southward. It would also be expected to occur as small fish (generally <40 cm) in pound-net catches in 1987.

h) Information on size composition of catches in 1987 and 1988

As mentioned in b(ii) above, length-at-age and thereby weight-at-age in the offshore stock component decreased significantly from 1979 to 1984. Although the growth rate will continue to vary among years and year-classes, the latest information has been taken as the basis for projections. With a local minimum landing size of 40 cm, the main question seems to be the size of age-groups 3-5, especially age-group 4 in 1987 and 1988. The results of the offshore trawl survey and the inshore gillnet survey in 1985 may be the best background for advice at present.

The age and length compositions of the samples from the Federal Republic of Germany trawl survey in 1985 showed that, if the 1984 year-class follows the growth of the preceding four year-classes taking into account that the survey took place at the end of the year, by age 3

(in 1987) and in the major fishing season, more than half the individuals could be expected to be below 40 cm. Also at age 4 (in 1988), a portion of the individuals may still be below that size.

Material (age-length keys) from the inshore gillnet survey seems to indicate that in the inshore area the mean length by age was lower in 1985 than in the offshore area. Thus, it would be expected that by 1987 the major part of age-3 cod will be below 40 cm but at a size where they could be retained in pount-nets. Also in 1988, a considerable number of individuals of the 1984 year-class might not yet have achieved a length of 40 cm.

If the 1985 year-class is also a relatively strong one, the proportion of small fish in 1987 and 1988 catches will be even higher than indicated above.

i) Management considerations

In its June 1985 report, the Scientific Council noted that, unless a relatively good year-class very soon recruited to the stock, a 65-year period of occurence of cod and a cod fishery at West Greenland may come to an end. However, should a good year-class recruit, the Scientific Council noted that, at the time of recruitment, the major part of the fishable stock would consist of these recruits. Substantial discarding would occur, and landings would consist almost entirely of fish just above the minimum marketable size of 40 cm.

The situation that was described last year may become a reality for 1987 and 1988. Both from the viewpoint of rebuilding the fishable stock and the spawning stock and from the viewpoint of harvesting a year-class to give maximum yield-per-recruit, STACFIS now advises that strict measures should be introduced for 1987 and 1988 to protect these young fish.

As noted in the previous section, the catches in pound-nets are likely to reflect the increased abundance of incoming year-classes. The capture of such small fish might be avoided by increasing the mesh size of pound-nets, although there may be practical problems in doing so, both from the cost of replacing the twine and from increased meshing of fish. In the latter respect, mesh sizes up to 102 mm are used in pound-nets in some other areas (Subarea 3), apparently without meshing problems. This should be examined by STACFIS in June 1987 in order to provide advice on a minimum mesh size for pound-nets. In any case, care in handling catches in pound-nets can allow for the release, with high survival rates, of fish below the marketable size.

In addition to special measures aimed at the protection of young fish, the general level of exploitation on this stock should be reduced as far as practicable in 1987 and 1988. This also would reduce further the catch of young fish in the respective years.

It is pointed out that the projections refer to landings only (i.e. fish of marketable size) and that the possible great amount of discards are not included in the catch figures. If these fish are lost, the consequence would be a reduction in the extent of the stock recovery.

2. Cod in Divisions 2J, 3K and 3L (SCR Doc. 86/19, 23, 24, 30, 32, 33, 47; SCS Doc. 86/13, 17, 19)

a) Introduction

Nominal catches for this stock declined from a peak of about 800,000 tons in 1968 to a low of about 139,000 tons in 1978. The catches in recent years (1982-85) have been about 230,000 tons. While Canada continued to take a major portion of the catch in 1985 (80%), the catch taken by other countries was the highest of the past 6 years, about 40,000 tons. The catch taken by inshore gears (trap, longline, handline and gillnet) increased from a low of 35,000 tons in 1974 to a high of 116,000 tons in 1982 and has declined since then to about 78,000 tons in 1985. STACFIS considered that the discrepancies between catches reported by member countries and Canadian surveillance estimates were not large enough to have a significant effect on this assessment. Recent catches and TACs (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Inshore catch	60	73	81	86	97	77	116	107	97[1]	78[1]	
Offshore catch	154	100	57	81	79	94	114	125	133[1]	149[1]	
Total Catch	214	173	139	167	176	171	230	232	230[1]	227[1]	
TAC	300	160	135	180	180	200	237	260	266	266	266

[1] Provisional data.

b) Input data

i) Commercial fishery

Approximately 5% of the nominal catch in 1985 came from Div. 2J, 47% from Div. 3K and 48% from Div. 3L. The catch in Div. 2J was at its lowest level since the late 1950's. It was suggested that this low level of catch may be attributed to ice conditions and higher than usual catch rates in Div. 3K. The dominant year-classes in the catch were those of 1978, 1979 and 1980. The numbers of older fish (age 8+) in the catch have been increasing in recent years. With the excellent level of sampling, the catch-at-age for this stock was well estimated.

The relationships of inshore and cod-trap catches to total stock abundance of age-groups 4+5 were examined. Ages 4 and 5 were used because these age-groups comprise a large portion of the inshore catch. In evaluating this relationship, it was noted that it would have been more appropriate to examine stock biomass instead of stock abundance. The total stock abundance estimates were taken from the cohort analysis (F_{84} = 0.23) that was accepted at the June 1985 Meeting. The inshore catch declined while abundance of age-groups 4+5 remained stable during the 1962-72 period and continued to decline as abundance declined during the 1973-75 period. The inshore and cod-trap catches subsequently increased as stock abundance increased. Significant relationships were demonstrated in this latter period (1976-84) between the abundance of age-groups 4+5 in the stock and total inshore as well as codtrap catches. However, the catch in the latter period was higher at a given level of abundance of age-groups 4+5 than in the 1962-72 period. Possible reasons for this are increased inshore effort during 1976-84, overestimates or underestimates of abundance of age-groups 4+5 in the 1962-72 or 1976-84 periods respectively, variation in the abundance of these age-grops with time, and a change in proportion of these age-groups migrating inshore with time. It is clear that there was a direct relationship between inshore catch and abundance of age-groups 4+5 for this stock in the 1976-84 period.

The appropriateness of using purchase-slip information as an estimate of inshore effort (number of trips) was discussed, and it was concluded that this data source merited further investigation. It was noted that there are potential biases in these data, but it was felt that they may be of use as a rough index, because no other inshore catch-rate data are available. From information for the 1984-85 period, it was observed that catch-per-purchase-slip remained stable for cod-trap, longline and handline fisheries and declined for gillnets. There is a possibility of extending this time series back to 1981, and further disaggregation of data would be useful (i.e. breakdown by vessel size category). Therefore, STACFIS recommends that further work with this purchase slip information, to be presented in 1987, should include extension of the time series, disaggregation of data, and the inclusion of amount and type of gear.

Offshore catch rates for 1962-85, standardized with respect to gear type by country, division and month, were dervied from catch and effort data, using a multiplicative model. The catch-rate series was analysed by two time-periods (1962-79 and 1978-85) and scaled by using the 1978-79 average as a reference in both periods. Catch rates by division, analysed in a similar manner, were also presented. Catch-rate indices were in good agreement among divisions for the earlier time period but rather inconsistent in the latter.

Because this procedure violates the assumptions of the model, it was suggested that alternate ways to combine the series for each division, as derived by using the multiplicative model, should be investigated. Some other problems which may also bias the resultant catch-rate series include increasing expertise in the fishery over the period when Canadian vessels first fished in more northern areas and the effects upon the fishery of intensely-aggregrated spawning and prespawning concentrations. With the problems outlined above, there should be caution in interpretation when these data are used for calibration of cohort analysis. The trends in catch rates may be good indicators of stock abundance, but the magnitude of changes with time may not be reliable. It was noted that the influence of experience in a new fishery would only be of importance for a short period. To resolve the problem of catch rates being inflated due to fishing on spawning concentrations it was suggested for next year's assessment, if adequate data are available, to carry out the multiplicative analysis with exclusion of catch and effort information for the first quarter and possibly for the second quarter. It was also suggested that the interaction between months and divisions in the multiplicative model be investigated.

In general, the catch-rate series for Div. 2J+3KL showed a decline through the late 1960's to the mid-1970's, followed by a subsequent increase. The 1985 level was about the same as those in the early 1960's. The trends in the catch-rate indices by division are similar to those of the combined series, with the exception of the Div. 2J index. This

series showed a decline in 1984 and 1985 which may be attributed to a disruption of fishery activity caused by unfavourable ice conditions.

ii) Research data

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

Country	Season	Div. 2J	Div. 3K	Div. 3L
Canada (N)	Autumn	1977-85	1978-85	1981-85
Canada (N)	Winter	1986	1976	1985-86
Canada (N)	Spring	-	-	1971-82, 85
F. R. Germany	Autumn[1]	1972-83, 85	-	-
USSR	Summer	-	1972-85	1972-85

[1] Discontinued after 1985.

Hydrographic information from surveys by these countries showed a considerable cooling trend in water temperature in recent years. This trend was more noticeable in depths from 100 to 300 m. Because lower-than-usual water temperatures above the shelf may cause fish to concentrate more densely in the slope area, biomass and abundance estimates may be biased. Because of the obvious cooling trend in recent years, results of calibration of cohort analysis with research-vessel survey indices should be viewed with caution. It was concluded that, in the future, more information on environmental conditions should be presented, if such data are available.

The Federal Republic of Germany surveys in Div. 2J showed a decline in biomass from the early to mid-1970's with a subsequent increase to 1983 and a further substantial increase in 1985. Surveys conducted by the USSR in Div. 3K and 3L showed a decline in biomass from the early to mid-1970's, an increase during 1977-78, relative stability during 1979-83, a considerable increase in 1984, and a decline in 1985. An overall abundance index for Div. 2J, 3K and 3L for age 6+ cod from Canadian surveys showed an increase from 1978 to 1981, relative stability during 1981-84 and a slight decline in 1985. The decline in abundance, observed in the 1985 Canadian survey, was caused mainly by a 50% decrease in the estimated abundance in Div. 3K. The decline in this division occurred in only one depth zone (201-300 m) and may have been caused by the lower-than-usual water temperatures that were recorded at these depths.

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 analysis for the 1962-85 period. For previous assessments, one set of average weight-at-age values was used for the 1962-76 period and annual values were calculated from 1977 onward. Because of the concern that was expressed during the assessment in June 1985 about the abrupt change in average weight from 1976 to 1977, sampling data were reevaluated and average weight-at-age values were determined separately for each year from 1972-85. As part of the reevaluation, the catch-at-age matrix was also considered. This reanalysis removed the abrupt change in weight-at-age that had been observed in previous years. Changes in the catch-at-age matrix occurred in some years as a result of updating the reported catches and more appropriate adjustment of sampling information. Mean values of weight-at-age were still used for all years prior to 1972. Natural mortality was assumed to be 0.20.

Partial recruitment values, used in the calibration of cohort analysis, were derived by adjusting year-class strengths based on a recruitment index that was calculated during the June 1985 assessment. In determining this partial recruitment vector, a cohort analysis with the same terminal fishing mortality (0.23) was used. It was noted that most of the calibration techniques would not be affected by partial recruitment. The results of cohort analysis, using these parameters, were used in the estimation of fully-recruited fishing mortality in 1985.

ii) Fishing mortality in 1985

Two research-vessel survey indices were used in calibration of cohort analysis. A survey abundance index for ages 6+ was obtained by combining results from Canadian autumn surveys in Div. 2J, 3K and 3L. Values for 1978-80 during autumn in Div. 3L were estimated from the ratio (1.25) of age 6+ autumn values to age 7+ spring Div. 3L values in the following year for two overlapping years (1981 and 1984). The age 7+ Div. 3L values for 1979-81 were adjusted by this ratio to give age 6+ autumn Div. 3L estimates for 1978-80. Calibration using this survey abundance index and age 7+ population numbers from the

cohort in the following year implied a high level of F in 1985 (0.45-0.50). However, the 1981 age 7+ spring index for Div. 3L seemed anomalously high, and, if this value was more in line with adjacent values, the relationship would imply a fully recruited fishing mortality in 1985 of about 0.35. The relationship of total abundance from November surveys by Federal Republic of Germany in Div. 2J versus age 4+ population numbers at the beginning of the following year implied a fully-recruited fishing mortality in the range of 0.20-0.30 and probably about 0.25. Some concern was expressed about the representativeness of this index, because the survey is conducted only in Div. 2J and may not reflect entire stock abundance.

An index, based on commercial catch rates, was regressed against offshore exploitable biomass for the 1962-85 period. Calibrations of the cohort analysis with this relationship implied an F-value of 0.15 in 1985. Concern was expressed, however, about using the entire series of catch rates which overlapped the time of extension of jurisdiction in 1977, because changes in fleet structure and season may have influenced the comparability of the series in the 1962-79 and 1978-85 periods. It was suggested that alternative means of linking the two time periods should be investigated. One such alternative was to use the Federal Republic of Germany survey series, since it spanned the time period in question. These relationships were examined, but no conclusions could be made at this time because of anomolous values in both time periods. It was noted that, if the survey results were made available by age, the relationships could be reevaluated. Therefore, a relationship between catch rate and offshore exploitable biomass for the 1979-85 period was used to calibrate the cohort analysis. This resulted in a best fit with an F-value between 0.15 and 0.20, probably about 0.18.

In view of the uncertainties associated with each of the indices of stock size (explained above and in 2b(i) and 2b(ii)) that were used to calibrate the cohort analysis, STACFIS was unable to precisely estimate a value for fully-recruited fishing mortality in 1985. With the range of fishing mortalities from various calibrations, STACFIS agreed that the most likely value for fully-recruited fishing mortality in 1985 would be 0.25.

Estimates of fishing mortality on 1974 and older year-classes in the 1978-80 period, as derived from tagging experiments, were in the range of 0.20-0.30. These estimates compare quite well with calculated fishing mortalities for 1978-80 from the accepted cohort analysis in the June 1985 assessment (F_{84} = 0.23). It was noted that these similarities may be influenced by the fact that the tagging data were adjusted with use of effort data derived from the multiplicative model which was also used to calibrate the cohort analysis. This possible influence should be investigated further. Consideration should also be given to the possible effects of including partially recruited age-groups in this experiment. The relationship between fishing mortality and fishing effort, although viewed with some reservation, also indicated age 6+ weighted fishing mortalities to be in the range of 0.20-0.30 for the 1981-84 period.

iii) Recruitment

Abundance estimates for ages 3-6 from Canadian surveys during 1977-85 in Div. 2J, 1978-85 in Div. 3K and 1976-85 in Div. 3L were examined as potential indicators of year-class strength. The objective of this examination was to determine the strengths of the 1979-81 year-classes at age 4, the 1979-80 year-classes at age 5, and the 1979 year-class at age 6. The regressions that were used to predict these values were restricted to the 1973-77 year-classes, with the 1978 year-class being omitted because it was thought to be seriously underestimated by the combined Div. 2J+3KL survey indices. The regression predicted the 1979-81 year-classes to be about 320 million, 450 million and 400 million fish at age 4 respectively. The regression for age 5 predicted the 1979-80 year-classes at this age to be about 250 million and 225 million fish and the regression for age 6 predicted the 1979 year-class to be about 140 million fish at this age. The overall best fit from these estimates resulted in year-class sizes of about 310 million, 375 million and 400 million fish for the 1979-81 year-classes at age 4, about 240 million and 290 million fish for the 1979-80 year-classes at age 5, and about 165 million fish for the 1979 year-class at age 6. The 1982 year-class was estimated at 390 million fish from the age 4 regression. Concerns were expressed about the estimates for the 1981 and 1982 year-class sizes from these relationships due to the shortness of the time series, the clumped nature of the observations, and the fact that predictions were made outside the range of observations. Survey abundance at age 2 was also examined to determine its benefit in predicting year-class strength. Because of availability problems to research gear for this age-group, the relationship was strongly influenced by large values. Some general observations,however, can be made. From fall surveys in Div. 2J and 3K, the 1981 and 1982 year-classes at age 2 were the strongest in the series, which is in line with the predictions using the survey indices discussed above.

In trial cohort analysis, using the predicted strengths of the 1979-81 year-classes and the estimated fully-recruited fishing mortality of 0.25 in 1985, the partial recruitment

pattern was slightly different from that initially calculated as described in 2c(i). The partial recruitment pattern in 1985 was adjusted to reconcile predicted year-class strengths and estimated fully-recruited fishing mortality in 1985. This adjusted partial recruitment was used in the final cohort analyses as well as in the catch projections.

A stock recruitment model was also examined. The model did not include environmental factors but the relationship of spawning stock biomass (age 7+) with recruiting year-classes at age 4 (lagged 4 years) seemed to fit quite well. It was suggested that some refinements to the model should include the use of environmental data and the use of actual maturity ogives rather than assumed "knife-edge" maturation at age 7 in the determination of spawning stock biomass. Depending on the interpretation of results from this relationship, the model estimates the 1981 and 1982 year-classes to be about the same size as estimated from research-vessel survey results.

d) Catch projections

The parameters that were used to project stock sizes and catches are given in Table 7. The partial recruitment vector used for projections was described in the preceding section. In previous assessments, average weight-at-age values for the most recent 2 years were used. There was a decline in weight-at-age from 1984 to 1985, but it was unclear if this could be attributed to a change in growth or change in fishing pattern. To account for the decreased average weight in 1985, but to dampen its effect, the utilized weight-at-age values are averages of the values derived in 1983-85. The TAC of 266,000 tons was used as the expected catch in 1986, and the 1983 year-class was set at the 1977-82 geometric mean of 250 million. The projections (Table 8) indicate that spawning stock biomass values are slightly below those calculated last year. Approximately 40%of the catch biomass in 1987 is accounted for by the 1981 and 1982 year-classes which may be imprecisely estimated and have been set, based on research-vessel survey results, at a level of 1.6 times the 1977-82 geometric mean and as large as the largest year-class in that time period.

Table 7. Cod in Div. 2J, 3K and 3L: parameters used in projections of stock biomass and catch.

Age (yr)	1985 population (millions)	1985 catch (millions)	Average weight (kg)[1] Annual	Beginning of year	Partial recruitment
4	402.8	15.2	0.83	0.69	0.17
5	293.9	37.2	1.21	1.00	0.60
6	166.9	33.6	1.66	1.42	1.00
7	137.6	27.7	2.21	1.92	1.00
8	34.8	7.0	2.66	2.42	1.00
9	18.4	3.7	3.12	2.88	1.00
10	24.8	5.0	3.49	3.30	1.00
11	14.4	2.9	4.38	3.91	1.00
12	7.9	1.6	6.17	5.20	1.00
13	1.5	0.3	8.16	7.10	1.00

[1] Annual average weights are used to calculate projected catch biomass and beginning of the year average weights are used to calculate population biomass.

Table 8. 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	1985	1986	1987	1988
Spawning stock biomass (000 tons)	591	666	758	877
Fishing mortality (F)	0.25	0.24	0.20	
Catch (000 tons)	227	266	246	

The calculated catch that would result from fishing at $F_{0.1}$ (0.20) differs from the 1986 TAC by 7.5% Due to variation in the data and reservations about relationships used to estimate parameters, STACFIS was unable to discriminate between the calculated catch at $F_{0.1}$ and the 1984-86 TAC of 266,000 tons. Therefore STACFIS advises that a catch of 266,000 tons would approximate exploitation at the $F_{0.1}$ reference level in 1987.

A target spawning stock biomass range for rebuilding the Div. 2J+3KL cod stock was adopted by ICNAF in 1977 (ICNAF Redbook, 1977, page 54). This target range of 1.2-1.8 million tons was based on stock-recruitment considerations derived from a cohort analysis that was presented in ICNAF Res. Doc. 77/26. That cohort analysis included estimated numbers of age 14 and older fish. The use of 14+ as a terminal age-group led to large overestimates of spawning stock sizes. With appropriate adjustments, the corresponding target spawning stock biomass range (beginning of year) would be 850,000 to 1,300,000 tons. There should be additional refinements of the appropriate target spawning stock biomass, when more study of spawning of this stock is complete. In particular, the assumption of "knife-edge" recruitment to the spawning stock at age 7 may not be appropriate, and the use of a maturity ogive warrants consideration.

e) Stock definition (Fig. 3)

A review of recent studies on the delineation of the various stock components of cod in NAFO Div. 2J, 3K and 3L (SCR Doc. 86/32) included discussion of genetic variation, migrations, meristics, infestation by parasites, growth rates and spawning times. Cod in Div. 2GH are probably also part of the Labrador-East Newfoundland stock complex but have been considered separately for management purposes.

Analysis of genetic variation in Atlantic cod suggested that there was a northern component from the deep northern slopes of the Grand Bank up to and including Hamilton Bank and a southern component from the shallow areas of the northern Grand Bank, St. Pierre Bank, Burgeo Bank and the Gulf of St. Lawrence north of the Laurentian Channel. The analysis showed that the cod stock of Flemish Cap was clearly distinct.

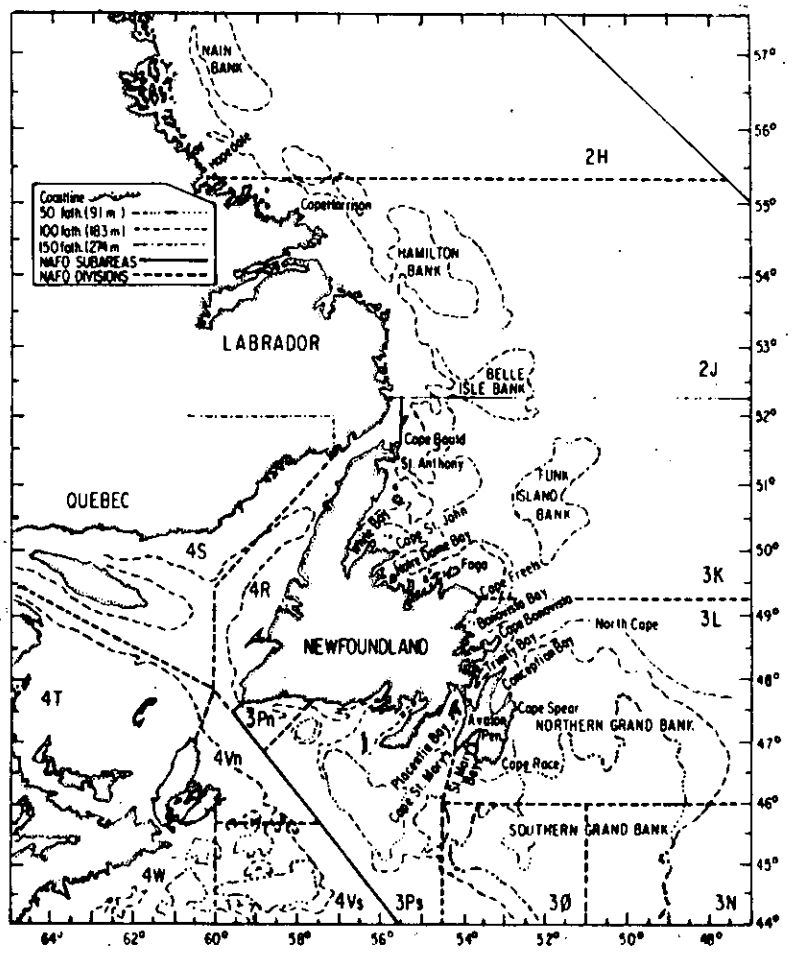


Fig. 3. Area map showing NAFO divisions, offshore banks and some of the place names mentioned under stock discrimination.

On the basis of inshore tagging during the 1950's and 1960's in inshore waters at many localities from Labrador to the Avalon Peninsula and in offshore waters from Hamilton Bank to the northern Grand Bank, cod of the Labrador-East Newfoundland stock were shown to intermingle

and overlap in their winter-spring spawning areas in deep water on the slopes of the Labrador and Northeast Newfoundland shelves. In June-September (the main feeding and growing period) in the years after tagging, the most obvious migratory characteristics was the homing of most of the coastally-tagged cod to or near the tagging area. Based upon the tagging of about 25,000 Atlantic cod during February-March 1978-81 on the prespawning concentrations on Hamilton Bank, Belle Isle Bank, Funk Island Bank, and northern Grand Bank, there was evidence of a consistent annual pattern of migration to inshore waters during summer and to offshore areas during winter for each group of cod tagged along the outer continental shelf. The Hamilton Bank component (Div. 2J) evidently contributes to the southern Labrador (Div. 2J) and northeast Newfoundland (Div. 3K) coastal fisheries mainly from Notre Dame Bay northward. The Belle Isle Bank component (located mainly in Div. 2J and a small portion in Div. 3K) migrates during summer mainly to southern Labrador (Div. 2J), the Strait of Belle Isle entrance (Div. 4R) and northeastern Newfoundland as far south as Notre Dame Bay (Div. 3K). The pattern of movement is similar to that of the Hamilton Bank component (Div. 2J) except for the greater proportion in the Strait of Belle Isle from the Belle Isle Bank component.

Cod on the northern and northeastern slopes of Funk Island Bank (Div. 3K) migrate during summer to eastern (Div. 3K) and southeastern Newfoundland (Div. 3L), with smaller proportions going to southern Labrador (Div. 2J) and the Strait of Belle Isle (Div. 4R) than from the taggings on Belle Isle Bank. Cod from the southwestern slope of Funk Island Bank (Div. 3K) contribute mainly to the summer inshore fishery of Notre Dame Bay (Div. 3K) and Bonavista Bay (Div. 3L) and on a smaller scale to the fishery in Trinity Bay, Conception Bay, and the eastern part of the Avalon Peninsula (Div. 3L). Thus, the components which overwinter and spawn on the northern, eastern, and western slopes of Funk Island Bank (Div. 3K) collectively form what might best be described as the "Eastern Newfoundland" stock, and the inshore fishery from White Bay to the Avalon Peninsula and to a small extent Labrador would likely be sensitive to changes in the size of this stock. Cod which overwinter on northern Grand Bank (Div. 3L) migrate southwards across the bank to the Virgin Rocks (Div. 3L) and to the eastern slope of the bank and to inshore areas in Div. 3L. This component contributes mainly to the inshore fishery from Trinity Bay southward to St. Mary's Bay, with little effect on the fishery north of Cape Bonavista (i.e. it is limited to Div. 3L).

STACFIS considered that the information on infestation by parasites, growth, timing of spawning and meristics should be further examined to determine whether definite discontinuities were present at specific geographical locations. Differences in these characteristics may be clinal (e.g. increasing growth from north to south) and not necessarily evidence of discrete stock components. STACFIS therefore

recommends

that the Scientific Council further consider the matter of stock discrimination of the cod stock complex in Div. 2J, 3K and 3L at its meeting in September 1986.

3. Cod in Division 3M (SCR Doc. 86/50; SCS Doc. 86/13, 17, 19)

a) Introduction

For the 1963-72, 1973-79 and 1980-85 periods, the average annual catches were about 41,000 tons, 29,000 tons and 12,000 tons respectively. The lower catch in the 1980-85 period may be attributed to lower TACs. Vessels from Portugal and Spain took most of the catch during 1985, as was the case in recent years. Also included in the 1985 catch were approximately 2,000 tons, derived from Canadian surveillance estimates, for non-member, non-reporting countries (Mexico, Chile and Panama). It was noted that there were large discrepancies between reported catches from member countries and Canadian surveillance estimates. It was agreed that these discrepancies should be referred to the Fisheries Commission. Recent TACs (000 tons) and catches are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	40	25	40	40	13	12.7	12.4[1]	12.4[1]	13	13	13
Catch	22	27	33	30	10	14	13	10	12[2]	14[2]	

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

b) Input data

i) Commercial fishery data

Catch rate indices, presented in SCR Doc. 81/12 for the 1960-80 period, have not been extended due to the scarcity of effort information after 1980. This series showed a

decline from a level of about 2.0 in 1963-64 to about 0.5 in 1978-79 and to 0.1 in 1980. Catch rate indices from Spanish pair-trawl data, derived from a multiplicative model, did not show any trend during 1983-85.

Length and age compositions for 1985 were available from Portugal, Spain and Canada (observers) for the otter-trawl, pair-trawl, longline and gillnet fisheries. These indicated that about 90% of the catch in numbers was comprised of ages 4 and 5 fish (1981 and 1980 year-classes). These year-classes were also dominant in the 1984 catch at ages 3 and 4. The 1981 year-class was dominant in both years. Some discrepancies that were observed in the average length-at-age and weight-at-age data from Portuguese and Canadian sources may be explained by the relatively small sample sizes, differences in gears sampled (longline and gillnet versus otter trawl), and the different seasons from which samples were taken.

ii) Research data

Research-vessel surveys have been conducted in the area by the USSR and Canada since 1971 and 1977 respectively. Biomass and abundance estimates from both surveys have been variable in recent years with no apparent trend. The 1981 year-class at age 4 was dominant in both survey catches in 1985. Ages 3 to 5 cod constituted most of the catch in both the USSR survey (91%) and the Canadian survey (97%). The 1983 year-class did not appear to be strong.

c) Estimation of parameters

Cohort analysis was not attempted because of inadequate sampling of the commercial fishery in 1981 and 1982 and the lack of confidence in the reported fisheries data in recent years.

d) Assessment results

The average biomass (age 3+) was in the range of 30,000-35,000 tons in the 1978-80 period (NAFO Sci. Coun. Rep., 1984, page 41). With no apparent trend in recent research vessel biomass, STACFIS concluded that there was no evidence to indicate that the current average biomass (age 3+) is greater than this level. Results from the USSR survey in 1985 showed only a slight decline in biomass from the previous year but indicated a decline of about 40% in abundance. The average biomass in the 1960-65 period was about 200,000 tons.

e) Prognosis

In view of the previous comments concerning relative year-class strengths, STACFIS emphasized that exploitation of the 1980-81 year-classes has already reduced considerably their potential contribution to the fishable biomass and subsequently the spawning stock, which is now estimated to be about 10,000 tons based on the proportion of mature fish in Canadian and USSR research-vessel survey catches (24-28%). It is inevitable that, if fishing is continued in this area, the potential contribution of yield-per-recruit of the 1982 year-class will also be reduced considerably. This situation is even more serious if the 1985 catch is as high as implied by the Canadian surveillance estimate (i.e. about twice the 1985 reported catch). STACFIS noted that the management strategy of the Fisheries Commission was not to increase the TAC beyond 12,965 tons until a target biomass (age 3+) of 85,000 tons has been reached. This target would require an increase in the biomass of age 3+ cod by a factor of about 3 from 1985 to 1987. Such an increase is unlikely to be achieved. To protect the remaining spawning stock biomass and to allow the 1980-82 year-classes to contribute to spawning stock and make this target attainable, STACFIS advises that a cessation of fishing would be the most appropriate management action.

f) Fisheries Commission request for information (Appendix IV, Annex 1, Sections 2c, 2d and 2e)

i) With respect to optimum yield management, the Scientific Council notes that fishing mortality (F) in recent years has been in the order of 1.0 (NAFO Sci. Coun. Rep., 1984), a level well in excess of the $F_{0.1}$ or F_{max} reference levels. Furthermore, MSY or the yield associated with F_{max} has been estimated previously to be about 35,000-40,000 tons.

There is no estimate of virgin stock biomass available for this stock. It was noted previously that the biomass (average) for the 1960-65 period was about 200,000 tons, and this may be considered to be a minimum estimate of virgin stock biomass. Two-thirds of this level, about 135,000 tons is about 3 to 4 times greater than the estimated biomass at present.

ii) The value of $F_{0.1}$ has been assumed to be 0.20, the same value used for almost all cod stocks assessed in the Northwest Atlantic area. F_{max} was determined to be 0.50 (ICNAF Redbook, 1973, Part I).

iii) As was noted previously, spawning stock biomass is now estimated to be about 10,000 tons, based on proportions of mature fish derived from Canadian and USSR research vessel survey catches (24-28%).

4. Cod in Divisions 3N and 3O (SCR Doc. 86/35; SCS Doc. 86/13, 17)

a) Introduction

Nominal catches declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Catches in 1985, as reported to NAFO by member countries and by Canadian surveillance personnel for non-member countries, were estimated to total 41,284 tons, of which more than 75% was taken in Div. 3N. In 1985, catches by Canadian otter trawlers increased substantially over the 1984 level and were the highest since the early 1950's. Spanish catches were mainly by the traditional pair-trawl fleet, with an additional 1,200 tons being taken by a new freezer-trawler component. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	43	30	15	25	26	26	17[1]	17[1]	26	33	33
Catch	24	18	15	28	20	24	32	32	27	41[2]	

[1] Excludes expected catch by Spain.
[2] Provisional. The 1985 catch also includes estimates of 4,700 tons by non-members.

b) Input data

i) Commercial fishery catch-effort data

Catch and effort data were available from ICNAF and NAFO Statistical Bulletins for the 1959-78 and 1979-83 periods along with provisional data for 1984. Catch and effort data for the Canadian fishery in 1985 were provided by the Canadian Department of Fisheries and Oceans. In the 1985 assessment for this stock, a catch-rate index was obtained from a combination of otter-trawl and pair-trawl catch-rate indices, each of which had been obtained with the use of a multiplicative model. However, problems with both catch-rate series were again noted, and concern was expressed as to the quality of some of the data from earlier years in terms of catch rates. It was considered more appropriate and reliable to use data for the 1977-85 period because this was the period when not only catch rates were thought to be better estimated but reported catches were considered more reliable and biological sampling was more extensive. As a consequence of these factors, catch-rate indices were recalculated in a multiplicative model by using data from the Canadian otter-trawl fishery during 1977-85. This series indicated that catch rates had generally increased (50%) from 1977 to 1982-83 but had declined (20%) in 1984 and remained at this level in 1985. Catch-rate indices derived from Spanish pair-trawl data for the 1982-85 period, as reported by Spanish observers, indicated an increase (100%) from 1982 to 1984 and a substantial decline (80%) in 1985.

ii) Research surveys

Stratified-random research surveys were conducted by Canada during 1971-85, with the exception of 1983. Div. 3O was not surveyed in 1971, 1972 and 1974 and strata coverage was imcomplete and inconsistent in the earlier years in both Div. 3N and 3O. Estimates of abundance for the non-sampled strata were obtained by using a multiplicative model. These estimates showed considerable variation over the survey period, with no consistent trends up to 1983, but biomass and abundance estimates in 1984 and 1985 were high relative to the earlier period. The Canadian survey in 1985 indicated that the 1980-82 year-classes were most abundant. Data from USSR surveys indicated an increase in biomass and abundance from 1984 to 1985.

iii) Catch-at-age data

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 catch in 1985. Assessments conducted since 1981 have used average weight-at-age values for the earlier years together with those obtained from commercial sampling for years beginning in 1977. Constant average weight-at-age values were used for both the 1959-65 and 1966-76 periods. The latter were obtained from averaging values for 1977-80. For the current assessment, data for the 1972-76 period were reanalyzed and average weights for each of these years were determined. The average for this time period was then used as an estimate for each year from 1966 to 1971. This adjustment produced some improvement in the results by reducing some large discrepancies in the calculation of sum

of products. The calculated "sum of products" for 1984 was found to be unacceptably low (-21%), and reanalysis of the data indicated that the difference was mainly associated with estimates for the Spanish catch-at-age. Average weights from the Canadian fishery had been applied to these data in the absence of reported figures. Because the average weight-at-age values reported by Canada and Spain for 1985 were similar, it was considered that the average weights used in 1984 might have been inadequate and, consequently, numbers-at-age from the Spanish fishery in 1984 were underestimated. For this reason, the Spanish catch-at-age vector for 1984 was adjusted so that the sum of products was consistent.

The 1980 year-class was most abundant in the Canadian and Spanish fisheries during 1985, with the Canadian fishery taking a higher proportion of fish from older age-groups.

c) Estimation of parameters

i) Partial recruitment

A partial recruitment vector for 1985 was estimated from the ratio of commercial catch-at-age to survey number-per-tow in 1985, after each had been normalized to its highest value. These data suggested full recruitment at age 6, with a diminishing exploitation pattern at older ages, as opposed to full recruitment age 7, which was used in 1985 assessment of this stock, with assumed full recruitment for the remaining ages. Previous cohort analyses, using a dome-shaped partial recruitment pattern, did not indicate similar patterns in the adjacent years. Therefore, an average partial recruitment vector for the recent period (1981-83) from cohort analysis was used in subsequent analyses. The values are as follows:

Age (years)	3	4	5	6	7	8	9	10	11	12
Partial recruitment	0.05	0.22	0.52	0.72	1.00	1.00	1.00	1.00	1.00	1.00

ii) Cohort analysis

Catch and average weight-at-age data from the commercial fishery over the 1959-1985 period were used in cohort analyses. 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 (7-10).

iii) Fishing mortality in 1985

Fishing mortality was estimated from the relationship between average exploitable biomass and catch-rate index in the 1977-85 period, for reasons previously described. Although the relationships were not significant, F in 1985 was estimated to be 0.45 based on the pattern of residuals in the last 3 years. A comparison of ratios of cohort exploitable biomass and commercial catch rates over the 1977-80 and 1981-85 periods implied F-values for 1985 in the range of 0.40-0.60, which included the value 0.45 derived above. A similar relationship in the 1985 assessment produced a significant regression and predicted a 1984 F at 0.20. A comparison of the current catch-rate series (data for 1977-85) with that used in 1985 (otter-trawl data for 1959-84) indicated a similar pattern in the earlier years but showed more variation since 1980. The previously-derived catch rates were generally higher in 1983 and 1984. In spite of the determination of a significant relationship in 1985, it was considered that fishing mortality for fully-recruited age-groups would not be reliably estimated because of the small number of data points. The discriminating power of a short data series could be significantly influenced by changes in the parameters and the inclusion of additional years.

By the method of Paloheimo, estimates of average fishing mortality from the research-survey data (1977-82, 1984) (ages 3+ and 6+) and commercial catch and effort data (age 6+) (1977-84) were 0.24, 0.20 and 0.45 respectively. In the previous assessment, similarly-calculated F's were compared with unweighted F's from cohort analysis. In the present assessment, the weighted F's averaged over the 1977-85 period were calculated from cohort analysis with the 1985 F's ranging from 0.20 to 0.50. The results showed little discriminating power in that average F's in 1977-85 ranged from 0.28 to 0.33, regardless of fishing mortalities exerted in 1985.

Biomass estimates for 1984-85 from the USSR and Canadian surveys were high relative to those of previous years. Because the average fishing mortality in the 1977-85 period was about 0.3, the higher biomass levels imply that catches in 1984-85 at the average 1977-85 level (26,000 tons) would have generated fishing mortalities lower than 0.3.

STACFIS noted that the estimate of fishing mortality (0.35) in 1985 is based upon rather

weak relationships between the commercial catch-rate index and cohort exploitable biomass as well as between survey abundance and cohort population abundance. The implication of this F-value (0.35) was not consistent with advice provided in 1984 (F_t = 0.20) and indicated that the age 3+ biomass is below 200,000 tons. The survey estimates of abundance for 1984 and 1985 are above the previous values. By September 1986, results from the 1986 Canadian and USSR surveys will be available and will allow for a more reliable estimate of biomass and also of fishing mortality in 1985. STACFIS therefore advises that the assessment of this stock be reconsidered at this time.

5. Cod in Subdivision 3Ps (SCR Doc. 86/34, 36)

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 1985, Canadian offshore catches increased substantially as a result of an increased allocation. Canadian inshore catches have averaged approximately 23,000 tons since 1976 and have been relatively stable since 1983. Line-trawl catches showed an increasing trend from 1975 to 1980 but have declined since then. Catches by both the gillnet and cod-trap components have shown an increasing trend in recent years. Catches by France in 1985 were substantially higher than in 1984 and, as in previous years, were mainly from the offshore otter-trawl fishery. Recent catches and TACs (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986[3]
Advised TAC	47.5	32.5	25	25	28	30	33	33	33	41	
Effective TAC	47.5	32.5	25	25	28	30	33	33[2]	35.8[2]	44.6[2]	
Catch	37	32	27	33	38	39	34	38	37[1]	51[1]	

[1] Provisional data.
[2] Effective TAC is obtained by combining the Canadian portion (as established by Canada) of the advised TAC with the EEC recommended catch as per EEC regulations.
[3] See Scientific Council Reports, 1985, page 59.

b) Input data

i) Commercial fishery catch-effort data

Catch and effort data from the commercial fishery during 1959-85 were analysed to obtain a catch-rate index by using a multiplicative model. Since 1977, catch-rate data were available only from the Canadian and French (SP) otter-trawl fisheries, with the exception of French data for 1980. Canadian catch rates alone have shown a rapid increase since 1982 to levels higher than any observed in the historical series, and fishing effort had decreased since 1980. The combined series showed a similar trend with decreased magnitude, but analysis of the French data alone did not indicate a rapid increase in catch rates in recent years, and fishing effort was shown to be increasing.

Catch-rate data from the Canadian inshore fishery were available only for 1984 and 1985. These data were derived from information provided on "purchase slips" regarding numbers of sales by inshore fishermen by gear and vessel category. It was felt that these data could provide an estimate of effort because each 'slip' usually represented the catch per trip. Analysis of these data indicated that there was no change in catch rates of fishing effort from 1984 to 1985.

ii) Research surveys

Stratified-random research-vessel surveys have been conducted by Canada since 1972. Abundance estimates for non-sampled strata were once again obtained by using a multiplicative model. The Canadian surveys were also conducted at different times (February-June) in different years. The abundance estimates were seasonally-adjusted to correspond to February surveys using monthly ln power estimates obtained from the commercial catch-rate standardization procedure. Biomass and abundance estimates have shown considerable variation over the survey period, but they have been relativley stable since 1981. Surveys have been conducted by France during February and/or March of each year since 1977. Data from the 1977 survey were not used in calibration analyses due to the inadequate sampling of the strata. Abundance and biomass indices showed an increasing trend since 1978, with the largest values being observed during the 1986 survey.

The timing of surveys in this area was considered to be an important source of variation between the two sets of data. In particular, it was thought that the higher abundance and biomass estimates in the French surveys, particularly in 1986, may have resulted from a migration of some cod from the eastern Gulf of St. Lawrence stock (Div. 3Pn+4RS) to the general area of Burgeo Bank in winter. Some intermixing of the two stocks, variable between years in this area during the early months of the year, has been documented previously and is based on tagging and growth data ("Migration and intermingling of stocks of Atlantic cod of the Newfoundland and adjacent areas from tagging in 1962-66", by W. Templeman; ICNAF Res. Bull., No. 14, pages 5-50). Therefore, survey data from both countries were analyzed, after excluding observation on the Burgeo Bank portion of the stock area (Strata 306-309). This procedure did not reconcile the two series, but they did show a similar population age structure in 1986. The 1980 and 1981 year-classes were most abundant in both surveys.

iii) Catch-at-age data

Catch-at-age and average weight-at-age data for the commercial fishery in 1985 were derived from sampling by Canada and France. Year-classes from 1978 to 1981 made up the majority of the catch, with the 1980 year-class being most abundant.

c) Estimation of parameters (Table 9)

i) Partial recruitment

In recent assessments of this stock, estimates of partial recruitment were those which had been adjusted so that the ratio between the abundance of recent year-classes at age 3 in adjacent years showed some correspondence between cohort and survey results. Survey numbers were those obtained by combining Canadian and French survey data. However, a comparison of age 3 abundance from the two revised survey indices indicated that they were poorly related and a combination was therefore considered inappropriate. In the present assessment, partial recruitment values were estimated by iteration from historical averages over the 1978-83 period.

ii) Cohort analysis

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

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

Age (yr)	1985 population (000) F(85)=0.25	1985 population (000) F(85)=0.45	1985 catch (000)	Mean weight (kg)	Partial recruitment
3	84,396	46,932	198	0.62	0.01
4	84,388	47,606	4,557	0.90	0.16
5	81,521	47,420	11,067	1.30	0.49
6	33,379	19,838	5,951	1.88	0.73
7	23,545	14,325	4,995	2.60	1.00
8	6,736	4,098	1,466	3.34	1.00
9	2,027	1,233	418	4.39	1.00
10	1,813	1,103	378	5.36	1.00
11	1,421	864	332	6.14	1.00
12	522	317	130	8.05	1.00
13	119	73	23	10.22	1.00
14	35	35	12	10.75	1.00

iii) Fishing mortality in 1985

The relationships of cohort to survey abundance from both French and Canadian surveys, excluding Burgeo Bank, at ages 3+ and 6+, by using unweighted least squares regression analysis, indicated a significant relationship only for the age 3+ French survey. Use of the criterion of best 'fit' on the basis of the balance of residuals from 1983 to 1985 implied an F-value of approximately 0.45 in 1985. Examination of the relationship between exploitable offshore biomass and catch rates indicated different trends in the 1977-85 period than in the earlier period. It was felt that, due to possible changes in fleet

behavior after 1976, the use of the recent series was more appropriate. STACFIS noted that fishing mortality in 1985 could not be precisely determined by this method but considered that the results suggested an F btween 0.25 and 0.45.

d) Projections

Projections were considered by assuming F-values in 1985 of both 0.25 and 0.45 and a catch in 1986 of 41,000 tons, with mean weight and partial recruitment vectors as given in Table 9. Recruitment in 1986 and 1987 was assumed to be equal to the geometric mean of 55 million fish, as used in previous assessments. These projections imply a catch at $F_{0.1}$ (0.2) in 1987 in the range of 26,000-58,000 tons which encompasses the 1985 effective TAC. STACFIS noted that the requested advice could not be provided because of the difficulty in estimating fishing mortality for 1985.

e) Recommendation for data base improvement

In its 1985 report, STACFIS recommended that action be taken to correct deficiencies in the database necessary for the assessment of this stock. Problems were related mainly to the lack of catch-rate data from the French otter-trawl fishery during 1983-85 and the lack of catch-rate data from the Canadian inshore fishery. The current assessment indicates that some of these problems have been corrected but further deficiencies were noted and additional work was suggested. Catch and effort data from France (M) were not available.

Because of problems with the interpretation of recent catch rates, STACFIS recommended that both Canadian and French (SP) catch-rate series be reexamined for trends over time and changes in catchability. Because of changes in management practices since the late 1970's (quota restrictions and enterprise allocations), the Canadian catch-rate series should be examined to determine relative monthly catch rates since that time.

STACFIS also recommends that research data from Canadian and French surveys (Div. 3Pn, 3Ps, 4R and 4S) be reexamined to account for differences in implied stock status and for possible accounting of the occurrence of cod from eastern Gulf of St. Lawrence stock in the Burgeo Bank area. With regard to the latter, this occurrence should be reviewed and results of current surveys, both in the Gulf of St. Lawrence and Div. 3P, as well as results of the recent tagging program, be analysed to look for growth-rate differences and migration patterns. Canadian and French scientists are encouraged to examine the possibility of coordinating their surveys so that apparent differences in results can be further examined.

STACFIS further recommends that current efforts to obtain catch-rate data from the Canadian inshore fishery be continued and extended to years earlier than 1984 and that data be broken down by gear and vessel size category.

6. Redfish in Subarea 1

a) Introduction

The overall nominal catch in 1985 was below 3,000 tons, the lowest reported in the last 10 years. The catch was taken mainly by Japanese trawlers, in a joint venture charter arrangement with the Greenland Home Rule authorities. Analysis of sampling data for redfish from commercial catches and research vessel surveys by the Federal Republic of Germany in recent years is in progress. Recent catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Catch	14	31	8	9	8	6	8	8	4	2[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), at which time a general production analysis indicated a maximum sustainable yield (MSY) level of about 10,000 tons, with an equilibrium catch at 2/3 MSY effort of about 9,000 tons. Further assessment has not been possible and no new information is available. STACFIS presently has no basis on which to advise whether a catch of 9,000 tons in 1987 will correspond to 2/3 MSY effort.

7. Redfish in Division 3M (SCR Doc. 86/27, 28, 64; SCS Doc. 86/13, 17, 19)

a) Introduction

The total nominal catch has been at the level of the TAC since 1983. The USSR continued to dominate the fishery, catching 13,800 tons in 1985. Large discrepancies (35%) between catches as reported to NAFO and those estimated from Canadian surveillance were noted. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	16	16	16	20	20	20	20	20	20	20	20
Catch	17	20	17	20	16	14	15	20	20[1]	20[1]	

[1] Provisional data.

b) Input data

Catch and effort data were extracted from ICNAF and NAFO Statistical Bulletins for the 1959-1984 period and utilized in a multiplicative model to derive a standardized catch-rate series. This series indicated a general decline during 1961-67, followed by a sharp increase to the highest level ever recorded in 1970. Catch rates declined to 1979, increased moderately to 1982 and have declined since then.

Commercial length frequencies were available from the Portuguese fishery in 1985. Length frequencies from Canadian surveys in 1979-85 and from USSR surveys in 1980-85 were also available. The estimated numbers at age (determined by otoliths)in the population from Canadian surveys were also available (NAFO SCR Doc. 86/27).

c) Estimation of parameters

A derived catch-at-age matrix was used in the VPA (SCS Doc. 86/17). Input natural mortality varied with age. The use of variable M was discussed, and it was indicated that simulation studies of the model were required. STACFIS agreed that these should be carried out before evaluating a VPA which used variable M.

The standardized catch-rate series was regressed (least squares) on effort (unlagged and lagged 6, 8 and 10 years). The regression with unlagged effort data was not significant. However, lagging the effort data by 6, 8 and 10 years resulted in significant relationships. The equilibrium general production models, using input from the regressions with lagged effort data, indicated a yield at 2/3 MSY effort of about 15,000 tons and a MSY of about 17,000 tons. It was noted that the regression of CPUE on lagged effort was dependent on the 1970 and 1971 points and, therefore, caution should be used in evaluating the results.

d) Catch projections

The few length frequencies that were available from commercial catches indicated that the 1985 fishery was again concentrated on the relatively strong year-classes of the early 1970's. The previous assessment of this stock (NAFO Sci. Coun. Rep., 1985, page 61) indicated a gradual decrease in biomass from 1983 to 1984, as estimated from Canadian and USSR research cruises in those years. The Canadian data indicated a further decline from 1984 to 1985. These declines, which had been predicated previously, are reflected in the decrease in catch rates from 1982 to 1984. This is 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 by length-group also revealed the decline in abundance of these year-classes. This could not be monitored further from Canadian data as there was no research survey to Div. 3M in 1986. STACFIS noted last year that recruitment of the year-classes of the early 1980's to the fishery may not be as great as previously anticipated, on the basis of Canadian research data, but no such data are available for 1986. Because the CPUE has been relatively constant since 1977 and catches have been stable around 20,000 tons, STACFIS therefore advises that the TAC for 1987 should remain at 20,000 tons.

There are insufficient data for this stock to provide answers to the questions posed by the Fisheries Commission.

8. Redfish in Divisions 3L and 3N (SCR Doc. 86/37, 38, 64; SCS Doc. 86/13, 17)

a) Introduction

The reported catch of 21,000 tons in 1985 was 6,000 tons higher than the 1984 catch. About 3,000 tons of this increase was attributable to a new Spanish freezer-trawler fishery,

primarily in Div. 3N. Only small discrepancies were noted between Canadian surveillance estimates of catch and those reported to NAFO. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	20	16	16	18	25	25	25	25	25	25	25
Catch	21	17	12	14	16	24	22	20	14[1]	24[1]	

[1] Provisional.

b) Input data

Catch and effort data from ICNAF and NAFO Statistical Bulletins for 1959-84 were combined with provisional Canadian data for 1985 and then used in a multiplicative model to derive a standardized catch-rate series for Div. 3L and 3N combined. In addition, in response to questions raised previously concerning variability in the catch rates for this stock, the above catch and effort data were separated by division and analysed separately using the same multiplicative model.

Seasonal surveys in Div. 3L by Canada in 1985 indicated a trawlable biomass of about 85,000 tons. A wide range of ages was present in the area. Available length frequencies from the commercial fishery indicated that larger fish were taken in Div. 3L than in Div. 3N. This phenomenon had been noted previously.

c) Estimation of parameters

Available catch-at-age data and natural mortality values which varied with age were utilized in a VPA (SCS Doc. 86/17). Discussion of the use of variable M indicated that further studies using simulation techniques were required. STACFIS agreed that these studies should be carried out before the VPA with variable M could be evaluated.

The catch-rate series (SCR Doc. 86/37) for Div. 3L and 3N showed considerable variability without a definite trend with time. Linear regressions of catch rate on effort (unlagged and lagged) were not significant. The catch-rate series for Div. 3L alone did not show any trend with time but that for Div. 3N did. Linear regressions of catch rate on effort for Div. 3N, excluding the anomalous 1974 point, were significant, with the best relationship for a lag of 8 years. This relationship were used in a general production model for Div. 3N with the following results:

Parameter	f(MSY)	2/3 f(MSY)
Fishing effort (hr)	21,688	14,459
Yield (tons)	17,437	15,500
CPUE (tons/hr)	0.804	1.072

d) Catch projections

The general production model for Div. 3N alone indicated a yield at 2/3 MSY effort of about 15,500 tons. An examination of catches in Div. 3L and 3N over time indicates that 63% of the total catch has been taken in Div. 3N. This was considered to reflect the distribution of redfish between the two divisions. Adjustment of the yield for Div. 3N by this figure results in a yield at 2/3 f_{MSY} for Div. 3L and 3N combined of about 25,000 tons and a yield at f_{MSY} of about 28,000 tons. Based on these observations, STACFIS advises that the TAC should remain at 25,000 tons for 1987.

e) Other research (SCR Doc. 86/38)

STACFIS has previously requested that scientists examine their databases in an attempt to answer questions regarding 'stocks' or 'stock complexes' of redfish in Div. 3K, 3L, 3N and 3O (NAFO Sci. Coun. Rep., 1985, page 62). Information from commercial catch-rate data and Canadian research survey data indicated clear separation of redfish in Div. 3O and 3Ps but the situation concerning Div. 3K, 3L, 3N and 3O was less clear. STACFIS recommended that further work be carried out to clarify the situation. However, the available data do not indicate that combination of Div. 3L and 3N as one redfish management unit is inappropriate.

With respect to the special request of the Fisheries Commission, because a general production model could only be applied to data for Div. 3N, STACFIS did not consider it appropriate to provide a graph of production on fishing mortality rate, and no data are available concerning virgin stock levels or spawning stock biomass.

9. Silver Hake in Divisions 4V, 4W and 4X (SCR Doc. 86/18, 54, 56, 57, 58, 59, 60, 62, 70, 82, 85, 88; SCS Doc. 86/13, 17, 18)

a) Introduction

The fishery for silver hake in Divisions 4V, 4W, and 4X is mainly undertaken by large trawlers using small-meshed bottom otter trawls. Prior to 1977, the fishery for silver hake was not restricted to a particular season or area. Since 1977, the fishing season has been from April to November and the fishery has been restricted to the seaward side of the Small Mesh Gear Line (SMGL). Nominal catches of silver hake in Div. 4VWX increased from about 169,000 tons in 1970 to 300,000 tons in 1973 and declined to 37,000 tons in 1977. Catches after 1977 fluctuated between 45,000 tons and 60,000 tons until 1983 when a catch of 36,000 tons was reported. The catch increased to 74,000 tons in 1984 and the provisional catch in 1985 was 76,000 tons. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	100	70	80	70	90	80	80	80	100	100	100
Catch	97	37	48	51	45	43	60	36	74[1]	76[1]	

[1] Provisional data.

b) Input data

i) Commercial fishery data

Catch and effort data from ICNAF and NAFO Statistical Bulletins for 1970-1984 were combined with Canadian International Observer Program (IOP) data for 1985 and then used in a multiplicative model to derive a standardized catch-rate series for Div. 4V, 4W, and 4X combined. In response to questions raised previously, the multiplicative regression model was used to estimate effects on the catch rate of changes in the fishery caused by changes in mesh size and the creation of the Small-Mesh-Gear-Line (SMGL). The history of the fishery is divided into two regimes. The period prior to 1977 represents the old regime with no SMGL and mesh size of approximately 40 mm. The new regime is from 1980 to the present with the SMGL and 60 mm mesh regulation. The period from 1977 to 1979 was an overlap period with some vessels licensed under the old regime and some operating under the new regime. All vessels operating under the old regime during the overlap period carried observers. Catch and effort recorded by the Canadian IOP for the old regime vessels were subtracted from the NAFO reported statistics and the difference assigned to the new regime.

The results indicated that the only significant effect in the model was "year". There was interannual variation in the catch rates but no variation that could be explained by month, division, fishing regime or data source (NAFO or Canadian IOP). A separate analysis was carried out by comparing monthly catch rates from NAFO and the Canadian IOP, and the regression was highly significant with correlation coefficient of 0.96, slope of 1 and intercept of 0 (SCR Doc. 86/82). STACFIS was encouraged by the progress in examining how the factors mentioned above might affect the catch-rate series and recommended that it should be updated annually and retained as an index of abundance. The new catch-rate series is as follows:

Year	1970	1971	1972	1973	1974	1975	1976	1977
CPUE	2.295	1.733	1.888	2.476	1.676	1.476	2.146	1.946

Year	1978	1979	1980	1981	1982	1983	1984	1985
CPUE	1.599	1.764	1.673	1.420	4.198	2.251	3.042	3.263

Commercial catch rates in 1982-85 have been at levels higher than any other year since 1970. The catch rate for 1982 was the largest in the series and was approximately 3 times larger than the 1981 value. It is considered unlikely that such a drastic change in CPUE was representative solely of a change in biomass. The 1983 CPUE was approximately half the 1982 value and the 1984 and 1985 CPUEs was higher than in 1983.

The age compositions of catches in 1970-84 were taken from the previous assessment (SCR Doc. 85/68). The 1984 catch composition was adjusted to the reported nominal catch in

that year. Commercial samples were available from Canadian and USSR observers, but the 1985 age composition adopted by STACFIS was calculated from the Canadian data, which is consistent with the procedure in the June 1985 assessment. Age-validation studies of silver hake are continuing and a more detailed account of the results of these is given elsewhere in this report (see Section V).

The 1985 commercial catch (in numbers) was dominated by the 1983 year-class (43%), the 1981 year-class (22%) and the 1982 year-class (16%). Since 1982, there was a declining trend in mean weight-at-age for ages 3-5. The mean weight at age 2 was stable but that for age 1 increased slightly.

ii) Research vessel indices

Population numbers and biomass were estimated from the Canadian July surveys (1970-85), and population numbers were estimated from the Canadian March surveys (1979-85). A joint Canada-USSR juvenile survey was also used as an index of incoming year-class strength (SCR Doc. 86/54).

The July survey results showed that the 1981 year-class remains strong and the 1983 year-class is almost as strong at comparable ages. The 1982 year-class continues to be weak and the 1984 year-class at age 1 is below the average for the 1980's but approximately equal to the overall average. Total abundance in 1985 was below the 1984 value, which was the highest in the series but still above the 1983 point. The March survey results showed much the same pattern of year-class strength with the exception that the 1980 year-class at age 3 (1983 survey) was much stronger than in the July survey, or indeed, in the fishery. The pattern of total numbers in March was very similar to that in July with the exception of 1983. The only explanation offered for this was that the 1980 year-class was abundant in March but not in July. The July biomass estimates for the 1982-85 period, despite their variability, were at an average level about 4-5 times higher than those of the 1970's.

Correlations of the March numbers, July numbers, July biomass and standardized CPUE were examined (SCR Doc. 86/62). For the 1970-85 period, the CPUE, July numbers and July biomass were all significantly correlated, and, for the 1979-85 period, the CPUE and July biomass were significantly correlated. The March numbers were not significantly correlated with the July numbers.

The different methods that were used in calculating abundance estimates from the cooperative Canada-USSR juvenile silver hake surveys were documented and compared in SCR Doc. 86/54. The Canadian index was calculated as the stratified mean catch/tow using only strata 60-78 ("core" area) which have been shown to contain the main juvenile concentrations. The USSR index is a total abundance estimate based on the "swept area" method with all available data, including strata outside the "core" area in years when these were covered. The Canadian method does not incorporate a conversion factor for the change in gear and methodology which was implemented in 1981, whereas the USSR estimates used conversion factors specfic to the trawls used to determine swept area. Canadian data have been edited and differ slightly from USSR data, particularly with regard to assignment of some sets to strata, where plotting of set locations indicated that sets were made inside strata other than those intended by the initial random selection. The USSR method, although valid as an index, does not represent actual abundance, because the "swept area" method does not give actual abundance for fish distributed throughout the water column. The conversion factors are, therefore, not appropriate because they do not account for differences in volumes filtered. The USSR index is dependent on the area covered, which varied from year to year, whereas the Canadian method assumes that the density of fish within the core area was directly proportional to the size of the year-class. Despite differences in calculation methods and in the original data used, both indices correlated well with each other and the ranking of year-classes was identical. The abundance indices are as follows:

Year-class	1981	1982	1983	1984	1985
USSR ($N \times 10^{-7}$)	110	2	34	11	62
Canada (N/tow)	579	9	232	43	285

It was agreed that because both methods produced similar results, either index could be used in assessments, and it was recommended that the same method be adopted by both countries for future work and that future surveys should cover as wide an area as possible, including strata outside the core area where juveniles have occurred during previous years. The decision on which method to use in future assessments was deferred until the September meeting of the Scientific Council.

iii) Environmental data

Unusually dense and persistent aggregations of silver hake were noted on the Scotian Shelf in 1985, while by-catches of pollock, hakes (*Urophycis* sp.) and mackerel increased considerably (SCR Doc. 86/57). The atypical distribution of catches for these species coincided with lower sea-surface temperatures on the Scotian Shelf in winter, spring and summer of 1985.

A multiple regression approach was employed to examine the relationship between seasonal bottom temperature landward of the SMGL and silver hake catch rates adjusted for biomass (SCR Doc. 86/56). Only data for 1977-82 were used, due to different fishing patterns prior to 1977 and the uncertainty of population biomass estimates from VPA since 1982. July bottom temperatures were not found to be significantly correlated with standardized silver hake catch rates for the 1977-82 period. However, the quantity of data (6 years) available for analysis was not sufficient to rule out the possibility of a relationship.

c) Estimation of parameters

i) Total mortality

At the June 1985 Meeting of STACFIS, weighted mortality estimates (Paloheimo Z's) for silver hake were presented, which used commercial CPUE at age and Canadian research vessel data (NAFO Sci. Coun. Rep., 1985, page 64). STACFIS requested further documentation of the methodology. This was presented in SCR Doc. 86/58. For the calculation of a weighted average total mortality across ages between years t and t+1, the CPUE at age in year t was used as the weighting factor.

The calculations were repeated using the most up-to-date commercial catch-at-age and effort series (SCR Doc. 86/62). Ages 3 to 8 were used with age 3 assumed to be fully recruited to the commercial fishery. It was noted that the high CPUE in 1982 and the subsequent low level of effort caused the 1981/1982 estimate to be negative and the 1982/1983 estimate to be high. An average total mortality for the 1977-85 period, excluding the two above-mentioned estimates, was 0.82. The range of individual values was from 0.48 (1978/1979) to 1.08 (1979/1980). For a natural mortality rate of 0.40, an average fishing mortality of 0.42 was indicated. The estimate of average fishing mortality for 1984/1985 was 0.39.

ii) Partial recruitment (PR)

The partial recruitment values for ages 1 and 2 in 1985 were calculated from iterations of a VPA, using the average ratio of F at age to average weighted F at ages 3 and 4 in 1977-84. Partial recruitment values for difference periods are as follows:

Period	Age 1	Age 2	Age 3+
1970-76 (SCR Doc. 83/59	0.350	1.000	1.000
1983 (Sci. Coun. Rep., 1983)	0.030	0.250	1.000
1977-85	0.041	0.304	1.000

iii) Natural mortality

One paper (SCR Doc. 86/60) contained a VPA which used estimates of natural mortality that varied with age, similar to that presented at the meeting in June 1985 (SCR Doc. 85/36). Natural mortality may indeed vary with age, but the available documentation was still insufficient to fully evaluate the analysis. Therefore, as in previous assessments, a constant natural mortality coefficient of 0.4 was used.

iv) VPA calibration

Based on the conclusion that the standardized catch-rate series may be a useful index of abundance, it was used in an attempt to calibrate the VPA. Exploitable biomass was calculated from VPA mean biomass and the two partial recruitment vectors given above. A preliminary calibration plot indicated that the 1982 CPUE was anomalously high, and this point was removed from the calibration. The criterion for selecting terminal fishing mortality (F_t) was a combination of the maximum correlation coefficient, the minimum sum of the last three squared residuals standardized by the standard error of the regression, the minimum absolute standardized residual for 1985 and the closeness of the intercept to zero. Calibration plots were also examined for serial correlation. The various criteria indicated different levels of F_t. The correlation coefficient was highest (0.88) at F_t = 0.10 and declined to 0.70 at F_t = 0.25. The residual sum of squares was minimized at F_t

= 0.05 and the 1985 residual was smallest at F_t = 0.30. The intercept lies closest to zero at F_t = 0.25. Serial correlations in the residuals indicated severe trends in catchability. Based on these results, STACFIS was not able to estimate fishing mortality in 1985. The VPA's with F_t = 0.25 and 0.40 showed that average F on ages 3 and 4 for the 1977-85 period was approximately 0.40. Under all levels of F_t used (0.05-0.50), the calculated biomass increased steadily from 1978 to 1985.

vi) Yield-per-recruit

With the use of the most recent partial recruitment and mean weight-at-age data for the commercial fishery (1977-85) and M = 0.4, a Thompson and Bell yield-per-recruit model was used to calculate $F_{0.1}$ = 0.474, with 0.063 kg as the yield-per-recruit (SCR Doc. 86/62). This represents an increase of 13% in fishing mortality at $F_{0.1}$ and only a slight change in the yield-per-recruit since the last assessment in 1983.

d) Prognosis and catch projections

The 1987 fishery will be supported by the 1983-85 year-classes based on past observations of the fishery. Evidence from the juvenile survey, the Canadian July research survey and the commercial catch-at-age data indicated that the 1983 year-class is above average in size. The 1984 year-class is larger than the year-classes of the 1970's, except for 1972, but below those since 1980 in the July research survey. It was the second lowest of the five estimates in the juvenile surveys, but it was the second highest catch at age 1 in the commercial fishery from 1981 to 1985. The estimate of the 1985 year-class from the juvenile survey was closest to that of the 1983 year-class, indicating that the 1985 year-class may be strong. However, no evidence to confirm this is available at present. If the 1985 year-class is as strong as that of 1983, the biomass in 1987 will be at least at the level of 1982-85.

STACFIS concluded that the silver hake stock in Div. 4VWX has increased in recent years. However, it was not possible to estimate F_t and catch projections could not be provided. Therefore STACFIS has no basis on which to advise a change in the TAC of 100,000 tons.

STACFIS noted that there is a great deal of uncertainty in the estimates of relative strengths of the year-classes that will contribute to the 1987 fishery, but, if the 1985 year-class is confirmed to be large and the 1984 year-class is larger than the 1982 year-class, a TAC of 100,000 tons is likely to be conservative.

e) Future studies

Discussion of future studies for this stock was deferred to the September 1986 Meeting.

10. American plaice in Division 3M

a) Introduction

This stock has been under TAC regulation since 1974, and nominal catches have been between 600 and 1,900 tons. USSR vessels have taken most of the fish in recent years, and the catches by all countries are taken mainly as by-catch in the cod and redfish fisheries. Recent TACs and nominal catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	2	2	4	2	2	2	2	2	2	2	2
Catch	1	2	1	1	1	1	1	2	1[1]	2[1]	

[1] Provisional.

b) Input data

There is no new information for this stock. On the basis of USSR and Canadian trawl surveys up to and including 1985, the stock size has been relatively stable.

c) Catch projections

Based on relative stock stability from surveys, long-term stability of catches, and the lack of new information, STACFIS advises that the TAC for this stock remain at the present level of 2,000 tons.

11. American plaice in Divisions 3L, 3N and 3O (SCR Doc. 86/41; SCS Doc. 86/13)

a) Introduction

This stock has been exploited consistently since the early 1950's, with the highest nominal catch occurring in 1967 at 94,000 tons. USSR vessels took significant catches during 1965-76, while Canada took over 90% of the catch during 1976-82. Since 1982, other nations, notably South Korea, Panama, USA and Cayman Islands have joined the fishery. This increased participation in the fishery resulted in an estimated catch of 51,042 tons in 1985, an increase of 29% over the 1984 catch. Including Canadian surveillance estimates for NAFO member countries, a figure of 52,800 tons in 1985 was arrived at, but STACFIS did not consider this to be a significant discrepancy. It was noted that virtually all of the catch of approximately 11,000 tons by non-Canadian vessels occurred on the tail of the Grand Bank, mostly in Div. 3N, outside the Canadian 200-mile fishery zone. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	47	47	47	47	47	55	55	55	55	49	55
Catch	52	44	50	49	49	50	51[1]	39[1]	40[2]	51[2]	

[1]Includes 40% of the "flounder non-specified" catch reported to NAFO by South Korea.
[2]Provisional

b) Input data

i) Commercial fishery

Catch rates from the directed fishery by Canadian offshore otter trawlers in Div. 3L and 3N declined steadily from about 0.9 tons/hr in the mid 1960's to about 0.4 tons/hr in the mid-1970's. Catch rates have subsequently increased and they have been above 0.56 tons/hr since 1979. The 1985 value of 0.66, being slightly higher than the 1984 value, was the highest since 1967. STACFIS noted that the CPUE series has not been analyzed for patterns in seasonality or location and recommended that such analyses (i.e. multiplicative model) be carried out.

The age composition and weight-at-age data for the 1985 fishery were derived from samples of the landings of Canadian trawlers from Div. 3L and 3N as well as inshore vessels from Div. 3L. The group examined length frequency information from Spanish catches and noted that there appeared to be good agreement with the Canadian data. Similar information from USA catches indicated that these vessels were catching larger fish, although the total USA catch was estimated to be only 1,300 tons.

STACFIS noted that estimates of catch-at-age continue to represent landings only, and as such, do not include discards. STACFIS recommended that available information on discarding for this stock be reviewed to determine if changes in discarding patterns could be determined and whether these changes could affect the assessment.

The catch-at-age, observed for 1985, was considerably different from that which was calculated for the 1984 fishery, with ages 6-10 constituting about 53% of the catch in numbers in 1985, compared to only 35% for these age-groups in 1984. It was thought that the change was due primarily to the fact that the catch in Div. 3N was much higher in 1985 than 1984. This resulted in an increase in the catch of some of the younger ages, given the higher growth rate of plaice in Div. 3N than in Div. 3L. The catch-at-age vector for 1985 was in general agreement with the predicted catch-at-age pattern indicated in the 1985 assessment.

The weight-at-age values for 1985 were higher than those calculated for 1984, with the values at ages 6-10 being close to the average of recent years. The mean weights for ages 11-19 were the highest in the time series, but in most cases were not excessively high when compared to recent values. Again, this increase in weight is probably due to the increased portion of the 1985 catch which came from Div. 3N.

ii) Research vessel surveys

Data from Canadian research vessel surveys, conducted in the spring of 1985 and 1986 in Div. 3L, 3N and 3O indicate a decline in biomass from the relatively-stable level of the 1977-82 period. However, survey coverage was incomplete in 1983-84, which are important years in evaluating the apparent decline between the estimates for 1982 and 1985. Preliminary analysis of the 1986 survey data indicates virtually the same biomass estimate

as was calculated for 1985 in Div. 3L and 3N and a decline of about 37% for the smaller portion of the stock in Div. 3O. Results from Canadian surveys conducted during autumn in Div. 3L during 1981-85 showed a decline in biomass from 314,000 tons in 1984 to 220,000 tons in 1985. However, the 1984 survey was about 2 months earlier in the year than the others in this series, and the value for 1985 was close to the average of the 1981-83 values (249,000 tons).

Results from six Canadian surveys, conducted in Div. 3L on a quarterly basis from January 1985 to May 1986, were also examined. Biomass estimates in five of the six surveys were between 170,000 and 220,000 tons. The exception was the winter (Jan-Feb) 1986 survey, which indicated only 46,000 tons. However, this figure was considered to be anomalous in view of the estimates from the other recent surveys. It was felt that this estimate was probably the result of an availability problem with American plaice, perhaps environmentally-induced, and this corresponded with reports of unusually low catch rates by Canadian trawlers on the Grand Bank in early 1986. STACFIS noted that 1985 was a very cold year hydrographically on the Grand Bank, and it was considered that the lower abundance calculated for 1985 may have been affected by water temperature.

A period of similarly cold water in the early 1970's coincided with low abundance estimates for this stock from surveys. Further analysis of the survey data was encouraged, particularly of the effects of temperature on the distribution of American plaice by depth and stratum. Because of several missing years in the spring survey series, particularly 1975-76 and 1983-84, STACFIS decided that it was not possible to use these data in attempts to calibrate a sequential population analysis (SPA).

c) Estimation of parameters

i) Partial recruitment

In the 1985 assessment, a short term (1981-84) average partial recruitment vector was used as input to SPA. A long term (1960-78) average vector was used in the 1985 catch projection. As noted previously, the observed catch-at-age pattern for 1985 was not substantially different from that predicted in the 1985 assessment. Based on this, it was decided to use this 1985 partial recruitment vector in the current assessment. These values are given in Table 10. While these values represent significant increases for the younger ages, it was noted that such changes between years have occurred before in this stock and that one reason for the variability in partial recruitment could be the changes in the location of the fishery both within and between divisions.

ii) Natural mortality

The value of 0.2 in the present assesment was the same as that used in recent assessments of this stock.

iii) Fishing mortality

The value of terminal fishing mortality (F_t) in 1985 was determined on the basis of unweighted least square regression of average exploitable biomass from SPA against CPUE of Canadian offshore trawlers in Div. 3L and 3N for 1965-85. The biomass estimates were obtained by multiplying the average biomass estimates at age from SPA by the average (1965-85) selectivity coefficients at age as determined from the SPA fishing mortality matrix. This is the same method that was used in previous assessments of this stock. The correlation coefficient was maximized for the regression at $F_t = 0.35$ and the sum of the 1984 and 1985 residuals was close to zero for this level of F_t.

The relationship between exploitable biomass, calculated from SPA by using annual selectivity coefficients, against the CPUE data was not particularly good. Extreme changes in the calculated exploitable biomass resulted from large variations in the annual selectivity coefficients. Consequently, this relationship was not considered acceptable for calibration of the SPA. For the reasons noted previously, the research survey data were also rejected as a means for calibrating SPA. Examination of the average exploitable biomass versus CPUE plots revealed a trend in the residuals of the points for the late 1960's. STACFIS noted that these may be indicative of changes in catchability of this stock, and recommended that this should be investigated.

d) Assessments results

The SPA (cohort analysis) for $F_t = 0.35$ showed a relatively stable population size at ages 8+ from 1981 to 1985. The 1985 biomass for these ages and the 1985 CPUE value compared well with the 1967-69 averages for ages 8+ biomass and CPUE. The population sizes at ages 6 and 7 in 1985, indicated by the SPA, were unreasonably low, and, given the sensitivity of these values to slight changes in partial recruitment, geometric means (GM) were used in the catch

Table 10. American plaice in Div. 3LNO: parameters used for biomass and yield projections.

Age	Population in 1985 (000)	Catch in 1985 (000)	Mean wt. kg	PR
6	214,000[1]	254	0.369	.025
7	180,000[1]	1,748	0.435	.100
8	75,448	5,081	0.500	.220
9	113,483	10,270	0.593	.300
10	109,435	15,086	0.648	.470
11	81,339	13,590	0.731	.580
12	42,013	8,622	0.914	.730
13	13,963	3,759	1.205	1.000
14	5,810	1,564	1.541	1.000
15	3,447	928	2.006	1.000
16	999	269	2.605	1.000
17	338	91	2.969	1.000
18	26	7	3.554	1.000
19	4	1	3.377	1.000

[1] Geometric mean (1974-83)

projections. The SPA value for the population at age 8 in 1985 was low compared to other years, and this agrees with the results of recent surveys which showed the 1977 year-class to be relatively weak.

e) Catch projections

The parameters used in catch projections are listed in Table 10. The population vector in 1985 was that generated by the SPA at $F_t = 0.35$, except that values for ages 6 and 7 were replaced by the GM of the 1974-83 values at these ages from the same SPA. These years were chosen as being representative of a period of stable recruitment. The partial recruitment values for the projections were the same as those used in the 1985 projections and also in the current SPA. The mean weights were average 1983-85 values, continuing the practice of using the most recent 3-year average weight-at-age data in projections for this stock.

$F_{0.1}$ for this stock is 0.262. F_{max} is unrealistically high (>3.0) because of the extensive flat-topped portion of the yield-per-recruit curve.

The projected catch for 1987 in Div. 3L and 3N is 44,100 tons. Catches in Div. 3O have averaged 3,700 tons during 1980-85. Therefore, STACFIS advises that a catch of 48,000 tons in in 1987 would correspond to fishing at $F_{0.1}$ for the stock in Div. 3LNO.

Various trends in the population parameters, a yield-per-recruit curve, and the projected yield in 1987 are illustrated in Fig. 4 to 7.

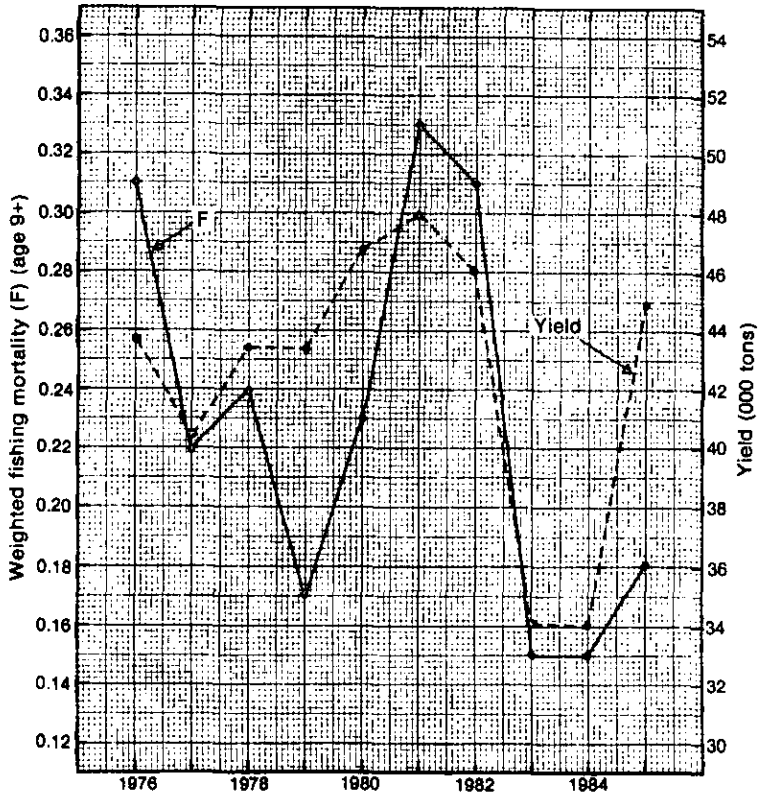


Fig. 4. American plaice in Div. 3LN: trends in yield and fishing mortality during 1976-85.

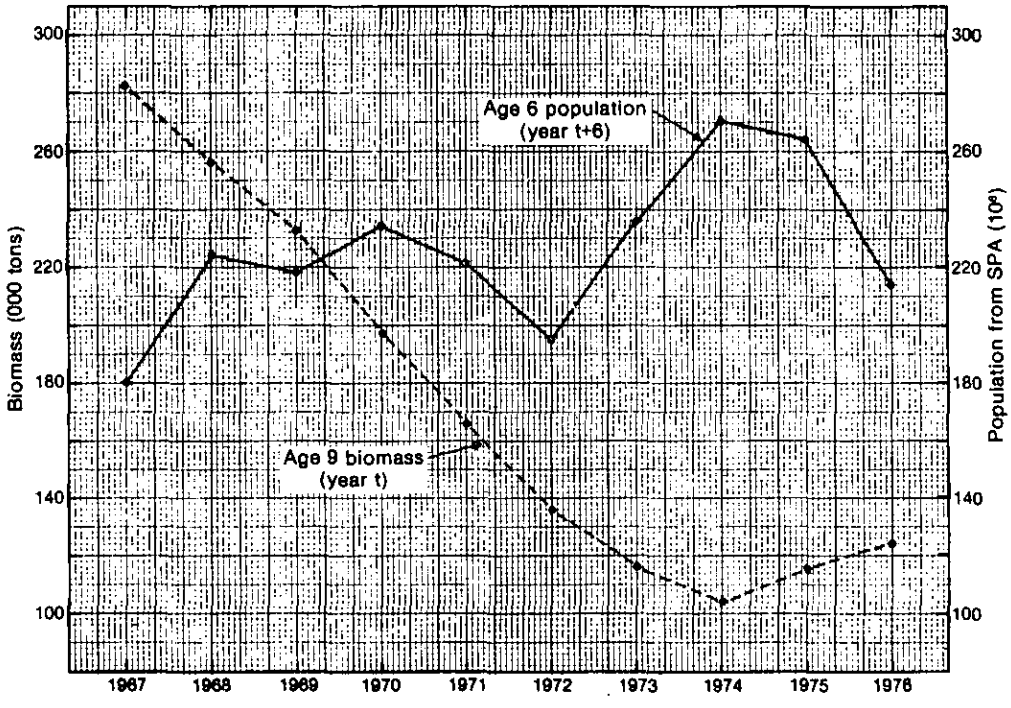


Fig. 5. American plaice in Div. 3LN: trends in age 9+ biomass in year t and age 6 recruits in year t+6, for the 1967-76 period.

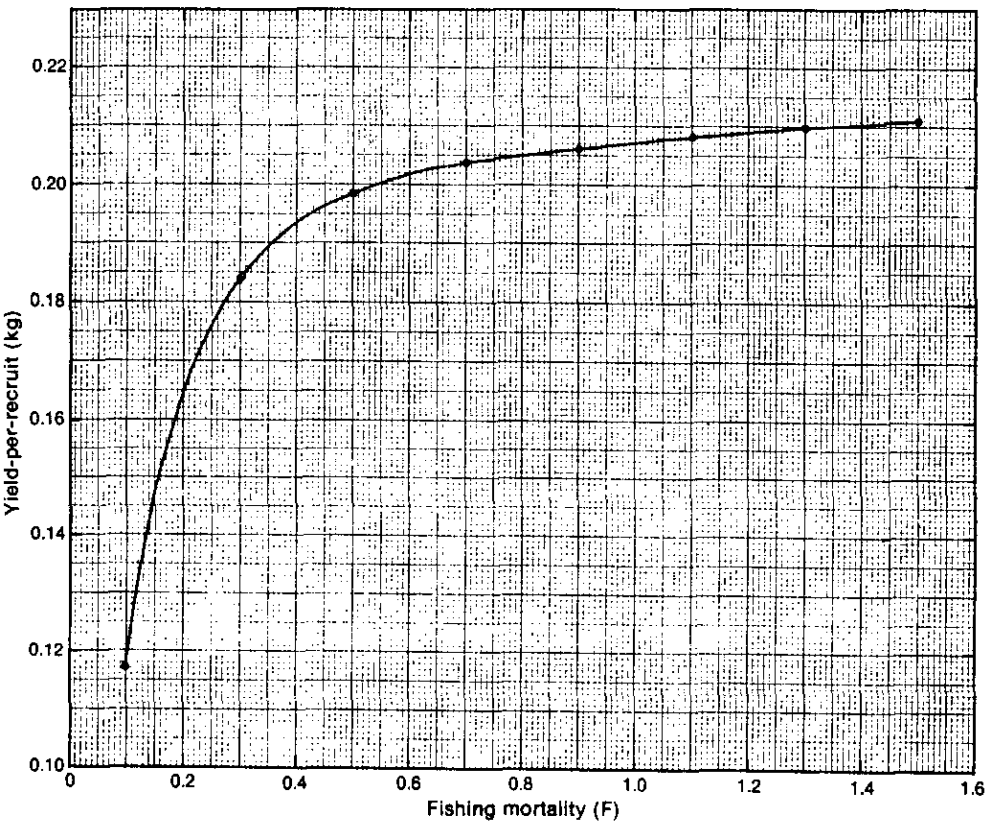


Fig. 6. American plaice in Div. 3LN: yield-per-recruit curve.

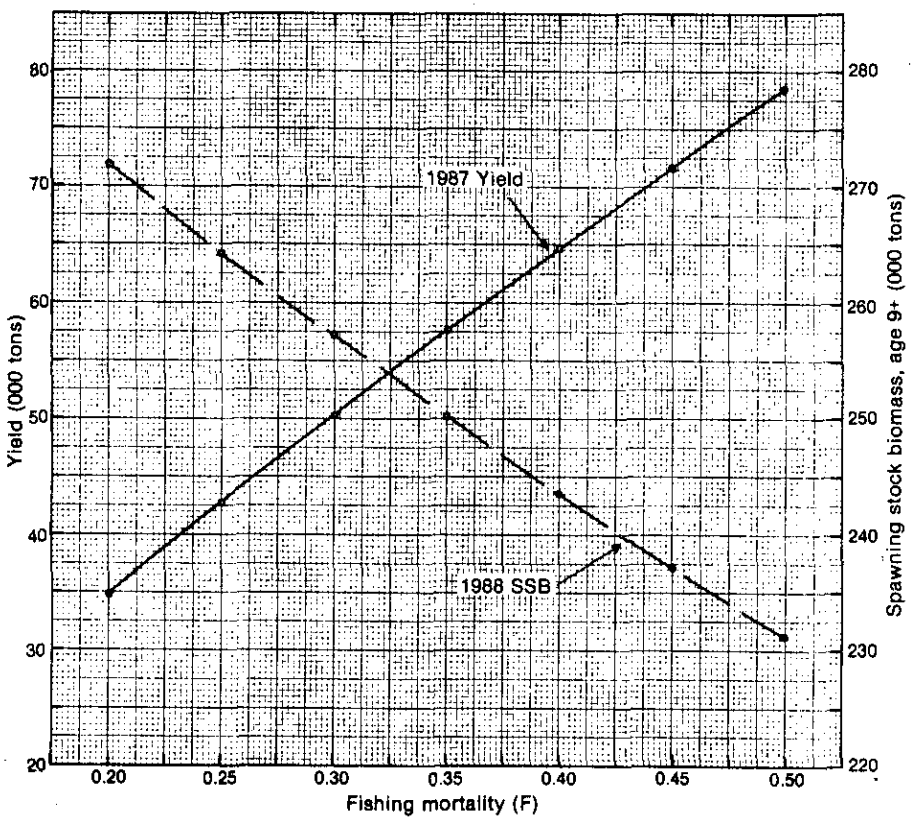


Fig. 7. American plaice in Div. 3LN: projected yield (1987) and age 9+ biomass (1 Jan 1988) for a range of fishing mortality (F).

12. Witch Flounder in Divisions 3N and 3O (SCR Doc. 86/22; SCS Doc. 86/13)

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 for 1985 indicate a catch of about 8,500 tons, the highest recorded catch since 1972. This catch is nearly twice the 1985 TAC. Recent catches and TACs (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	10	10	10	7	7	5	5	5	5	5	5
Catch	6	6	3	3	2	2	4	4	3[1]	9[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 during winter and spring in 1972-85. As in previous analyses, a directed fishery was assumed when the main species in the catch was witch flounder. The highest catch rate of 0.716 tons/hr was recorded in 1972. The catch rate declined to 0.252 tons/hr in 1975, then increased to 0.667 tons/hr in 1981 and 1982 and declined to 0.379 tons/hr in 1983. The catch rate in 1985 was 0.573 tons/hr. This is the third highest catch rate in the past 14 years. Considering the level of the 1982, 1983 and 1985 catch rates and the fact that they are based upon relatively high proportions of directed catch, STACFIS concluded that the stock may have been relatively stable in 1982-85 at some level higher than in the previous 10 years. An attempt was made to update the general production analysis of 1980, upon which the present TAC is based, but the CPUE-effort relationship was not statistically significant.

c) Catch projections

Considering the available data, STACFIS was not in position to advise any change in the TAC for 1987 from the 5,000-ton level in effect since 1985. STACFIS expressed concern, however, about the great increase in catch in 1985 and felt that the stock would unlikely sustain such catch levels without a decline in stock abundance.

13. Yellowtail flounder in Divisions 3L, 3N and 3O (SCR Doc. 86/39, 40; SCS Doc. 86/13)

a) Introduction

Nominal catches since 1967 have ranged from 8,000 to 39,000 tons and have averaged about 15,500 tons annually in 1980-85. Catches by USSR vessels exceeded 3,400 tons in the 1967-85 period, while Canada was virtually the only nation involved in the fishery during 1976-81. Since 1981, other nations have joined the fishery, notably South Korea in 1982-85 and Panama, Spain, USA and Cayman Islands in 1985. This increased participation in the fishery in 1985 resulted in an estimated overall catch of 26,938 tons, an increase of 79% from the provisional catch in 1984. The estimated catch of 13,581 tons by non-Canadian vessels in 1985, 82% of which was taken by non-member countries, was taken exclusively in Div. 3N and 3O, outside the Canadian 200-mile fishery zone. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	9	12	15	18	18	21	23	19	17	15	15
Catch	8	12	15	18	12	15	13[1]	10[1]	15[2]	27[2]	

[1] includes 60% of the "flounder non-specified" catch reported to NAFO by South Korea.
[2] provisional.

b) Input data

i) Commercial fishery

Average catch rates of yellowtail flounder by Canada (N) offshore otter trawlers declined from about 0.6 tons/hr during 1969-73 to about 0.4 tons/hr in 1974-77. The catch rate increased steadily from 1976 to a level of 0.6 tons/hr in 1980-81 and has been about 0.55 tons/hr from 1982 to 1985.

The age composition and weight-at-age data for 1985 were obtained from samples of landings of Canadian trawlers from Div. 3LNO. Sampling data from non-Canadian vessels were not available when the age composition and weight-at-age vectors were calculated. Subsequent examination of length frequency data from non-Canadian catches did not indicate that recalculation of the above parameters was necessary. Catch-at-age data (numbers) for 1982-84 were increased by factors of 1.145, 1.129 and 1.194 respectively to account for catches which had not been included in previous calculations. The catch-at-age proportions in 1985 were similar to those observed in 1984, with ages 6 and 7 contributing close to 80% of the catch in numbers. The 1978 year-class was again particularly strong in the commercial catch, constituting 47% of the catch in numbers in 1985, the highest value at age 7 for any year-class in the series which began in 1968. The weight-at-age values for 1985 were very close to those calculated for the 1984 fishery.

ii) Research vessel surveys

Juvenile surveys in Div. 3LNO during 1981-85. The 1981-82 surveys were conducted mainly as trials to determine suitable gears, fishing methods and survey locations. The 1983 survey was incomplete, there was no survey in 1984, and the 1985 survey was also incomplete, although coverage was reasonably good. The 1985 survey used a random-stratified design, with more fishing sets in areas of historically-higher yellowtail abundance. The survey was also designed to give separate and comparable biomass estimates for sets made during daylight and dark hours. There appeared to be an increase in the catches of both juvenile and adult yellowtail in the night sets, but statistical analyses of these results were inconclusive. The juvenile survey in the fall of 1985 caught more yellowtail at most ages than the groundfish survey did in the spring of 1985, and this was attributed to the different trawl gears used for the juvenile surveys. However, the differences were greatest at the older ages (7 and 8) and were minimal at ages 1-3. In view of current survey methodology, the average number-per-tow at these ages (less than 0.5 for ages 1 and 2, and 1.3 for age 3) may be too low to give an adequate index of abundance. However, in view of the importance of recruiting year-classes to catches of this stock, investigations into the development of recruitment indices should be continued.

Stratified-random groundfish surveys in Div. 3LNO during 1971-86. These spring surveys indicated a relatively stable population size of American plaice during 1978-82. There was no survey in 1983, and the 1984 biomass estimate was about twice the 1982 value. However, results from the 1985-86 surveys indicate a return to a level close to that observed in the 1978-82 period. A preliminary estimate of the biomass in Div. 3LNO from the 1986 spring survey showed only a 1.5% change from the comparable 1985 estimate. It was also noted that the 1978 year-class was relatively strong in recent surveys, which was in agreement with the commercial catch data for 1984 and 1985.

c) Assessment results

Cohort analysis was attempted for this stock, and calibrations using cohort population numbers at ages 5 and 6 versus corresponding survey population numbers indicated that fully-recruited (age 7+) fishing mortality in 1985 was close to 0.9. However, while recognizing that this analysis showed relative stock stability in recent years, the previously-documented problem with very high apparent fishing mortalities at ages 7+ persists. STACFIS again considered that these high fishing mortalities (often greater than 2.0) were unlikely and that significant declines in population numbers after age 7 could be due to natural mortality. Therefore, STACFIS was not able to use the SPA to form the basis of catch projections.

d) Catch projections

STACFIS was concerned that the nominal catch in 1985 exceeded the TAC by 80%. It was noted that high catches, between 23,000 and 37,000 tons in 1970-75, were followed by a sharp decline in stock abundance and catches. During this period, commercial CPUE decreased by 35% in one year (from 1973 to 1974). Because the SPA and the research vessel surveys did not indicate anything other than average recruitment, it was agreed that the current stock size cannot sustain catches of 25,000-30,000 tons. Noting that the increase in the 1985 catch was due to a large increase in fishing effort, and hence fishing mortality, rather than increased stock abundance, and recognizing that most indices point to recent stock size stability, STACFIS advises that the total removals from this stock in 1987 should not exceed the current TAC of 15,000 tons.

STACFIS concluded that there were insufficient data to answer the questions posed by the Fisheries Commission on this stock.

14. Greenland halibut in Subareas 0 and 1 (SCR Doc. 86/67; SCS Doc. 86/16, 17)

a) Introduction

Nominal catches peaked at 25,000 tons in 1975 and have been less than 10,000 tons annually since 1980. In recent years, the fishery has been prosecuted mainly by inshore Greenland fishermen using gillnets and longlines with a small by-catch in the offshore fishery. The Greenland inshore catch increased by 38% from 1984 to 1985 to about 9,000 tons. The increase was due to an increase in fishing effort in a directed fishery as compensation for the decrease in the trap fishery for cod. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	20	20	20	25	25	25	25	25	25	25	25
Catch	16	13	12	19	8	10	9	9	6[1]	9[1]	

[1] Provisional data.

b) Input data

The only available information on this stock in 1985 was from a USSR survey in Div. 0B in November-December. The biomass index from the survey was 330 kg/hr compared to 62 kg/hr in December 1984 and 518 kg/hr in November 1983. In September 1984, the biomass index was 436 kg/hr, but only 87% of the survey area was covered. The low index in December 1984 was probably the result of low number of sets (21) and the fact that coverage was restricted by severe ice conditions. USSR investigations during 1970-84 have indicated that years of cold hydrological conditions, particularly during the early 1980's, have caused Greenland halibut often to move into deeper water beyond the limit of commercial fishing and probably beyond the survey area. Therefore, any decline in estimates of biomass should be treated with some caution. It was also noted that, during years of warm hydrological conditions, Greenland halibut moved to the upper slope area resulting in higher commercial catch rates and higher abundance estimates from surveys.

c) Catch projections

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

15. Greenland halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 86/21, 67; SCS Doc. 86/17)

a) Introduction

Greenland halibut catches during 1970-76 ranged from about 24,000 tons to 30,000 tons annually. The highest annual catch of 39,000 tons occurred in 1978. Although some fish are still taken by Poland, USSR, German Democratic Republic and Japan, most of the catch in recent years was taken by Canada, with substantial portions by inshore gillnet fishermen along the coasts of northeastern Newfoundland and southern Labrador. The catch of 17,000 tons for 1985 was the lowest in the 1969-85 period and was largely a result of reduced fishing effort. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	30	30	30	30	35	55[1]	55[1]	55[1]	55[1]	75	100
Catch	25	32	39	34	33	31	26	28	25[2]	17[2]	

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

b) Input data

i) Commercial fishery data

Some information on directed fishing effort by Canada (N) trawlers in Div. 2H, 2J and 3K was available for 1980-85, although the calculated catch rates (tons/hr) were often based upon relatively low levels of directed catch. Similar information was also available from Polish vessels for 1979 and 1981-85. However, catch rates from this fishery were also based upon some low levels of directed catch, particularly in the more recent years. In all cases, the catch rates declined from 1984 to 1985 in all three divisions. The

decrease may be related to the fact that the strong year-classes of the early 1970's, which contributed to the relatively high catch rates during the early 1980's, have now passed through the accessible fishery. On the other hand, it was expected that the entry of the strong 1979 and 1980 year-classes to the fishery would help maintain the catch rates in 1985. Although they did account for much of the 1985 catch by numbers, it may have been too early to have expected them to contribute much in terms of weight to the 1985 catch rates. It was also believed that the decline in catch rates from 1984 to 1985 could be related in part to environmental factors. During the summer of 1985, catch rates for Greenland halibut by the Canadian trawler fleet were reasonable when the fishery began, but they declined so abruptly that the fishery was no longer economical. Consequently, fishing effort was diverted to other species.

ii) Research vessel surveys

Estimates of biomass from research-vessel surveys by both Canada and the USSR declined from 1984 to 1985. However, in view of the estimates of minimum trawlable biomass that have been associated with this stock in the recent past (435,000 tons in 1984, assuming 200,000 tons in 2GH), it is obvious that exploitation was not the reason for this decline. It was noted from the USSR surveys that the highest abundance occurred in depths greater than 1000 m, possibly a result of very cold water at shallower depths. Because very little area is surveyed beyond 1000 m in USSR surveys and none at all in Canadian surveys, it is possible that much of the biomass was outside the range of the surveys. This could also partially explain the decline in Canadian commercial catch rates, because most Canadian vessels are not capable of fishing at such depths.

From the 1984 survey results that were presented in the previous assessment, the 1979 and 1980 year-classes were shown to be as strong as those of the early 1970's, particulary the 1972 and 1973 year-classes. In the 1985 survey, the 1979 year-class at age 6 was stronger than any other year-class in the series for Div. 2J and about the same as the 1972 and 1973 year-classes at age 6 in Div. 3K. Similarly, the 1979 and 1980 year-classes generally dominated the catches in Div. 3L.

Modal analysis of mean catch-per-tow by length of Greenland halibut from the northern shrimp surveys in Div. 2H and 2J (Hopedale and Cartwright Channels respectively) identified the 1979 and 1980 year-classes as being relatively strong at age 1. They were also strong at ages 2 and 3, but it became difficult at age 4 to distinguish them in the modes. The age composition in Div. 2H, from the 1984 survey, indicated that the 1979 year-class was dominant followed by the 1980 year-class. In the 1985 survey, the 1984 year-class was dominant followed by the 1980 year-class. According to the length frequency data, the 1984 year-class was stronger than either the 1979 or 1980 year-classes at the same age.

In Div. 2J, the age composition from the 1984 survey showed the 1979 and 1980 year-classes as being dominant compared to older age groups. However, the 1981, 1982 and 1983 year-classes all appeared more dominant, with 1983 being the highest. In the 1985 survey in Div. 2J, the 1981, 1982 and 1983 year-classes were still dominant, but the 1984 year-class also appeared about as strong as that of 1980. According to length frequency data, the 1984 year-class at age 1 appeared to be stronger than any in the series, with the 1983 year-class about the same as the 1979 year-class at age 2. The available data indicated that the 1979, 1980 and 1984 year-classes may be stronger than average. However, in view of the short time series of shrimp surveys and the age structure of the Greenland halibut population, it was still too early to relate abundance estimates from these surveys to those of the groundfish surveys and the commercial fishery with a high degree of confidence.

c) Estimation of parameters and assessment results

Age composition and mean weight-at-age data for the fishery during 1975-84 were taken directly from the previous assessment with some adjustment to 1983 and 1984 catch-at-age vectors as a result of updated catch figures. The estimates of catch-at-age for 1985 were derived from the data in SCR Doc. 86/21. The sum of products, by multiplying the catch-at-age and weight-at-age for 1985, indicated an error of less than 1% relative to the provisional nominal catch.

Partial recruitment for 1985 was derived, as in previous years, by comparing the catch-at-age from the commercial fishery to catch-at-age from the Canadian research-vessel survey in Div. 2J and 3K. Because of the anomalous value at age 13, the partial recruitment value was made equal to that of age 12. Also, because of low values at age 16 and 17, they were made equal to that of age 15. The partial recruitment curve was typically dome-shaped with age 8 being the only age at full recruitment. It was noted once again that the survey does not cover the major depth zones where older fish occur, implying overestimation of partial recruitment for older ages. Consequently, SPA (sequential population analysis) estimates of population numbers with the use of this partial recruitment vector are likely to be minimal.

Due to the lack of suitable calibration procedures for the SPA, estimation of fully-recruited fishing mortality for this stock remains difficult to calculate with any degree of precision. Although STACFIS still considered the overall fishing mortality of this stock to be quite low, it was pointed out that fishing mortality on the major age-groups may be considerably higher. Furthermore, most exploitation may occur on age-groups which have not contributed to the spawning stock. Despite these concerns, STACFIS continues to believe that commercial exploitation of this stock is minimal.

d) Catch projection

In view of the low level of exploitation on the entire stock, the evidence of strong recruiting year-classes, and the high level of overall biomass, STACFIS advises that a catch of about 100,000 tons from Subarea 2 and Div. 3KL in 1987 is unlikely to exceed $F_{0.1}$.

STACFIS noted that this stock undergoes extensive migrations in its life history, with spawning mainly in the northern Davis Strait area. Younger immature fish (ages 6-10) are found to a greater extent in the southern range of the stock. It is these age-groups that are being fished. STACFIS further advises that the TAC of 100,000 tons should be taken from the entire age composition and not only from the age-groups currently being fished complemented by fishing further north at greater depths.

16. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 86/29)

a) Introduction

Although the catch in 1985 was twice that of 1984, only 51 tons were taken. Since 1978, all catches have been by-catches in the Greenland halibut fishery. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	14	8	8	8	8	8	8	8	8	8	8
Catch	9	3	6	7	2	+	+	+	+	+	-

b) Input data

There has been no directed fishery for this species since 1978. Catch and effort data for the 1968-78 period had been examined previously (NAFO Sci. Coun. Rep., 1985, page 72).

c) Catch projections

In the absence of new information, STACFIS has no basis to advise a change in the TAC of 8,000 tons for 1987.

17. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 86/29, 67)

a) Introduction

The reported catch in 1985 (about 4,700 tons) represented an increase of about 1,000 tons over the 1984 catch but still only represented about 43% of the TAC. This increase is the result of an increase in catch by the USSR. The German Democratic Republic reported similar catches in 1984 and 1985, about 3,700 tons. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	35	35	35	35	30	27	27	11	11	11	11
Catch	21	15	21	8	2	7	4	4	4[1]	5[1]	

[1]Provisional.

b) Input data

Catch and effort data were extracted from ICNAF and NAFO Statistical Bulletins for the 1967-84 period and were available from the Canadian Observer Program for the 1978-85 period. These data were analyzed separately with the use of a multiplicative model to derive two standardized catch-rate series. Data concerning the distribution of roundnose grenadier with depth in relation to hydrological conditions were available from USSR surveys.

c) Estimation of parameters

The available data are insufficient to carry out an analytical assessment of this stock. Ordinary least squares regressions of standardized catch rates on standardized effort (unlagged and lagged 4 and 6 years) were either not significant or significant with a positive slope. As a result, no general production analysis could be carried out.

d) Catch projections

Low catches relative to TACs in recent years have been, in part, due to by-catch limitations on Greenland halibut. Data from USSR surveys indicated that the increased overlap in distribution of roundnose grenadier and Greenland halibut in the Northwest Atlantic in recent years can be, in part, attributed to a generted to a general cooling of the water mass in the area. STACFIS reiterates its previous recommendation that more appropriate by-catch levels of Greenland halibut in the roundnose grenadier fishery would be 20% in Div. 3K and 30% in Subarea 2.

The two catch-rate series indicate that the CPUE has been relatively stable in recent years, and STACFIS has no basis to advise a change in the TAC for 1987 from the present level of 11,000 tons.

18. Wolffish in Subarea 1 (SCR Doc. 86/44, 45, 81)

a) Introduction

The nominal catches off West Greenland include 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 officially-reported catches for 1977-79 were overestimated. Recent catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Catch	6	6	6	17	5	4	4	3	2[1]	2[1]

[1] Provisional data.

b) Input data

Groundfish surveys by the Federal Republic of Germany indicated a drastic decline in biomass (75%) of Atlantic wolffish from 1982 to 1984, and the only explanation seems to be a migration out of the survey area. The biomass estimate for 1985 remained at the low level of the preceding year. For spotted wolffish, biomass and abundance in 1985 were observed to be considerably lower and the surveys revealed a continuing decline from 1982 to 1985.

The survey catch-per-hour for Atlantic wolffish decreased from north to south. While Atlantic wolffish occurred mainly in depths to 400 m, spotted wolffish was uniformly distributed over all depths throughout the survey. Both species increased in length toward the south, and this trend was most pronounced for Atlantic wolffish.

The results were discussed in the light of migration patterns. The previous theory suggested that adult spotted wolffish live chiefly in the southern part of West Greenland waters where they propagate. The larvae in the southern area are then carried by surface currents toward the north where they settle at the bottom. Upon reaching maturity, they migrate to the southern spawning grounds. The length distributions for both species support this theory. However, there are no age determinations, and other interpretations can be placed on the length frequencies. These differences in length distributions may also be the result of fishery effects and differences in growth.

Tagging experiments of spotted wolffish do not support the hypothesis. They show that spotted wolffish are rather stationary, although, in the Nuuk area, there seems to be some indication of a local seasonal migration, possibly related to spawning and feeding.

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, the available statistics and earlier biological information (NAFO Sci. Coun. Studies, No. 7, pages 35-40; NAFO Sci. Coun. Rep., 1979-80, pages 85-86) indicate that a catch in the range of 5,000-6,000 tons, corresponding to a long-term average catch, seems to be reasonable.

19. Capelin in Divisions 3L, 3N and 3O (SCR Doc. 86/14, 15, 53, 64, 65, 79)

a) Introduction

Nominal catches of capelin 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 1979-85. Provisional statistics for 1985 indicate a total catch of 26,000 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:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Advised TAC[1]	200	200	200	16	16	30	-[2]	60	38	60	130
TAC[1]	180[3]	200	200	10	16	30	30	30	26	26	55
Catch	144	74	30	12	14	24	27	25	33[4]	26[4]	

[1] For Div. 3L only in 1979-85.
[2] Management 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. 86/15)

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 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 5-year period, increasing from 1981 to 1983, declining in 1984 and increasing in 1985. The relative increase from 1984 to 1985 was greater for trap nets and the trap-net catch rate was the highest in the series.

The increase in catch rates for 1985 may be biased upward because fishing patterns were different in 1985. The opening of the fishery was delayed, and, as a result, trap-net catches were high from the first fishing days. In earlier years, trap nets were set before capelin were available to the gear, resulting in fishing days with no or very low catches early in the season. In 1985, capelin migrated to spawning beaches quickly and were unavailable to purse seiners for the same length of time as in 1984. The values for trap net catch rate are different from those reported last year because of adjustments to effort estimates to account for fishermen who fished more than one trap but did not report for individual traps.

	1981	1982	1983	1984	1985
Trap nets (tons/day)	2.9	3.1	3.4	2.9	4.6
Purse seines (tons/day)	9.4	16.4	18.8	14.3	16.4

Discarding of capelin in 1985 was higher than in 1984 and was comparable to or higher than the 1983 estimates. The lower market needs and "redfeed" problems contributed significantly to the high rates of discarding in 1985. The reported by-catch of cod in 1985 was low (1.0%), which is similar to those of previous years.

The 1983, 1982, 1981 and 1980 year-classes accounted for 13%, 61%, 20% and 6% of the commercial catch (by numbers) in the 1985 inshore fishery.

ii) Research data (SCR Doc. 8614, 53, 64, 65, 79)

Aerial surveys of capelin in Trinity Bay and Conception Bay have been conducted in June and July since 1982 (SCR Doc. 85/14). Total of surface-area schools, estimated from aerial photographs, provided an index of abundance. The patterns in this index agree with the patterns of trap-net catch rate and predictions of mature biomass derived from acoustic estimates of immature capelin from offshore surveys.

An acoustic survey, conducted by Canada in Div. 3L during 10-29 May 1985, provided a biomass estimate of 3,426,000 tons, in contrast to an estimate of 353,000 tons from an

April-May survey in 1984 (SCR Doc. 86/79). The difference is attributable to both the presence of large numbers of the 1983 year-class in the 1985 survey and the fact that a portion of the planned survey in 1984 could not be completed due to ice cover.

An acoustic survey was also conducted by Canada in Div. 3L and 3NO during 21 June-8 July 1985. The capelin biomass in Div. 3L was estimated to be 1,001,000 tons and the 1983 year-class dominated by number and weight. A comparable survey in 1984 resulted in a biomass estimate of 458,000 tons. The 1983 year-class dominated by numbers and the 1982 year-class dominated by weight. The estimates from the June 1985 survey were much lower than estimates derived from the survey conducted approximately one month earlier. It was considered unlikely that natural mortality could account totally for the decline, but it was possible that some portion of the capelin stock had moved out of the survey area.

The capelin biomass for Div. 3NO, estimated from the June 1985 survey, was 214,000 tons, of which 169,000 tons were mature. The 1984 survey gave an estimate of 88,000 tons (revised from previous reports, see SCR Doc. 86/79). The 1982 year-class dominated by number and weight during 1985. The 1983 year-class accounted for 45% (by number) of the population estimate.

An acoustic survey by Canada in Div. 3L during 13 May-2 June 1986 resulted in a biomass estimate of 3,697,000 tons. The 1983 year-class dominated by numbers (168,000 million fish) and weight (2,649,000 tons). A preliminary estimate indicated that approximately 38% of this year-class was mature. The 1984 year-class was approximately one-sixth the strength of the 1983 year-class at age 2, as estimated from comparable surveys in 1985 and 1984 respectively.

An acoustic survey by the USSR (SCR Doc. 86/65) in Div. 3LNO during 5 May-13 June 1985 provided a biomass estimate of 2,200,000 tons. The 1983 year-class dominated in both numbers (230,000 million fish) and weight (1,281,000 tons). Estimates of abundance were provided for mature and immature specimens, but, because of the timing of the survey, it was not possible to determine the abundance of the mature specimens that belonged to the Div. 3L and Div. 3NO spawning stocks. The 1984 year-class was not numerous, and no estimates for the abundance of this year-class were provided. Although both the USSR and Canadian surveys in 1985 indicated that the 1983 year-class was strong, the absolute estimates of abundance of this year-class were different. The Canadian estimate from the May survey was higher than the USSR estimate despite the fact that the Canadian survey occupied a smaller area. Different values of target strength were used to estimate abundance from the two surveys. The differences in target strength were greatest for small fish and could account for the higher Canadian estimates, because small fish dominated in both surveys. STACFIS noted that both estimates of target strength were derived from in situ measurements but could not resolve the differences.

A review of information for the Div. 3NO capelin stock indicated that biomass estimates since 1981 (average 213,000 tons) were about 23% of average biomass estimates for 1975-77 (912,000 tons). A biomass estimate for 1972 was approximately the same as the estimates from 1981 to the present. Catch rates of trawlers did not exhibit a trend between 1972 and 1977 but dropped dramatically in 1978. During the same period, catches increased from 21,000 tons in 1972 to more than 100,000 tons during 1973-1976, and dropped to 4,700 tons and 5,000 tons in 1977 and 1978 respectively. Catch rates of purse seiners did not exhibit any trends between 1974 and 1978. Catch-per-day was approximately the same in 1976 and 1978 and the catch-per-set was higher in 1978 than in 1974 and 1976. Although not well documented, the 1969 and 1973 year-classes were considered to be abundant in the three major capelin stocks (Div. 2J+3K, Div. 3L and Div. 3NO) in the Northwest Atlantic. An examination of age-composition data indicated that the 1979 year-class was strong in these stocks, but the 1980 year-class, which appeared to be relatively strong in Div. 3K and Div. 3L, did not appear strong in Div. 3NO. It could not be determined if this difference was due to variation in recruitment or due to differences in sampling between the years of the fishery in Div. 3NO and recent years when data only from acoustic surveys are available.

c) Estimation of parameters (SCR Doc. 86/64)

The estimates of year-class size in Div. 3L from Canadian survey in May 1986, indicated that the relative strengths of the 1983 and 1984 year-classes were consistent with results of previous surveys. The 1983 year-class was strong in USSR and Canadian surveys in 1985 and this year-class also appeared in unusually high proportions in the spawning areas in inshore Newfoundland and Div. 3NO during 1985. Results from USSR larval surveys indicated that the 1984 year-class was 4-21 times lower than the 1983 year-class, depending on the method of analyzing the data. The 1984 year-class was about one-sixth the size of the 1983 year-class based on results of the 1985 and 1986 Canadian surveys. The 1984 year-class was not detected in large numbers during the USSR survey in 1985 and no estimate of abundance was provided.

Spawning mortality and mean weight-at-age vectors were the same as used in previous assessments (Table 11). Estimates of proportions mature were available from the Canadian survey in 1986 and these were used to estimate numbers of mature and immature capelin in 1986. For 1987, the proportions of mature fish were the same as those used in previous assessments.

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

Age (yr)	Spawning Mortality	Proportion mature from 1986 surveys	Proportion mature from past assessments	Mean wt (g)
3	1.39	0.38	0.47	21.2
4	1.69	0.83	0.87	28.4
5	2.23	0.98	0.93	31.1
6	2.23	0.89	1.00	32.4

A method of estimating natural mortality rates (SCR Doc. 86/64) was reviewed, and a summary of this review is given in Section VI of this report.

d) Catch projections

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.

STACFIS continues to consider an exploitation rate of 10% of the mature biomass to be appropriate for capelin, and accordingly advises a TAC of 283,000 tons for Div. 3L in 1987.

Table 12. Capelin in Div. 3l: projections of stock size for 1987.

Age	Number of fish (millions) June 1986	January 1987	June 1987
2	63,700		
3	168,100	53,500	47,100
4	22,600	120,300	89,100
5	800	6,100	5,400
6	400	150	130
Biomass of mature fish:			2,830,000

STACFIS noted that a TAC of 283,000 tons in 1987 would be more than double the advised TAC for 1986 and almost five times the advised TACs in recent years. The estimates of abundance of the 1983 and 1984 year-classes were derived from acoustic surveys and therefore exhibit large variances. The large variance in the acoustic estimates results, in part, from the variance around target strength values, and, as previously noted, the Canadian target strength values result in higher estimates of year-class abundance than the target strength values used by USSR scientists. Projections in this report were derived from acoustic surveys conducted in May 1986 and represent the most up-to-date information. Thus, while the abundance estimates may exhibit large variances, STACFIS is confident that the relative year-class strengths reasonably reflect the age composition of the stock. The 1983 year-class has been reported to be strong and the 1984 year-class to be much weaker, as observed in both larval and acoustic surveys. Based on these projections, the 1983 year-class will account for approximately 78% of the mature biomass in 1987.

Even though STACFIS has used the most recent estimates of year-class abundance, the projected values of mature biomass may be biased upwards. The estimates of proportions mature from the 1986 survey may be underestimated, because a portion of the mature stock may have already moved inshore to spawn and would not have been available to the survey. This would result in overestimates of mature biomass in 1987. The estimates of year-class strength were obtained from an acoustic survey that was conducted in Div. 3L where it is believed that capelin from the Div. 3L and Div. 3NO stocks mix. However, the relative proportions of these two stocks could not be quantified, and projections have been calculated for Div. 3L using the total estimate of year-class abundance from Div. 3L. This would result in an overestimate of projected abundance in Div. 3L for 1987.

No stock projections were made for capelin in Div. 3NO because estimates of year-class size for this stock were not available. On the basis of the recommendation from the June 1985 Meeting, STACFIS reviewed available historical data on the Div. 3NO stock and noted that, although stock

sizes since 1981 have been considerably lower than those estimated during the mid-1970's, they have been higher than that observed in 1978. It was concluded that the small catch in that year (5,000 tons) represented the bulk of the spawning stock (ICNAF Redbook, 1979, page 33) and, as a result of the deliberations in 1979. it was recommended that the fishery be closed. It would now appear that this stock was recovered enough to permit a small commercial fishery, and, accordingly, STACFIS advises that a catch of 10,000 tons from Div. 3NO in 1987 would probably not be detrimental to the stock. This precautionary TAC would represent approximately 5% of the average biomass observed since 1981. The 1983 year-class has been observed to be very abundant in other capelin stocks in the Northwest Atlantic and was detected in unusually high numbers in this area during the Canadian acoustic survey in 1985.

e) Future research

STACFIS recommends that research be initiated to provide an index of recruitment for the Div. 3NO capelin stock. One possibility would be a prerecruit survey in the area prior to the capelin spawning season. Such a survey would have to be conducted over a number of years, and, to estimate the size of the Div. 3NO spawning stock, the present surveys would have to be continued.

STACFIS also noted that acoustic surveys have been used as the basis for advice for a number of years and recommends that these surveys and projections resulting from them be evaluated. STACFIS noted that projections from the offshore acoustic surveys have been consistent with indices of abundance of mature capelin inshore and recommends that these comparisons be continued and expanded, if possible. A further evaluation might entail a comparison of age compositions of the mature stock in inshore waters with age compositions predicted from the offshore acoustic surveys.

20. Squid *Illex* in Subareas 2 to 6 (SCR Doc. 86/17, 26, 52; SCS Doc. 86/9, 14, 22)

a) Introduction

Nominal catches of short-finned squid (*Illex illecebrosus*) in the Northwest Atlantic from 1976 to 1985 are given in Table 13. In Subarea 2 to 4, the total catch peaked at 162,000 tons in 1979, declined rapidly to about 400 tons in 1983 and has remained this level since then, with catches of about 700 tons in 1984 and 1985. In Subareas 5 and 6, the total catch peaked at 25,000 tons in 1976 and 1977 before declining to an average of about 17,000 tons between 1978 and 1982. Since 1982, catches have declined steadily, with provisional data for 1985 indicating a catch of nearly 7,000 tons.

Table 13. Nominal catches (tons) of short-finned squid in the Northwest Atlantic, 1976-85.

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	-	-	421	421	11,623	12,044
1984[1]	-	393	316	711	9,876	10,587
1985[1]	-	404	269	673	6,069	6,742

[1] Provisional data.

In Subarea 3, the 1985 offshore catch was only 5 tons and the inshore catch was 399 tons. In Subarea 4, the total catch was 269 tons, of which 11 tons were caught inshore and 258 tons were caught offshore, largely as by-catch in the silver hake fishery. In Subareas 5 and 6, the total catch was 6,069 tons, virtually all of which was taken in Subarea 6 and most of which was taken by USA vessels.

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

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	25[1]	25[1]	100	120	150	150	150	150	150	150	150
Catch	42	83	94	162	70	33	13	+	1[2]	1[2]	

[1] Countries whithout specific allocation could each take up to 3,000 tons.
[2] Provisional data.

b) Input data

i) Abundance indices (SCR Doc. 86/26, 52; SCS Doc. 86/9)

Commercial catch rates were available only for the offshore international fishery in Div. 4VWX in 1985. With only a single day of effort, the catch rate of 0.1 ton/day could not be interpreted in terms of either the 1977-84 commercial fishery data time series or research vessel survey data.

Research survey abundance indices were available only from Canadian surveys in Div. 4VWX. The July abundance indices for 1972-85, which have been standardized with the currently-used vessel and gear (*Alfred Needler*/Western IIA) as the standard (SCR Doc. 86/32) are as follows:

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Mean No. per tow	16.2	16.6	23.2	70.9	376.6	102.8	39.1	147.5	32.7	47.9	11.1	57.0	13.5	69.2

These indices of relative abundance showed an increase in 1985 to 69.2 squid per tow, a level similar to those of 1981 and 1983. Despite the smaller size of squid in July 1985, biomass was also high relative to levels in the 1980-84 period (except for 1981).

In Subareas 5 and 6, commercial landings declined substantially and catch-per-tow indices from the 1984 autumn research survey were about 90% below the average during the 1975-81 period of high abundance, but comparable to those of the prior period (1968-74) of low abundance.

ii) Distribution (SCR Doc. 86/17, 26, 52)

In 1985, as in most years, squid were virtually absent from Div. 4VWX in March. Small numbers were observed in the area of LaHave Bank and Browns Bank and on the northeast corner of Georges Bank in Div. 5Ze. By July, the distributional pattern on the Scotian Shelf was very similar to that seen in 1983 and 1984, with squid spread throughout the western and central areas of the shelf. Catch rates were generally low, with the exception of three large catches between Western Bank and LaHave Bank. There appeared to be an increase in the inshore abundance and distribution of squid in Div. 4VWX. The July 1985 mean bottom temperature (5.5°C) on the Scotian Shelf was considerably below than that seen in 1984 (7.3°C) and essentially the same as that seen in 1982 and 1983. The overall pattern of bottom temperatures was very similar to that seen between 1980-84.

Commercial and research data for Subarea 3 in 1985 again indicated extremely low abundance both inshore and on the Grand Bank. Temperatures from Holyrood indicated that the overall trend was toward slightly lower temperatures in Subarea 3 during 1985.

iii) Biological characteristics (SCR Doc. 86/18, 26, 52)

In 1985, the arrival time of short-finned squid on the Scotian Shelf was intermediate to that seen in the 1978-84 period. First-arriving squid were the smallest, with the exception of those in 1983, seen throughout the same period and, as the season progressed, mean size remained small relative to that previously observed. As in the most recent years, two cohorts of squid were seen in Div. 4VWX. The smaller squid of the second cohort were restricted largely to the intermediate (51-100 fm) depth range. Two cohorts were also seen inshore in Subarea 3, and, based on sizes relative to times of observations, these appear to have been the same two size groups that occurred on the Scotian Shelf. The second cohort appears to have arrived inshore at Newfoundland roughly two months after being observed on the Scotian Shelf. Although two cohorts are commonly seen on the Scotian Shelf, the second cohort is rarely seen inshore at Newfoundland.

c) Catch projections

No new information was available for prediction of squid biomass in 1987. Therefore, STACFIS has no reason to change its advice from that which was formulated in 1980 (NAFO Sci. Coun. Rep., 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; and

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.

21. Shrimp in Subareas 0 and 1 and in Denmark Strait

The shrimp stocks in Davis Strait and Denmark Strait were assessed and advice for the fishery in 1986 was provided by the Scientific Council at its meeting in January (SCS Doc. 86/1). Request by Denmark (Greenland) and Canada for advice regarding the 1987 fisheries were received for consideration at this meeting. For various reasons, as noted in previous reports, STACFIS proposed that the shrimp stocks could best be assessed at an interim meeting in January 1987.

III. RESPONSE TO FISHERIES COMMISSION REQUEST

1. Cod in Divisions 2J, 3K and 3L (SCR Doc. 86/11, 51)

a) *What is the evidence for stock separation of cod in Divisions 2J, 3K and 3L, i.e. what stock divisions exist, if any?*

A review of recent studies on the delineation of the various stock components of cod in Div. 2J, 3K and 3L included discussion of genetic variation, migrations, meristics, infestation by parasites, growth rates and timing of spawning. Some conclusions from genetic and tagging studies are presented in Section II(2)(2). Further examination of available data is planned for the September 1986 Meeting.

b) *What proportion of the biomass of the cod stock(s) in Divisions 2J, 3K and 3L is available, on average, seasonally and annually, in the Regulatory Area?*

There are insufficient data available to fully answer this question. The only series in which surveys were conducted in all three divisions (2J, 3K and 3L) during the same season in the same year is that of the Canadian autumn research vessel surveys for the 1981-85 period. Results from these surveys indicate that about 0.9% of the entire Div. 2J+3KL cod stock biomass is available on average in the Regulatory Area during the autumn. This proportion may not be indicative of all seasons. From these same survey results, an average divisional breakdown of biomass was calculated as follows: 42% in Div. 2J, 30% in Div. 3K, and 28% in Div. 3L. Assuming that the relative distribution among divisions in autumn is similar to that during winter, when the maximum proportion of biomass in Div. 3L occurs within the Regulatory Area (25%), the maximum proportion of the entire Div. 2J+3KL cod stock estimated to occur in the Regulatory Area is less than 10% in winter and less than 5% on average throughout the year.

c) *What proportion of the biomass of the cod stock(s) in Division 3L is available, on average, seasonally and annually, in the Regulatory Area?*

Canadian research-vessel surveys were conducted in Div. 3L in the spring during 1971-82 and 1985, in the autumn during 1981-85, and in the winter during 1985-86. Biomass estimates from spring surveys are given only from 1977, because survey coverage was only adequate enough in these years to answer this particular question. From results of the seven spring surveys in Div. 3L, the proportion of cod biomass on average in the Regulatory area was estimated to be 3.5%, from five fall surveys about 3.1%, and from two winter surveys about 25%.

Results from USSR research vessel surveys in Div. 3L were also discussed. Although the information was general in nature, it seemed to reflect the findings of the Canadian surveys. In winter and spring, cod concentrate in deep water along the slopes and migrate over the bank in late spring. In summer and autumn, it was estimated that more than 90% of cod biomass was within the Canadian fishery zone.

d) *What would be the catch associated with fishing mortality levels of $F_{0.1}$ and F_{max} for the cod stock(s) in Division 3L?*

Until evidence for stock separation of cod in Divisions 2J, 3K and 3L can be evaluated more thoroughly than has been done at this meeting and stock divisions, if any exist, are defined, this question cannot be answered precisely.

e) *What program of research will be necessary to answer these questions on an ongoing basis?*

Although the questions posed regarding the annual and seasonal variations in the proportions of the Div. 2J+3KL cod stock in the Regulatory Area could not be answered precisely, it is clear that the maximum proportion of the biomass of Div. 2J+3KL cod occurring in the Regulatory Area is less than 10% in winter, very low at other times of the year and less than 5% on average throughout the year. To refine these estimates further would require an extensive and very costly research program, which STACFIS feels could not be justified.

2. Cod in Division 3M

What will be the effect on stock status if the fishing mortality on cod younger than 3 years is reduced by 50%?

Although this question cannot be answered precisely at this time, some general comments can be made. Cod of ages 2, 3 and 4 include specimens of sizes unacceptable to the market (Table 14) and the proportion discarded will depend on current discarding practice. STACFIS noted that, for the 1981 year-class, growth increases from ages 2 to 4 at the instantaneous rate of 0.35. Since the instanteneous natural mortality rate is 0.20, there is clearly a substantial loss in yield-per-recruit if cod of these ages are taken.

Table 14. Cod in Div. 3M: length compositions of the 1981 year-class, derived from research vessel surveys in 1982-85.

Length (cm)	1982	1983	1984	1985
7	2			
10	71			
13	42	2		
16		82		
19		908	3	
22		5235	53	2
25		4846	189	7
28		1197	360	26
31		125	565	92
34		18	818	173
37		2	822	313
40		-	561	537
43		2	332	684
46		-	140	681
49		2	41	640
52			11	485
55			1	308
58			-	200
61			-	87
64			1	26
67				4
70				1
73				1
Total	115	12420	3899	4269
Average length	11.04	23.61	35.22	45.94

3. Greenland halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 86/51)

a) *What is the evidence for stock separation of Greenland halibut in Subarea 2 and Divisions 3K and 3L, i.e. what stock divisions exist, if any?*

Several stock identification studies on Greenland halibut in the Northwest Atlantic have been published in the primary literature using various techniques such as parasites as biological tags, biochemical systematics, tagging and meristics. STACFIS recommended that a review of these data should be carried out at the September 1986 Meeting by the appropriate experts in order to evaluate the delineation of Greenland halibut stocks in the Northwest Atlantic.

b) *What proportion of the biomass of the Greenland halibut stock(s) in Subarea 2 and Divisions 3K and 3L is available, on average, seasonally and annually, in the Regulatory Area?*

Recent estimates from fall surveys are available for Div. 2J, 3K and 3L. The estimated biomass in the Regulatory Area during the fall of 1985 was 5,782 tons or 3.5% of the total. Estimates were unavailable for Div. 2G and 2H in 1985, but surveys in 1978, 1979 and 1981 estimated

biomass in this area to be about 200,000 tons, thus implying that 3.5% is a maximum for the stock as a whole.

c) *What proportion of the biomass of the Greenland halibut stock(s) in Division 3L is available, on average, seasonally and annually, in the Regulatory Area?*

Estimates of Greenland halibut biomass in Div. 3L were available from Canadian seasonal surveys in 1984-86. Estimates of biomass in the Regulatory Area ranged from 1,773 tons (78.1%) in the winter of 1986 to 7,005 tons (32.3%) in the summer of 1985. However, it is noted that the biomass in Div. 3L is quite low in comparion to the rest of the stock.

d) *What would be the catch associated with fishing mortality levels of $F_{0.1}$ and F_{max} for Greenland halibut in Division 3L?*

Data are insufficient to provide an answer to this question.

e) *What program of research will be necessary to answer these questions on an ongoing basis?*

Although the question posed regarding the annual and seasonal variations in the proportions of Subarea 2 and Div. 3KL Greenland halibut stock in the Regulatory Area could not be answered precisely, it is clear that the maximum proportion of the biomass occurring in the Regulatory Area is less than 3% on average. Further refinement of these estimates would require an extensive and very costly reserach program which, in the opinion of STACFIS, could not be justified.

4. Roundnose grenadier in Subareas 2 and 3

a) *What is the evidence for stock separation of roundnose grenadier in Subareas 2 and 3, i.e. what stock divisions exist, if any?*

The available information is insufficient to determine if the roundnose grenadier in Subareas 2 and 3 constitute a single stock or a number of separate stocks.

b) *What proportion of the biomass of roundnose grenadier stock(s) in Subareas 2 and 3 is available, on average, seasonally and annually, in the Regulatory Area?*

The available data are insufficient to answer this question with any precision. It may be deduced, from an examination of historical fishing patterns, that only a very low percentage of the Subareas 2 and 3 roundnose grenadier biomass resides in Subarea 3 south of Div. 3K. This implies that only a small percentage is available in the Regulatory Area.

c) *What proportion of the biomass of roundnose grenadier stock(s) in Division 3L, is available, on average, seasonally and annually, in the Regulatory Area?*

The available data are insufficient to answer this question. As noted above, roundnose grenadier are probably not present in commercial quantities in Div. 3L, and hence the Regulatory Area.

d) *What would be the catch associated with fishing mortality levels of $F_{0.1}$ and F_{max} for the roundnose grenadier in Division 3L?*

The available information is insufficient to answer this question. The average catch from all of Subarea 3 (excluding Div. 3K) for the 1967-84 period was only about 130 tons.

e) *What program of research will be necessary to answer these questions on an ongoing basis?*

It is obvious that, if answers to the above questions are considered necessary, an extensive survey program throughout the deepwater areas of Subareas 2 and 3 would be required. STACFIS, however, does not feel that there are commercial quantities of roundnose grenadier in Subarea 3 south of Division 3K, and hence in the Regulatory Area. Results of such a research program would most likely not change this view.

5. Capelin in Division 3L (SCR Doc. 86/65, 84)

What proportion of the biomass of capelin is available, on average, seasonally and annually, in the Regulatory Area?

The amount of capelin occurring seasonally and annually in the Regulatory Area was investigated by examining the occurrence of capelin in bottom-trawl catches during stratified-random surveys by Canada and the occurrence of capelin in cod and American plaice stomachs during some of the same surveys. The same general patterns of occurrence of capelin in trawl catches and predator stomachs were observed. It was concluded that the sources complement each other, because there were cases where one sampling source provided information on the occurrence of capelin when the other did not.

The results of this study did not allow STACFIS to answer the question posed by the Fisheries Commission, because neither sampling technique is considered to provide quantitative estimates of relative capelin abundance. However, it is clear that capelin may be found in strata outside and overlapping the Canadian 200-mile fishery zone in any season. In spring, the season for which there was the longest time-series, capelin intensity appeared to be moderately high in some years and very low in others. Although there were few surveys in which depths greater than 366 m were fished, it appeared that capelin were more prevalent in depths less than 366 m. STACFIS noted that a comparison of results of acoustic surveys conducted in the same area at approximately the same time might provide an evaluation of the results of the present study.

Acoustic surveys conducted by USSR and Canada in Div. 3L are designed to provide estimates of capelin abundance and cover areas in which past experience have indicated that most of the biomass occurs. They usually do not extend outside the 200-mile limit. A portion of a USSR acoustic survey conducted during 5 May-13 June 1985 was carried out beyond the 200-mile limit in Div. 3L, but it was not possible to extract a biomass estimate for this part of the survey from the total biomass estimate. Relative capelin densities were low and this, taken with the fact that the proportion of the survey area outside the 200-mile limit was low compared to the survey area inside, indicated that the biomass of capelin outside the 200-mile limit was low. Both mature and immature capelin were taken in fishing sets outside the 200-mile limit.

6. Squid in Subareas 3 and 4

What portion of the biomass of squid (Illex) is available to be fished, on average, seasonally and annually, in the Regulatory Area?

There is evidence that squid (*Illex*) migrate as juveniles from the Gulf Stream Frontal Zone into the Regulatory Area of both Subareas 3 and 4 in the spring. They are subsequently harvested as adults during their on-shelf residency period which extends well into the autumn. In Subarea 4, there is no fishery beyond the 200-mile fishery zone boundary, which might intercept a portion of the juvenile biomass as it migrates to the Scotian Shelf. In Subarea 3, fisheries do occur in the Regulatory Area both on the Grand Bank and Flemish Cap. These fisheries could intercept migrating juveniles as well as harvest that portion of the biomass remaining as adults outside the 200-mile fishery zone. The proportions of squid biomass either migrating into and/or later remaining in the Regulatory Area of Subareas 3 and 4 and in the area within 200 miles in Subarea 3 are unknown. However, historical fishing patterns and catch data indicate that squid biomass on the Grand Bank and Flemish Cap is considerably less than that found inshore in Newfoundland and on the Scotian Shelf. Data on nominal catches of *Illex* in Div. 3N (Tail of Grand Bank) and Div. 3M (Flemish Cap) relative to total catches in Subarea 3 during 1976-82 are presented in Table 15. Since the 200-mile fishery zone roughly bisects that area of the Grand Bank falling within Div. 3N, it has been assumed that 50% of the catch for this division is fished outside the zone. It has also been assumed that the proportion of total catch from those parts of Div. 3O (Tail of Bank) and Div. 3L (Nose of Bank) in the Regulatory Area are negligible. Of the total of 238,210 tons caught in Subarea 3 during 1976-82, it is estimated that only 1,367 tons (0.6%) came from the Regulatory Area (0.5% from Div. 3N and 0.1% from Div. 3M). If catches are assumed to reflect availability of biomass, it would appear that only a very small proprotion of the stock is found in the Regulatory Area. It is recognized that allocation and restrictions of fishing areas subsequent to establishment of the 200-mile fishery zone may have influenced the distribution of catches.

Table 15. Estimated catches (tons) of squid (*Illex*) in the Regulatory Area (RA) relative to the total catch of *Illex* in Subarea 3, 1976-82.

Year	Subarea 3 total	3N Total	3N (RA)	3M (RA)
1976	11,257	81	40	10
1977	32,748	987	494	1
1978	41,369	525	263	59
1979	88,832	477	239	103
1980	34,779	29	14	58
1981	18,061	152	76	10
1982	11,164	-	-	-
Total	238,210	2,251	1,126	241
% of Subarea 3 total			0.5	0.1

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The fifth meeting of the Subcommittee on Environmental Research was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, during 9-10 June 1986, with M. Stein (EEC) as Chairman. Annex 1 contains the detailed report of the meeting but a brief summary follows.

2. Review of Environmental Studies in 1985

A total of 22 documents referred to environmental conditions in Subareas 1-6 during 1985. Slightly warmer-than-normal conditions were observed in summer and autumn over Fyllas Bank, ending several years of extremely cold conditions. Investigations of the Baffin Island Current showed that, between the autumn of 1984 and the end of 1985, the volume of cold water had decreased, indicating that warming has taken place. The negative temperature anomalies of the Labrador Current to a depth of 200 m in the region of Hamilton Bank were smaller than in the previous year, and it was suggested that the very cold conditions that have existed since 1982 may be changing. Colder and fresher than normal subsurface waters were observed during the spring over the tail and the eastern slope of the Grand Bank and over Flemish Cap. In contrast, water along the southwest slope were observed to be warmer than the long-term. In 1985, water temperatures of the 'cold pool' in the Mid-Atlantic Bight southeast of Sandy Hook, New Jersey, were warmer-than-normal.

3. Overview of Environmental Conditions in 1985 (SCR Doc. 86/72)

As a continuation of a project which began in 1983, the 1986 presentation provided an overview of (i) sea-surface temperature data from the Gulf of Maine to Labrador and southwestern Greenland, (ii) subsurface temperatures off Newfoundland and subsurface temperatures and salinities in Fundy Bay, (iii) wave heights and ice conditions in the Labrador Sea region, and (iv) meteorological observations on air temperature and sea-surface pressure. Except for warmer-than-normal conditions off southwestern Greenland, sea-surface temperature anomalies were negative in the north and positive in the south. Air temperatures were above normal in the north and below normal in the south. Anomalous low pressure systems dominated the atmospheric circulation patterns over the North Atlantic, which could account for the milder conditions off West Greenland.

4. Environmentally-induced Variations in Stock Assessment Parameters

In accordance with previous discussion by STACFIS, documentation was presented which dealt with environmentally-induced variations in stock assessment parameters. It was noted that the "early eighties anomaly" in the environment and its possible impact on distribution and availability of marine species in the North Atlantic would be of interest for a Special Session, possibly in September 1988.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Validation of Age Determinations for Flemish Cap Cod (SCR Doc. 86/90)

Concern was expressed by the Scientific Council about the proper identification of weak and strong year-classes of cod on the Flemish Cap (NAFO Sci. Coun. Rep., 1985, page 115), and age validation studies were suggested. Material relevant to the validation of age determination from the Canadian surveys in 1977-85 were available at this meeting. Intensive sampling was conducted in 1978, 1983, 1984 and 1985. Age-length keys from widely-separated locations produced similar age compositions and average length-at-age vectors when they were applied to the overall length composition from the bank as a whole. It was concluded that the location on the Flemish Cap from which otolith samples were taken was not critical.

From the progression of modes in the age compositions, growth appeared to be linear over the range of modal lengths examed. Regression of modal length and year allowed the identification of year-classes as the years at which the modal lengths were predicted to be about zero. Modal lengths were consistent with average lengths that were derived for the same year-classes from age determinations. The modal length at age 1, either observed or extrapolated from the linear regressions, ranged from 10-15 cm. J. T. Anderson (NAFO SCR Doc. 82/37) extrapolated to February 1982 the standard length of the 1981 year-class of cod on the Flemish Cap from growth rates of larvae, his estimate of 11 cm being consistent with the range from modal analysis. Eleven-cm cod taken off West Greenland in December have been designated age zero (age 1 in the following month).

Repeated readings (4,320) from a batch of 360 otoliths, of which the age reader was unware of the length of the specimens or the year of capture, indicated a probability in excess of 90% of determining the same age. Discrepancies were almost always within one year of the modal age. A comparison of the modal ages from this test with the original age readings showed agreement of about 85% for the years 1977, 1980, 1982 and 1984. Agreements in 1978 and 1979, however, were 70% and 72% respectively. Further, there was a bias in that, where there were differences, the original ages

were almost invariably higher. The samples to 60 otoliths each from these two years indicated inconsistencies both in the age compositions and average lengths. The variation in these parameters to be expected from samples as small as 60 otoliths was not quantified. STACFIS concluded that the age determinations from this series were reasonable and indicated that the provision of other validation studies of cod on Flemish Cap would be welcome.

2. Redfish on Flemish Cap (SCR Doc. 86/27)

The available data indicated that two relatively strong year-classes appeared in both Canadian and USSR surveys in the early 1980's. Canadian ageing indicated that these were the year-classes of 1979 and 1980. Back-calculation from annual growth increments, based on modal lengths in successive surveys, tended to support this. On the other hand, studies on the size of 0-group redfish in other areas (Gulf of Maine, Irminger Sea) supported the suggestion that these small fish represented the 1980 and 1981 year-classes. STACFIS acknowledged that such precise determination of a year-class for redfish was unnecessary for assessment work, but noted that this was not the case when studying recruitment mechanisms. For these studies, the assignment of the correct year-class is a necessity. It was agreed that this issue could not be resolved in time for the Special Session in September 1986. In preparing papers for this session, researchers should adopt their own preference with regard to year-class assignment and document their reasons. STACFIS noted that resolution of this issue could be augmented by surveys of Flemish Cap in September-October with the use of different gears so that fry could be examined. Scientists were encouraged to examine their data-bases further and review the literature in an attempt to resolve this issue.

3. Proposal for Second Workshop on Ageing Shrimp (SCS Doc. 86/11)

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. STACFIS reaffirmed this recommendation at its June 1985 Meeting. Consequently, in early April 1986, the NAFO Secretariat circulated a letter to participants in the 1981 Workshop and to other interested scientists asking for their comments on progress in work on ageing shrimp and on their thoughts about an appropriate time for a second workshop.

Available information at the present meeting indicated that work in the national laboratories has been insufficient to warrant a second workshop in 1986 or 1987. STACFIS was informed that some of the scientists have planned to take an informal collective look at sampling data from West Greenland, and urged them to do so. STACFIS agreed that planning for a Second Shrimp Ageing Workshop be discussed at the Mid-term Meeting of STACFIS to discuss shrimp assessment in early 1987.

4. Ageing Studies of Silver Hake (SCR Doc. 86/18, 59, 70)

A sample of 100 pairs of otoliths, taken by Canadian scientists, was aged by readers of Canada and the USSR to continue investigation of sources of possible disagreement. The overall level of agreement for the two readers (85%) was higher than that obtained for an exchange in 1984 (82%) (SCR Doc. 85/66). The new results again indicated a bias with the USSR reading tending to be higher than the Canadian readings (14% higher in 1985, 15% higher in 1984). The main differences were at ages 1-4 in the 1985 exchange, whereas the differences were mainly at ages 4-5 in the 1984 exchange.

A sample of 100 pairs of otoliths, collected by Cuban scientists, was exchanged with Canada and the USSR, the main purpose being an assessment of the degree of agreement of Cuban readers with that of the other two countries. From the results, the Cuban reader had a greater degree of agreement with the Canadian reader (83%) than with the USSR reader (72%). The lowest agreement was between the USSR and Canadian readers (62%), and, in this case, there was a high number of cases where the Canadian ageing was higher (25%) compared to cases where the USSR ageing was higher (7%).

The results of exchange between Canadian and the USSR indicate a good level of agreement with the possibility of a bias with the USSR ages being somewhat higher. However, in the exchange among the three countries the agreement between Canada and the USSR was poor with an opposite bias suggested. On the basis of these conflicting results, STACFIS recommended that the exchange of silver hake otolith samples among the three countries should be continued and that contacts among the age readers should be established to eliminate sources of disagreement. Furthermore, because the length compositions of catches is also important in the calculation of catch-at-age, it was recommended that these estimates be made available during assessment meetings.

VI. REVIEW OF SCIENTIFIC PAPERS

1. Variable Rates of Natural Mortality for Fish of Different Ages (SCR Doc. 86/64)

The method of natural mortality rate assessment by age, in this paper, has a direct bearing on the fisheries management. The work on variable rates of natural mortality for fish of different ages seems to be very interesting. For some stocks, use of age-specific natural mortality rates may lead to biologically more realistic assessments. It is clear, however, that age-specific natural

mortality calculations cannot be adopted without considering how the M(t) vector interacts with other parts of the sequential population analysis (SPA). In particular, M(t) is expected to interact with the partial-recruitment vector, but less obvious interactions with other terms in SPA are also possible. Concerns were also expressed that, for some stocks, older fish which are not frequent in catches may still have important roles in the spawning stock. Assessments, using methods which assume that older fish necessarily die due to greater rates of natural mortality, should be done with careful attention to consequences on estimated and functional spawning stock biomass. It was also noted that calculations of M(t) values are apparently more sensitive to estimates of t_e than t_s. The ability to extract good estimates of t_e from catch statistics, and ways that estimates of t_e change with other features of SPA which may interact with M(t) require careful documention. It was also pointed out that the accuracy of natural mortality by age is dependent upon the reliability of the minimum mortality estimates used in the equation.

Finally, if assessments and SPA were to use variable rates of natural mortality, traditional reference standards for fisheries management, specifically $F_{0.1}$ and F_{max}, are expected to be different. Recalibration of these standards of reference would also be necessary. To understand how age-specific natural mortality rates interact with other components of SPA will require simulation studies. The simulations should include at least exploring how age-specific natural mortalities interact with partial recruitment vectors, how M(t) changes with changing fishing mortality, and how reference fishing standards change. Noting the timeliness of the problem, STACFIS agreed that research in this field should be continued.

2. Horizontal Distribution of Capelin During the Spawning Season at West Greenland (SCR Doc. 86/49)

Capelin are common at West Greenland but they are caught only locally and in very small quantities in shallow water, especially in the fjords. Very little is known about the biology, distribution and abundance of capelin at West Greenland. During the last two years, there has been an interest in Greenland for catching roe-bearing capelin for the Japanese market, which led to a commercial experimental fishery in the 1985 spawning season. In connection with that fishery, a research cruise was carried out to investigate the biology of West Greenland capelin. Some of the data and results from both fisheries are presented.

Maturing, mature, spawning and spent capelin in both sexes were caught in shallow water very near the shore. At some distance from shore in deeper water (10-50 m), maturing and mature females made up the largest proportion (average 81/% by weight) of the catch. Immatures of both sexes and spent females were found in the middle of the fjords in deeper water (50-600 m), but very few maturing males were found. The proportions of females in catches in near-shore areas at Greenland were very low, and no spent males were found with the immature capelin in the middle of the fjords. It was noted that investigations of capelin in Newofundland waters have shown that males were usually closer to bottom in the same areas where maturing females were found.

The described pattern agrees well with the patterns that have been described for beach-spawning capelin elsewhere. The implications for representative sampling of such a distribution pattern is that one should be very conscious about sampling strategy during the spawning season. On the other hand, the distribution pattern makes it possible to get clean catches of maturing and mature females for the Japanese market.

3. Fishing Grounds of Canadian Longliners in Subarea 5 (SCR Doc. 86/16)

A survey of longliner fishermen in the Cape Sable Island area of southwest Nova Scotia was conducted to obtain information relevant to the possible disruption of fishing patterns resulting from the 1984 International Court of Justice (ICJ) decision on the maritime boundary between Canada and the USA. Examination of catch statistics indicated that over 80% of Canadian longline landings from Subdiv. 5Ze (Georges Bank) were landed in the Cape Sable Island area. Questionaries in the form of seasonal maps were distributed to fishermen in the area. They were asked to indicate fishing areas, the number of trips to each area for the 1982-84 period, and the species sought there.

The return of 30 questionaires, representing approximately 20% of the longline vessels in excess of 40 feet in the area, indicated that activity was lowest in the winter months when fishing was conducted on the banks in Div. 4X close to the home port. Cod and haddock were the main species sought. Fishing activity increased in spring and summer when over 85% of the trips were to Georges Bank and the Fundian Channel. Cod and haddock were sought on the northern edge of the bank, and cod, cusk and halibut were sought in the Channel. In the fall, fishing activity declined and became more widespread. The northern edge and northeast peak of Georges Bank remained the most important area, but fishing effort on the banks in Div. 4X increased.

While the sample size in the survey may have been small and the anlaysis somewhat subjective, the results give the first maps which illustrate the detailed locations of the Canadian longline fihsery in the Georges Bank area.

4. Study of Ichthyoplankton on Flemish Cap, 1985 (SCR Doc. 86/63)

The paper explains the results of the ichthyoplankton survey on Flemish Cap in 1985. Eggs and larvae were characterized quantitatively and qualitatively, and the pattern of distribution of

redfish larvae was considered. *Sebastes* redfish larvae (5.0-10.7 mm) predominated in the ichthyoplankton. Eggs and larvae of cod (*Gadus morhua*) were found throughout the entire area of the bank.

5. Redfish in the Irminger Sea (SCR Doc. 85/113)

The paper considers the results of a survey for 0-group redfish, (*Sebastes mentella*) during August and September 1984 in the Irminger Sea. The densest concentrations of juveniles were found north of 61°N, with noticably less dense concentrations southward of 61°N. Juveniles were actually absent over Reykyanes Ridge. Regarding resolution of the question of *S. mentella* stock identification, the paper emphasized the need for a similar survey to extend from the larvae-hatching area in the Irminger Sea toward western Iceland, East and West Greenland, and possibly Labrador.

6. Egg and Larval Silver Hake Surveys on the Scotian Shelf (SCR Doc. 85/114)

Results of ecological surveys for silver hake under a joint USSR-Canadian program were summarized. The surveys were carried out in August-October 1977-82 on the Scotian Shelf. The data indicated that mass spawning of silver hake occurred in August-September on the Sable Island shallows, Browns Bank and Banquereau Bank where bottom water temperatures were 6° to 9°C. The highest abundance of eggs and larvae were found west of Sable Island in the surface layers, where temperatures were 6° to 7.5°C. Feeding conditions were considered to be the major factor responsible for the survival of juvenile silver hake in this area.

7. Ichthyoplankton Studies in the Western Atlantic Ocean (SCR Doc. 86/69)

An ichthyoplankton survey was made in the area of elevated seamounts between 33°40' and 36°00'N and 47°00' and 53°00'W in September-October 1983. The species composition of ichthyoplankton was determined and the abundance of fish larvae under a square meter of surface in the area was evaluated.

8. Comparative Studies of Trawl Gear Used for the Study of Juvenile Silver Hake (SCR Doc. 85/112)

In October 1983, comparative tows with an international IGYPT trawl and a USSR 13.6 m trawl were made to determine the effect of the design characteristics of the two trawls on the size composition of juvenile silver hake in the catches. The results of the analysis indicated that length frequencies of silver hake in the catches of both trawls were basically the same, with only a slight shift toward smaller average length of fish in the IGYPT trawl catches.

9. Acoustic Surveys of Capelin in Divisions 2J and 3K (SCR Doc. 86/13)

Abundance and biomass of capelin were assessed by the acoustic method in Div. 2J+3K between 21 October and 7 November 1985. During the survey, capelin was distributed from 51°00'N to 55°00'N, and from 53°40'W to 56°00'W. The bulk of the conentrations consisted of 12-14 cm capelin of the 1983 year-class. The total abundance of capelin in Div. 2J+3K was estimated to be 103 billion fish with a biomass of 1.5 million tons.

10. Biology of *Benthosema glaciale* (SCR Doc. 86/68)

Some aspects of reproduction, growth and distribution of this lanternfish on the Grand Bank and Flemish Cap slopes were studied from materials collected in 1982-85. Information on the areas and time of spawning of was presented. The fish become mature at a length of 50 mm and an age of 2-3 years. The life span is approximately 5 years. Maximum densities were observed at depths of 30-320 m in the daytime and at 250-300 m during the night.

11. Food of Greenland Halibut in Divisions 2J and 3K (SCR Doc. 85/109)

Examination of the stomachs of 7,340 Greenland halibut (*Reinhardtius hippoglossoides*) from waters off southern Labrador and northeastern Newfoundland (Div. 2J+3K) during the autumn in 1981 and 1982 revealed that small Greenland halibut (<20 cm) preyed mainly on small crustaceans and cephalopods, Greenland halibut of intermediate size (20-60 cm) preyed primarily on capelin (*Mallotus villosus*), and large Greenland halibut (>70 cm) preyed on a variety of demersal fish, particularly redfish (*Sebastes* sp.) and Greenland halibut. Predation on capelin was most intense on Hamilton Bank and on or near the coastal shelf off southern Labrador and northeastern Newfoundland. An approximate estimate of the consumption of capelin by Greenland halibut was presented.

12. Food of Cod in Divisions 2J and 3K (SCR Doc. 86/80)

Examination of the stomachs of 16,787 Atlantic cod (*Gadus morhua*) from waters off southern Labrador and northeastern Newofundland (Div. 2J+3K) during the autumn in 1977-85 revealed that the major prey were capelin (*Mallotus villosus*), hyperiid amphipods, Arctic cod (*Boreogadus saida*), shrimp (primarily *Pandalus borealis*) and crabs (primarily *Chionecetes opillo*). Total stomach fullness of Atlantic cod tended to be much higher and more variable on Hamilton Bank (Div. 2J) than on Funk

Island Bank (Div. 3K). The rate of predation by Atlantic cod on capelin varied with capelin abundance. The only prey other than capelin to be preyed upon with considerable annual variability were hyperiid amphipods, but predation on hyperiids did not vary inversely with predation on capelin. During periods of low capelin abundance, Atlantic cod apparently did not compensate by preying more intensively on any other prey. With the size structure of the Atlantic cod population in recent years, Atlantic cod of intermediate size (54-71 cm) are the major predators on capelin in the offshore area of Div. 2J+3K.

During the discussion, it was noted that the stomach-content data should be weighted for geographic variation in catch and that it would be useful to obtain independent estimates of abundance for prey other than capelin.

13. Newfoundland Fleet Discarding Practices (SCR Doc. 86/12)

The discarding practices of the offshore fleet of Newfoundland trawlers in 1984 were examined and compared with other years. In terms of the total discard rate, a slight reduction was observed from the 1983 value. Although the discard rate for cod, flatfish and redfish combined was about twice the 1981 level, this value was still less than 5% of the total catch. The increase was attributed to the observed increase in dumping, a practice whereby entire by-catches or even entire catches are discarded at sea. It was noted that this practice was observed more often in the winter fishery for cod in Div. 2J+3KL. Overall, in most fisheries, discarding was observed to be at a relatively low level. STACFIS recommended that an attempt should be made in the future to collect samples of discards for ageing purposes.

14. Changes in Weight-at-Age of Cod During 1980-85 (SCR Doc. 86/35, 36, 43, 47, 55)

Declines in the average weight-at-age of cod in the commercial fishery during 1980-85 were noted in the cod stocks of Subarea 1, Div. 2J+3KL and Div. 3NO. For ages 4-11, average weight-at-age data for the 1980-81 period were compared to those for the 1984-85 period. The decline in average weight of cod was about 40% in Subarea 1 and about 15% in Div. 2J+3KL and Div. 3NO. Cod in Subdiv. 3Ps showed no overall trend, but average weights were rather higher for ages 4-7 and lower for ages 8-11 in 1984-85 than in 1980-81.

Such declines in average weight-at-age, if reflective of changes in the stock rather than fishing patterns over the very wide area from West Greenland to the Grand Bank, could, at least in part, be due to some pervasive environmental change. It is noted that the changes in average weights of cod in West Greenland coincided with the pronounced cooling in that area during 1982-84, but possible selective migration of larger fish of the various year-classes out of the area cannot be ruled out completely.

VII. OTHER MATTERS

1. Reporting Problems with Catch Statistics

Estimates of the catches of cod, flounders and redfish in Div. 3L, 3M, 3N and 3O by various countries from Canadian surveillance data were compared with the provisional statistics that were reported to the NAFO Secretariat (Table 16). The estimate from surveillance data were from inspections of the catches and logbooks aboard vessels of different countries either at sea or in port by Canadian surveillance officers. Estimates of the catches from the inspected vessels for each country were then used to provide estimates of total catch by multiplying them by the ratio of the total days on ground by vessels of that country, as determined from overflights, to the days on ground, as determined from the inspections referred to above, allowing for lost time due to weather, mechanical failures, etc.

Table 16. Cod and flatfish catches in 1985 (provisional).

Stock	A	B	C	D	E
Cod 2J3KL	226,102	0	226,102	234,314	234,314
Cod 3M	12,787	0	12,787	26,259	26,259
Cod 3NO	36,460	4,770	41,230	44,862	49,632
A. plaice 3LNO	45,904	5,235	51,139	43,875	49,110
Yellowtail 3LNO	19,681	7,395	27,076	15,084	22,479
Witch 3NO	8,701	245	8,946	3,598	3,843
Redfish 3M	19,184	-	19,184	28,106	28,106
Redfish 3LN	21,284	375	21,659	20,150	20,525

A Catches reported to NAFO by all countries (SCS Doc. 86/22, and research reports.
B Canadian surveillance estimates for non-members not reported to NAFO.
C Sum of A and B (totals used for assessments).
D Canadian surveillance estimates for countries that reported to NAFO (If no surveillance data, catch reported to NAFO was used.)

STACFIS was not able to fully evaluate the validity of the technique used to estimate these catches because of lack of documentation of the method. Therefore, the following procedure was adopted for the 1985 assessment of stocks that were affected by these estimates: The most recent catch as reported by each country would be combined with the estimated catch from Canadian surveillance data for non-member countries (that have not reported catches to NAFO) to provide an estimate of the total removals for use in stock assessment; after the assessment was complete, the Canadian surveillance estimate for member countries would then be utilized to derive an alternate level of total removals in 1985; the implication of this alternate level to the advice provided from the assessment could then be evaluated.

In view of the major discrepancies between the catches reported by some member countries and those estimated from Canadian surveillance data and the fact that some non-member countries fished in Div. 3L, 3M, 3N and 3O without reporting their catches (Table 16), STACFIS

recommends

that the Scientific Council request the Fisheries Commission at its meeting in September 1986 to evaluate these estimates from surveillance data and the estimation procedure involved and advise the Scientific Council on the appropriateness of using such estimates to derive total removals in future assessments.

2. Progress Report on Contributions for the Special Session on Recruitment Studies in September 1986

There was good response to the call for papers for this Special Session and 23 potential contributions were noted. Four additional contributions were identified at this meeting for a total of 27. Nine papers deal with Flemish Cap with the focus on cod and redfish, 14 papers deal with Georges Bank and adjacent waters with the focus on herring but including other species, and 4 papers are not specific to these regions. Contributions cover the range of topics identified in the announcement, from sampling methods to biological and physical processes controlling recruitment success to stock-recruitment modelling studies.

The Special Session is scheduled for 3 days which should allow adequate time for discussion. Following the presentation of papers for each area, a discussion leader will provide a critique and guide the discussion on the knowledge gained about the recruitment process for target species, the robustness of current hypotheses and implications for future research. A complete list of potential contributions will be circulated in early July 1986.

3. Acknowledgements

Before adjourning the meeting, the Chairman thanked the conveners of the working groups and the Environmental Subcommittee and all participants for their support in making the meeting a successful one. A special note of thanks was extended to J. Baird and C. Bishop who carried out an unusually high proportion of the assessment workload and yet whose efforts helped to keep the meeting moving on a timely basis. The Chairman also expressed his appreciation to the Secretariat for their excellent support.

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 9-10 June 1986, to consider environmental-related topics and report on various matters related to it by STACFIS. Scientists attended from Canada, Cuba, Denmark (Greenland), EEC, Japan, USA and USSR. The representative from the German Democratic Republic attended during presentation of the report to STACFIS on 14 June 1986.

The Subcommittee reviewed the following documents: SCR Doc. 86/13, 17, 19, 20, 25, 31, 43, 46, 48, 56, 57, 63, 65, 67, 71, 72, 73, 74, 75, 76, 77, 78; SCS Doc. 86/8, 9, 15, 17, 20).

1. Marine Environmental Data Service (MEDS) Report for 1985/86 (SCR Doc. 86/78)

a) Data collected in 1985

Approximately 12,671 oceanographic stations were occupied within the NAFO area during 1985, of which data for 6,732 were sent directly to MEDS and data for 2,575 were received through IGOSS (Integrated Global Oceans Services System). This more than doubled the amount of data received last year through IGOSS. Again this year, only Canada and the USSR sent data directly to MEDS. Cruise tracks of the processed data, which have been provided in past records, were not available this year due to recent cutbacks at MEDS. Most of the processed data were collected with bottles and it was noted that the operational processing of CTD data by MEDS has not proceeded as rapidly as anticipated.

b) Historical data holdings

Data were received from only 1,874 historical stations during 1985, a substantial decrease from the previous years total of over 7,500. Part of this decrease was a consequence of MEDS not having received regular updates from NODC (National Oceanographic Data Center) and WDC-A (World Data Center A) in the United States. In the discussion which followed, the USA observer noted that there was a new NAFO liaison person at NODC who probably would facilitate the return to regular data updates being forwarded to MEDS and also possibly some special handling of data to allow for more timely submissions to MEDS of NAFO sections and other data of particular interest to NAFO.

c) Drifting buoy-data

MEDS has recently been accredited as the Regional National Oceanographic Data Centre (RNODC) for drifting-buoy data. As a result, MEDS will receive on a regular basis drifter data from throughout the world's oceans. Data presently available for the NAFO area were listed in SCR Doc. 86/78.

d) Review of environmental conditions

No review of environmental conditions in 1985, based on the MEDS data, was undertaken owing to the recent cutbacks mentioned above. In its place, sea-surface temperature (SST) data from the USA publication "Oceanographic Monthly Summaries" were presented. These data indicate that negative temperature anomalies were observed over the Grand Banks and the Scotian Shelf in most months of the year. Positive anomalies were observed in Subareas 1 and 2 during the latter months of 1985. In Subareas 5 and 6, conditions oscillated between positive and negative anomalies.

2. Review of Environmental Studies in 1985

a) Subarea 0 and 1 (SCR Doc. 86/20, 43, 46, 48, 67, 73; SCS Doc. 86/8, 17)

Slightly warmer-than-normal conditions were observed in summer and autumn over Fyllas Bank, ending several years of extremely cold conditions. The warming was attributed to local meteorological events. In the deeper-water layers (400-600 m) within the core of the Irminger component of the West Greenland Current, temperatures were found to be higher than in the past two years. Cause of the increase is unknown. An extreme negative temperature anomaly in this same water observed in July 1984 was attributed to local conditions in the West Greenland region which prevented the normal flow of warm Irminger water.

The cooling that occurred off West Greenland in the early 1980's coincided with a decrease in salinity. It was speculated that this freshening may be related to advective processes throughout the North Atlantic, as has been suggested for the low salinities observed in the early 1970's. The low air temperatures over West Greenland during the early 1980's were shown to be similar to conditions that prevailed in the latter part of the last century. Air temperature records back to 600 A.D. created from isotope measurements of ice cores taken from

the Greenland icesheet indicate that temperatures throughout the last century had generally been well above the average.

Several possible temperature effects on cod were noted, and a temperature-dependent growth model was used in one paper to assess whether observed temperature changes off West Greenland could account for the measured changes in growth rate of cod. Although successful, the author noted that verification of such a model was difficult due to uncertainty about the temperature history of the fish, given the spatial and temperal variations in temperatures.

USSR investigations of the Baffin Island Current (Subarea 0) showed that, between the autumn of 1984 and the end of 1985, the volume of cold water (less than 0°C) had decreased, implying that warming had taken place.

b) Subareas 2 and 3 (SCR Doc. 86/25, 57, 67; SCS Doc. 86/15, 17)

The waters of the Labrador Current in the region of Hamilton Bank (Div. 2J) during the autumn-winter period of 1985 were colder and fresher than normal, relative to 1962, 1964-79 and 1979-80. However, the negative anomalies down to 200 m were smaller than in the previous year, and it was suggested that the very cold conditions which have existed since 1982 may be changing. In the deep layers (200-500 and 500-1000 m), however, temperature conditions in 1985 were near those of 1984.

Colder-than-normal (relative to 1978-85) water was observed during mid-summer along 47°N latitude (Flemish Cap Section) between about 50 and 200 m. This is the fourth consecutive year of extremely cold conditions in the subsurface waters over the Grand Bank and in the inshore and offshore branches of the Labrador Current. In addition to a decrease in temperature from 1978 to 1982, the area of cold water (less than 0°C) increased in volume. The areal extent of this water since 1982 has remained relatively constant.

SST data that were collected during USSR fish surveys showed a substantial decrease (up to 3°C in the monthly means) over the Grand Bank from 1984 to 1985. Colder-than-normal and fresher-than-normal subsurface waters were observed during spring over the tail and eastern slope of the Grand Bank (Div. 3L and 3N) and over Flemish Cap (Div. 3M). In contrast, water along the southwest slope (Div. 3O) were observed to be warmer than the long-term mean.

Two hydrographic transects were occupied in the St. Pierre-Green Bank region during February-March 1985. Very cold (-1.2°C to -0.6°C) temperatures extended down to 200 m. These were the lowest temperatures observed at this time of the year since 1977.

c) Subareas 4, 5 and 6 (SCR Doc. 86/ 57, 71, 74, 75, 76, 77; SCS Doc. 86/8)

During the winter, spring and summer periods USSR scientists found SST on the Scotian Shelf (Div. 4V, 4W and 4X) to be lower in 1985 than in 1984. At the Halifax section, they also noted an increase in the areal extent of the intermediate cold layer and a decrease in its core temperature between November of 1984 and 1985.

During 1985, water temperatures in the 'cold pool' in the Mid-Atlantic Bight southeast of Sandy Hook, New Jersey (Div. 6A), were higher than normal and bottom waters at mid-shelf and outer-shelf positions during fall were 1° to 2°C above normal. A distinct temperature increase at mid-shelf, observed in November, was attributed to intrusion of warm water by the passage of a Gulf Stream eddy. For the first time since 1977, temperatures of 12°C or warmer persisted on the bottom at upper-slope depths for the entire year. In 1985, the mean position of the shelf-slope front in the region from Cape Romain (off South Carolina) to Georges Bank was generally 10-30 km shoreward of the annual mean position over the 10-year period (1974-83). In the Mid-Atlantic Bight (Cape Hatteras to Nantucket), the area covered by Shelf Water was estimated to be 14% less in 1985 than the 10-yr mean. An analysis of warm-core Gulf Stream rings in the area west of 60°W showed that 8 rings formed during 1985 which was one less than the long-term mean (1974-84). Three additional rings formed in 1984 and persisted in the area into 1985 for a total of 11 rings present during the year. The age of rings varied from 18 to 362 days with a mean age of 126 days.

Summaries of monthly mean SST's which have normally been prepared for NAFO by the USA will henceforth be discontinued due to budgetary constraints and organizational redirection. In the future, monthly anomalies of SST's in the Northwest Atlantic can be obtained from the USA publication OMS (Oceanographic Monthly Summary). In 1985, these monthly charts showed positive anomalies throughout most of the year over the continental shelf south of Cape Cod, over Georges Bank and in the Gulf of Maine. Comparison of these SST anomalies with those in the MEDS report, which were taken from the OMS, show large differences. Indeed, two products are provided in the OMS. One is a basin-wide analysis covering all of the North Atlantic, which was reproduced in the MEDS report. The second is a more regional coverage off the east coast of the USA which was included in the USA report (SCR Doc. 86/75). The differences between the two products arise because of differences in the climatological means and in the procedures for combining the *in situ* (ship and buoy) and satellite data. Care must be taken in noting which analysis is used when utilizing the OMS summaries.

Two additional papers were considered by the Subcommittee. One described mean temperature and salinity conditions during 1951-80 at Prince 5, a station in the Bay of Fundy, off St. Andrews, New Brunswick. Another paper examined the possible effect of bottom-water temperatures on the catch rates of silver hake on the Scotian Shelf.

3. Overview of Environmental Conditions in 1985 (SCR Doc. 86/74)

The overview paper was based on several long-term oceanographic and meteorological data sets as well as a summary of data and results from available research documents and research reports. Highlights not covered in Section 2 above are listed below.

a) Coastal SST data at Halifax, Nova Scotia (Subarea 4), showed a positive annual anomaly relative to 1951-80, whereas near-normal temperatures were recorded at Boothbay Harbour, Maine (Subarea 5).

b) Offshore SST data from ships of opportunity showed negative annual anomalies from the southern Scotian Shelf, over the Grand Bank and in the Labrador Sea including waters over the Labrador Shelf. Positive anomalies were found on Browns Bank and south of the Scotian Shelf. The pattern of negative anomalies in the north and positive to the south reverses the trend that had been maintained since approximately 1976. The only exception to this general pattern was higher-than-normal temperatures off southwestern Greenland, which is consistent with the reports of warming conditions in the Fyllas Bank region.

c) At Station 27 off St. John's, Newfoundland (Div. 3L), subsurface temperatures were again below normal, the fourth consecutive year that these have been observed. Surface salinities in mid-summer were near the record low values for the second year in a row.

d) At Prince 5 off St. Andrews, New Brunswick (Div. 4X), salinities showed a trend through the year from above to below normal with maximum anomalies of about 0.5 psu (practical salinity units). No significant trends in temperatures could be detected at this station.

e) Wave height and frequency of large waves in the Labrador Sea region were well above their long-term mean in 1985, whereas they were near normal over the Scotian Shelf. Slightly above-normal conditions were observed on the Grand Bank.

f) Heavy ice conditions prevailed over the Labrador Shelf, off northeastern Newfoundland and in the Gulf of St. Lawrence. Ice formed early and left late, and extended further south than normal on the Grand Bank.

g) The number of icebergs crossing 48°N latitude was slightly over 1,000, approximately one-half of the total observed in 1984.

h) Annual air-temperature anomalies were above normal over Baffin Island, northern Quebec and Labrador and below normal in more southern regions. Only over Baffin Island did the anomalies exceed one standard deviation. The pattern of above-normal air temperatures in the north and below-normal values in the south is the reverse of conditions that were observed over the previous 2 years.

i) During winter, spring and autumn of 1985, anomalous low-pressure systems dominated the atmospheric circulation patterns over the North Atlantic. These resulted in winds predominantly from the southeast over Greenland, thus possibly accounting for the milder conditions observed there.

4. Remote Sensing Activities at the Bedford Institute of Oceanography

Delays in the launching of remote-sensing satellites of use to oceanographers have been experienced because of recent failures within the USA and European space programs and financial constraints of governments. Work at the institute with the image-analysis system (reported last year) included studies of ice on the Labrador Shelf and several separate investigations on fronts in the Grand Bank, Scotian Shelf and Georges Bank areas. Work on the Florescence Line Imager is continuing.

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

A brief verbal report indicated that a larval-juvenile squid cruise was undertaken by Canadian scientists (from the Scotia-Fundy region) in January 1986. Transects were taken south from Halifax through the Gulf Stream, through the Sargasso Sea and then back towards shore passing near the Great Bahamas Islands, which is farther south than previously undertaken. Extensive physical oceanographic measurements were also taken along these transects. Initial results indicate that the numbers of larval and juvenile squid were low, but the data are still being analysed. A similar cruise undertaken by scientists of the St. John's Laboratory (Newfoundland region) south of the Grand Bank was also reported as having low catches of larval squid. The opinion was expressed that squid are now believed to be pelagic spawners, whereas it was previously thought that they were demersal spawners.

6. Marine Environment and Ecosystems Subcommittee (MEES) (SCR Doc. 86/87)

MEES is a subcommittee of the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC). Its mandate is to examine environmental and ecosystem issues relevant to fisheries and to provide advice to Canadian fisheries managers. MEES chairman (J. Rice) provided an overview of issues that were addressed at a workshop in November 1985. Three different topics were discussed: the first dealt with cooperation between biologists and economists, the second dealt with cod-capelin interactions, and the third dealt with environmental effects on recruitment to Canadian Atlantic fish stocks. The papers relevant to the third topic will be published later this year in a Technical Report of Canadian Fisheries and Aquatic Sciences. Working groups were established to consider requirements for further studies. There will be another meeting in November 1986, when the primary topics will be the tools used in bioeconomics and in studies of juvenile fish, including environmental effects.

7. Environmentally-induced Variations to Stock Assessments (SCR Doc. 86/13, 17, 19, 31, 56, 57, 67)

At the June 1985 Meeting, the Subcommittee was asked by STACFIS to provide a more extensive review of the problem of catchability, especially of environmentally-induced variations to stock assessments. It was agreed by a small group of scientists, including the Chairman of the Environmental Subcommittee, that documentation of catchability problems and anomalies in biological and hydrographic time series of data should be provided. From one such study which was designed to test the hypothesis that the relationship between biomass and catch rates of silver hake was not influenced by bottom temperatures, it was concluded that there was not an adequate time-series of reliable biomass estimates to test the hypothesis. Another study on cod distribution in Div. 2J in 1981 was reported. Meandering of the offshore Labrador Current north and south of Hamilton Bank due to topography was observed. This resulted in bottom water of 2° to 3°C north of the Bank at depths of about 200 m. This coincided with the area of largest mean catches of cod. It was suggested that environmental conditions may have led to local concentrations of cod. However, data in other years, as well as those collected by the USSR in October-November of 1985, did not show warm (2° to 3°C) water north of the Bank. A study of squid in a coastal area of Newfoundland indicated no adverse effect of temperature on abundance during 1985. Finally, an annotated bibliography (ICNAF, NAFO and CAFSAC documents) of environmental factors affecting assessment of some fish stocks in the Newfoundland area during 1972-85 was presented. Most of the 36 references, primarily on cod and capelin, dealt with temperature effects and are speculative, but several papers dealt with the effects of severe ice conditions on the commercial fishery.

Extensive discussion revealed that several participants had examples of possible environmental effects on catchability, but most of these were undocumented. In particular, several examples of the recent (1981-85) cold conditions in the Labrador and Grand Bank regions were noted. It was suggested that these extreme conditions can be used as a natural experiment and further documentation of their effect on catchability could be the focus of a Special Session of NAFO. There was general support within the Subcommittee, but the view was expressed that any session should include time series analysis of available data. It was noted that the "early-eighties-anomaly" in the environment and its possible impact on distribution and availability of marine species in the North Atlantic would be of interest for a Special Session, possibly in September 1988.

8. Environmentally-related Aspects of Special Session in September 1987

The theme of the Special Session in 1987 is "Biology of Demersal Resources of the North Atlantic Continental Slope, with Emphasis on Greenland Halibut and Grenadiers". The Chairman noted the extensive research being done on physical oceanography at the Bedford Institute of Oceanography and suggested that these researchers could provide overview talk on slope processes. The Canadian oceanographers in attendance indicated that this could be done.

9. National Representatives

The Subcommittee was informed of four changes in national representatives responsible for submitting oceanographic data to MEDS. The new representatives are H. Hecht (Federal Republic of Germany), Mr. Francois (France), W. Tuiele (German Democratic Republic), and K. Hughes (USA). Other national representatives are R. Keeley (Canada), R. J. Dominguez (Cuba), E. Buch (Denmark), S. Kawahara (Japan), R. Leinbo (Norway), A. J. Paciorkowski (Poland), G. I. Luka (USSR) and P. Edwards (United Kingdom).

10. Other Matters

a) Symposium on Marine Sciences of the Arctic and Subarctic Regions

The Chairman noted that an ICES-sponsored symposium on Arctic and Subarctic regions would be held in Spain in Septmeber 1987. All facets of marine science, including physics, biology and fisheries, will be discussed.

b) World Ocean Climate Experiment (WOCE)

The Chairman updated the Subcommittee on WOCE. This international program is concerned with developing experiments and investigations on climate change in the oceans on time scales of decades. Three projects are being planned. These are the global description, the southern ocean and the gyre dynamics experiment. The intensive observational period is tentatively set for 1990-95.

c) ICES Working Group on Hydrography

The Chairman noted that the ICES Hydrography Committee had conducted a salinometer calibration experiment. Forty-two laboratories in Canada, Europe and USA participated in the intercalibration. Each laboratory was given four salinity samples of known values covering a range from 8 to 35 psu. Standard deviations of the measurements were of order 0.005 at the high salinity end but increased to 0.01 at the low end.

d) Sea-surface Temperature Maps

R. Trites informed the Subcommittee that the oceanographic analysis charts of SST, published triweekly by the National Weather Service (NWS) of NOAA, recently changed the areal coverage in the NAFO region. It was reduced from 50°N to 47°N and from 44°W to 47°W. This eliminates the Flemish Cap, the northern end of the Grand Bank and the shelf region off northern Newfoundland. Particpants agreed that data from there areas were extremely useful for monitoring environmental conditions and in planning cruises. The Subcommitte therefore recommended that the Scientific Council write to the National Weather Service indicating the usefulness of the oceanographic analysis charts and request that the areal coverage revert back to the origin boundaries of 50°N and 45°W.

11. Acknowledgements

The Chairman, noting no further business, thanked the participants for their contributions and cooperation.

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

Chairman: R. Dominguez Rapporteurs: D. Cross, D. Power

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 17 June 1986 to consider and report on various matters referred to it by the Scientific Council (see Appendix IV) dealing mainly with fishery statistics, biological sampling, biological surveys, and the statistical boundary between Subareas 4 and 5. Scientists attended from Canada, Cuba, Denmark (Greenland), European Economic Community (EEC), German Democratic Republic, Japan, and USSR, and an observer attended from USA.

I. STATISTICS AND SAMPLING

1. Fishery statistics

a) CWP activities relative to NAFO (SCS Doc. 86/4)

The Committee noted the report of the *ad hoc* Inter-agency Consultation on Atlantic Fishery Statistics which was held in London on 5-6 October 1985. Mr. D. Cross, is his capacity as Deputy Secretary of the CWP, reviewed this report and drew the Committee's attention to those times of particular interest to NAFO: namely, the detection of discrepancies in the statistics of the different international agencies and the compilation of a handbook of fishery statistics. The Committee considered the Consultation's provisional agenda for the 13th Session of the CWP to be held in Rome on 11-18 February 1987 and proposed that NAFO be represented at the 13th Session of the CWP by the Assistant Executive Secretary and the Chairman of STACREC. It was further proposed that Canada be invited to be the participating NAFO Contracting Party and that the EEC be invited to provide a substitute should Canadian participation not be forthcoming.

b) Progress report on activities in 1985/86 (SCR Doc. 86/21)

The Committee noted with pleasure that there had been an improvement in respecting the deadlines for the submission of data on STATLANT 21A forms and that, as a result, for the first time in several years, the Secretariat had been able to prepare a provisional inventory of nominal catches (SCS Doc. 86/22) in time for the June 1986 Meeting. The Committee expressed the hope that, following the attention drawn to the importance of timely submission of data at the June 1985 Meeting of the Scientific Council, the Contracting Parties would maintain this improvement with the submission of the STATLANT 21B data, thereby eliminating the delays experienced in recent years in the publication of the Statistical Bulletin.

STACREC noted that several non-member countries fish in the Convention Area and agreed that effort be made to obtain their catch data. Noting the importance of having complete catch and effort data for stock assessment work, STACREC

recommends

i) that Contracting Parties inform the Secretariat of non-member countries identified as fishing in the Convention Area, and

ii) that the Executive Secretary contact the authorities of these non-member countries requesting data for inclusion in the NAFO data base.

c) Conversion factors

The Committee noted that information on the conversion factors used by national authorities to derive the live weight equivalent of the landings would be desirable (e.g. in analysing discrepancies between official catch statistics and information from fishery surveillance schemes) and accordingly

recommends

that the Secretariat prepare, for the September 1986 Meeting of the Scientific Council, a document containing national conversion factors, including the latest information available from FAO.

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

The Committee expressed general satisfaction with the format of the STATLANT forms and the deadlines for their submission (April 15 for STATLANT 21A and July 30 for STATLANT 21B).

However, in recognition of the need for national authorities to have complete and precise knowledge of their obligations under the NAFO Convention, STACREC

recommends

that the Secretariat prepare a document, for the Scientific Council at the meeting in June 1987, containing complete and precise information on the catch and effort statistics to be submitted by Contracting Parties in respect of their obligations under article VI(3) of the NAFO Convention.

The Committee noted that two sets of STATLANT 21B data had been received for the Canadian Gulf region for 1984 (one with and one without fishing effort data) and agreed that the Secretariat's program for generation of Table 5 of the Statistical Bulletin be modified to accommodate publication of both types of records.

e) Effort data and prorating

The Assistant Executive Secretary reported on the information which he received from the statistical offices of Contracting Parties, following the expression of concern at the June 1985 Meeting on the question of "prorating". Although prorating could be appreciable in some fisheries, the general impression was that it was not currently a serious problem. The Committee considered that the situation should be kept under review and proposed that an additional line should be added to the STATLANT 21B form requesting information on the percentage of prorated fishing effort.

f) Historical 22-year catch series (SCS Doc. 86/2)

The Committee welcomed the appearance of this document as recommended at the June 1985 Meeting. It was noted that scientists should check the material and report any discrepancies to the Secretariat.

2. Biological sampling (SCS Doc. 86/20, 21, 23)

a) Progress report on activities in 1985/86

A preliminary 1985 inventory of sampling data was presented. It was noted that Scientific Council representatives should ensure that the list for this year and those of earlier years are checked by appropriate scientists at their institutions with a view to identifying data not yet provided to NAFO.

b) Updating of sampling database

An inventory of the 1967-78 sampling data has been compiled early in 1986 by the Secretariat. This was printed and distributed to scientists and laboratories involved in the work of NAFO.

c) Adequacy of sampling requirements

There were no proposals to alter the format of the sampling forms or the deadlines for their submission. However, it was brought to the Committee's attention that the use of non-standard length groups had resulted in some data not being comparable for assessment purposes at recent STACFIS meetings. STACREC emphasized that sampling methods in the NAFO area should conform to NAFO standards.

II. BIOLOGICAL SURVEYS

1. Review of Survey Activities in 1985

An inventory of surveys conducted in 1985 and reported by Canada, Federal Republic of Germany, France, Denmark (Greenland), USA and USSR is given in Table 1.

2. Survey plans for 1986 and Early 1987

A similar form for the provision of information on surveys planned for 1986 and early 1987 resulted in a list for Canada, Federal Republic of Germany, France, Denmark (Greenland), USA and USSR (Table 2).

3. Review of Stratification Schemes

Accurate bathymetric charts are still not available for Subarea 0 and Div. 2G and 2H. The St. John's Laboratory has received preliminary contour charts from the Canadian Hydrological Service and is in the process of contouring these charts to formulate a stratification scheme. If completed, the scheme will be presented to the Committee in 1987.

4. Coordination of Surveys in 1986 and 1987

There was no new information on coordination of surveys. Such coordination is most often done on a bilateral basis.

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1985.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
			STRATIFIED-RANDOM SURVEYS		
E. Greenl.		DEU	10-11	Groundfish (OTB)	136
0	B	USSR	11-12	Groundfish	78
1	ABC	GRL	7-8	Shrimp (Research)	33
	BCDEF	DEU	11-12	Groundfish (OTB)	133
2	GH	USSR	12	Groundfish	43
	HJ	CAN-N	8	Shrimp	132
	J	"	10-11	Groundfish	115
		DEU	10-11	Groundfish	74
2+3	JK	CAN-N	11	Groundfish	131
3	K	CAN-N	8	Shrimp	50
		"	11-12	Groundfish	106
		USSR	6	Groundfish	55
	KL	CAN-N	6	Cod (acoustic)	57
	L	"	1-2,4-5,7-10	Groundfish	915
		USSR	5-6	Groundfish	102
	M	CAN-N	2	Groundfish	157
		USSR	3-4	Groundfish	126
	N	CAN-N	5	Groundfish	36
		USSR	5	Groundfish	85
	NO	CAN-N	4	Groundfish	142
	O	USSR	5-6	Groundfish	79
	Ps	CAN-N	3	Groundfish	123
		FRA	2-3	Groundfish	98
3+4	Pn,RST	CAN-Q	1	Groundfish	165
4	R	FRA	1-2	Cod	41
	RST	CAN-G	8	Redfish	190
		CAN-Q	9-10-11	Shrimp biomass	125
	T	CAN-G	9	Groundfish	110
	VWX	CAN-SF	7	Groundfish	157
		"	10	Redfish	96
		CAN-USSR	10-11	Juvenile silver hake	179
	WX	CAN-SF	2,3	Groundfish	54
		"	5	Scallop	157
4+5	XZe	CAN-SF	8	Scallop	264
5	YZ	USA	3-4	Groundfish	201
		"	10-11	Groundfish	219
	Z	"	2	Yellowtail	111
6	A	USA	2	Yellowtail	10
	ABC	"	2-3	Groundfish	156
	ABC	"	9-10	Groundfish	148
			OTHER SURVEYS		
1	A	GRL	8-9	Marine mammals	-
	ABCD	"	6-7	Plankton	58
	BC	"	2-3	Scallop	77
	BCD	"	5-6	Harp seals (sampling)	-
	BCF	"	2,4,10	Groundfish & shrimp (com.)	3
	BCDEF	"	7-8	Young cod (res.)	176
	BDE	"	5-6	Capelin	29
	CD	"	4-5	Minke whales (tagging)	-
2	J	CAN-N	7-8	Cod tagging	-
2+3	JK	CAN-N	9-10	Capelin (acoustic)	31
		USSR	10-11	Trawl (acoustics)	22
	JKLMNOP	CAN-N	8	Annual hydrographic	-
3	KL	CAN-N	11-12	Salmon	-
	KLNO	"	3	Groundfish	76
	L	"	6	Cod tagging	-
		"	5	Capelin (acoustic)	-
		"	10	Gear experiment	51
		"	3-4	Oceanography	-
		"	7-10	Herring & capelin larvae	-
		"	6-8,11	Crab	...
		"	11	Pelagic (acoustic)	-
	LN	"	9	Juvenile flatfish	81
	LNO	"	6-7	Capelin (acoustic)	-
		USSR	5-6	Trawl (acoustics)	53
		"	11	Trawl	34
	M	"	5-6	Ichthyoplankton	42
	NOPs	CAN-N	6	Squid	129
	Ps	"	4,9	Scallop	581
		"	3-4	Herring	-
		"	2-3	Oceanography	-
		FRA	3	Scallops	61
4	R	CAN-N	10	Crab	-
	RS	"	7	Redfish (acoustic)	38
		CAN-Q	5-6	Larval	52
	S	"	8	Shrimp-cod interactions	48
		"	10	Shrimp vert. migration	66
		"	10	Juvenile	61
		"	10-11	Scallop explor. fishing	232
	ST	"	5	Snow crab	27
	T	"	8	Snow crab (photographic)	11
		"	9	Snow crab (sampling)	...
		"	8	Scallop	88
		"	7	Scallop (photographic)	99
		CAN-G	5	Herring spawning beds	
	TVn	CAN-Q	6-7	Mackerel eggs & larvae	438
		CAN-G	11	Herring (acoustic)	...
	V	CAN-N	2-3	Squid	-
	VW	CAN-SF	10	Comparative fishing	109
		"	4	Shrimp	27
		"	10	Shrimp	...
		"	4	Mesh selectivity	76
		"	5	Mesh selectivity	78
	VWX	"	6	Plaice parasite coll.	20
	W	"	1	Herring acoustics	4
	WX	"	7	Lobster larvae	9
	X	"	5	Groundfish (acoustic expt.)	44
		"	9,10	Deepwater	3
		"	3	Groundfish (acoustic expt.)	13
		"	4	Benthic	27
		"	7	Cod & haddock tagging	70
		"	7	Live fish gear test	
4+5	XZe	CAN-SF	3,4	Haddock tagging	380
		"	6	Juvenile haddock	107
		"	6	Juvenile haddock	58
		"	10,11	Larval herring	172
		"	2	Ichthyoplantkon	95
		"	2,3	Cod tagging	150
		"	3	Ichthyoplankton	68
		"	4	Ichthyoplankton	110
		"	5	Ichthyoplankton	73
		"	6	Ichthyoplankton	79
		"	10	Scallop larvae	179
		"	11	Larval herring	40
		"	12	Pollock ichthyoplankton	27
4+5+6	WXZeD	CAN-SF	9	Larval & juvenile squid	67
	XYZAB	USA	9,10,11	Fish eggs, larvae, temp.	58
	XYZABC	"	2,3,4	Fish eggs, larvae, temp.	140
		"	4,5	Fish eggs, larvae, phyto-plankton, hydrography	190
		"	5,6	" "	168
		"	11,12	" "	179
5	Y	USA	7	Fish eggs, larvae hydrog.	22
	YZ	"	6	Environmental monitoring	38
		"	12	" "	25
	Z	"	7,8,11	Juvenile fish	568
5+6	YZABC	USA	1,2	Fish eggs, larvae, phyto-plankton, hydrography	131
	YBC	"	9,10	Fish eggs, larvae, temp.	58
	ZABC	"	7,8	Fish eggs, larvae, temp.	126
		"	8,9	Fish eggs, larvae, phyto-plankton, hydrography	192
6	ABC	USA	6	Environmental monitoring	116
		"	12	Environmental monitoring	44
	BC	"	4,5	Fish eggs, larvae, phyto-plankton, hydrography	158
South of SA 6		CAN-SF	1	Larval & juvenile squid	208

Table 2. Biological surveys planned for the NAFO Area in 1986 and early 1987.

Country	Area	Type of survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1986	
CAN-N	OAB+SA1	Groundfish	Aug 15-Sep 18
	2GH	Groundfish	Sep 10-29
	2HJ	Shrimp	Jul 29-Aug 13
	2J+3K	Groundfish	Oct 01-Dec 11
	3L	Groundfish	Oct 01-20
	3LNO	Groundfish	Apr 15-May 27
CAN-SF	4VWX	Groundfish	Jul 07-Aug 01
		Redfish	Sep 29-Oct 10
		Groundfish	Oct 13-Nov 07
	4WX	Scallop	May 19-30
	4VW+5Ze	Groundfish	Mar 02-28
	4X+5Ze	Scallop	Aug 11-29
CAN-G	4RST	Redfish	Aug 04-29
	4T	Groundfish	Sep 02-26
CAN-Q	3Pn+4RST	Groundfish	Jan 07-28
DEU	E. Greenl.	Groundfish (OTB)	Oct 09-Nov 11
	1BCDEF	Groundfish (OTB)	Aug 26-Oct 06
FRA	3Ps	Groundfish	Feb 05-Mar 11
	4R	Cod	Jan 18-30
GRL	OA+1ABC	Shrimp (research)	Jul 21-Aug 28
	1ABCD	Large cetaceans	Jun-Jul
USSR	OB+2GHJ	Greenland halibut	Sep, Nov-Jan
	3KLMNO	Groundfish stocks	Feb 28-Aug 05
	4VWX	Silver hake spawning	Oct 15-Nov 30
USA	4X	Groundfish	Apr 07-25
		Groundfish	Oct 13-31
	5YZ	Groundfish	Mar 24-Apr 25
		Groundfish	Sep 29-Nov 07
	5+6	Scallops	Jul 29-Aug 29
		Clams	Jun 16-Jul 17
	6	Groundfish	Mar 03-Apr 04
		Groundfish	Sep 11-Oct 10
		OTHER SURVEYS - 1986	
CAN-N	2J	Cod sampling	Jul 29-Aug 27
	2J+3K	Capelin (acoustic)	Oct 09-28
	2J+3KLM	Salmon tagging	Oct 22-Nov 10
	2J+SA3	Oceanography	Jul 28-Aug 18
		Gear trials	Nov 12-Dec 01
	3K	Herring	Oct 08-15
	3KL	Cod (acoustics)	Jun 04-23
		Cod tagging	Jun 10-Jul 04
		Capelin tagging	Jun 10-Jul 04
	3L	Capelin (acoustic)	May 10-Jun 02
		Oceanography	Apr 01-25
		Crab	May 29-Jun 12
		Pelagic larvae	Jun 16-27
		Pelagic larvae	Jul 15-25
		Cod tagging	Sep 08-Oct 06
		Crab	Oct 20-31
		Oceanography	Jun 02-06
		Crab	Aug 04-14
		Pelagic larvae	Aug 18-29
		Squid	Sep 02-06
	3LNO	Capelin (acoustic)	Jun 25-Jul 06
		Juvenile flatfish	Aug 20-Sep 08
	3LPs	Herring	Nov 10-Dec 12
	3NO	Groundfish	Apr 01-10
	3NOPs	Squid	May 29-Jun 12
	3Ps	Scallop	Mar 26-Apr 08
		Scallop tagging	Jun 16-24
	3P	Redfish (acoustic)	Jul 08-27
	4R	Crab	Apr 28-May 12
CAN-SF	4RS	Capelin (acoustic)	Jun 02-20
	4VW	Shrimp	May 05-16
		Shrimp	Oct 13-24
	4VWX	Pollock ichthyoplankton	Jan 06-10
		Pollock ichthyoplankton	Jan 03-07
		Gear trials	May 05-13
	4W	Herring acoustic	Jan 13-Feb 28
	4WX	Deepsea trawling	Feb 10-21
		Deepsea trawling	Aug 25-Sep 05
		Lobster larvae	Jun 30-Jul 18
	4X	Observer training	Feb 24-28
		Groundfish acoustic exp.	Mar 10-28
		Plankton gear trials	Jan 27-31
		Gear trials (VW camera)	May 19-30
		Lobster bycatch study	Sep 15-26
		Plankton gear trials	Apr 14-18
		Lobster habitat study	Apr 21-May 02
		Live fish gear test	Jul 21-Aug 01
		Juvenile gadoid study	Jun 02-13
	4X+5Ze	Juvenile gadoid study	Jun 16-27
		Scallop larvae	Sep 29-Oct 14
		Herring larval abundance	Oct 27-Nov 14
		Herring larval process	Oct 27-Nov 14
	South of 6	Larval & juvenile squid	Jan 02-Feb 06
CAN-G	4T	Herring spawning beds	Oct
		Herring acoustic & trawl	Nov 10-Dec 05
CAN-Q	4RS	Larval fish & invertebrates	Apr 28-Jun 13
	4RST	Shrimp biomass	Sep 02-Oct 10
	4S	Herring tagging	Apr 28-May 16
		Scallop exp. fishing	Jun 09-20
		Snow crab prerecruit	Jul 21-Aug 01
		Lobster tagging (2 boats)	Aug 02-15
	4T	Snow crab tagging	Apr 14-May 02
		Herring	May 26-Jun 13
		Snow crab prerecruit	Jul 01-10
		Scallop photographic	Jul 21-Aug
		Scallop	Aug 04-15
	4TVn	Mackerel egg & larvae	Jun 16-Jul 08
FRA	3Ps	Scallop	Mar 17-24
GRL	E. Greenl.	Shrimp (commercial)	Jan, Apr
		Hooded seals (sampling)	Jul-Aug
	1A	Narwhals	Aug-Sep
	1ABC	Plankton	Jun 16-Jul 04
	1ABCDEF	G. halibut & cod (res.)	Jun, Aug
	1BC	Shrimp (commercial)	Mar, Jun-Oct
	1BCD	Scallop	May, Jun, Aug
	1BCDEF	Cod (commercial)	Jan-Dec
	1CD	Capelin	Oct, Nov
	1DEF	Juvenile cod & redfish (res.)	Oct
	1EF	Groundfish	Nov, Dec
	1F	Hooded seals (sampling)	Apr-Jun
USSR	2J+3K	Capelin prerecruits (acoustic)	Oct 21-Nov 15
	3LNO	Capelin prerecruits (acoustic)	Oct 01-20
		Prespawning capelin (acoustic)	May 15-Jun 20
	3M	Ichthyoplankton	Mar 20-Apr 20
USA	5YZ	Environmental monitoring	Aug 25-Sep 24
	5Z	Juvenile fish (IK, IYGPT trawls)	May 02-22
		MOCNESS	Jun 09-Jul 03
		Bottom trawl & IYGPT	Jul 23-Aug 08
		Submersible	Aug 03-15
	6ABC	Environmental monitoring	Aug 25-Sep 24
	4X+5+6	Fish eggs, larvae, phyto-plankton, hydrography	Jan-Feb
		" " " "	May-Jun
		" " " "	Aug-Sep
		" " " "	Nov-Dec
		Fish eggs, larvae, temp.	Feb-Apr
		Fish eggs, larvae, temp.	Sep-Nov
	5Z+6	Fish eggs, larvae, temp.	Jun
		Fish eggs, larvae, temp.	Jul-Aug
		SURVEYS PLANNED FOR EARLY 1987	
CAN-N	3M	Groundfish	Jan 30-Feb 18
	3Ps	Groundfish	Jan 30-Feb 18
	3LN	Cod tagging	Feb 20-Mar 09
	4Vs	Squid	Feb 20-Mar 09
CAN-SF	4W	Herring acoustics	Jan 05-30
	4X	Groundfish acoustics	Mar 23-Apr 03
	4VW+5Ze	Groundfish	Mar 09-Apr 03
	4X+5Ze	Larval cod condition	Mar 23-Apr 03
	6 and South	Larval & juvenile squid	Jan 05-30
USA	4X	Groundfish	Apr 06-24
		Groundfish	Oct 12-30
	5YZ	Groundfish	Mar 23-Apr 24
		Groundfish	Sep 28-Nov 06
	5+6	Scallops	Jul 28-Aug 28
	6	Groundfish	Mar 02-Apr 03
		Groundfish	Sep 07-25

5. Documentation of Survey Design and Procedures

The Committee noted that materials and methods for conducting bottom trawl groundfish surveys in Subareas 2 and 3 as recommended in June 1985 is now available. The Committee agreed that a working group be set up at the September 1986 Meeting to evaluate the submitted material. The group should also evaluate past survey results in order to derive more precise indices for assessment purposes. Stratis Gavaris (Canada) was nominated to be convener of the working group and to provide guidelines for the working group on what information should be compiled from the documentation. Mr. Gavaris will confirm his ability to accept these duties before the September 1986 Meeting of the Scientific Council. The documentation was considered valuable and the Committee encouraged member countries to submit their ideas on the matter to the Scientific Council in September 1986.

III. OTHER MATTERS

1. Review of Scientific Observer Program

It was noted that coverage in 1985 (76 days) by the Canadian Scientific Observer Program was reduced considerably from that in 1983 (145 days) and 1984 (134 days).

2. List of Fishing Vessels

The list was considered valuable as an indication of fishing effort on a broad scale and should be maintained in its present format. It was recommended that the Secretariat update the list for 1986.

3. Tagging Activities Reported for 1985 (SCS Doc. 86/3)

It was agreed that compilation of the list should be continued, because the document was considered to be a useful one.

4. Review of Relevant Documents (SCR Doc. 86/12, 61; SCS Doc. 86/2)

The Committee took note of a paper on the estimates of discarding by the Newfoundland fleet in 1984 which was already considered and discussed by STACFIS.

A paper by USSR authors was tabled on the use of a new system of length measurement of the North Atlantic roundnose grenadier. After some discussion, STACREC confirmed it's 1979 recommendation that *length measurements of both roundnose grenadier (Coryphaenoides rupestris) and roughhead grenadier (Macrourus berglax) separated by sex be made and reported as partial lengths measured from the tip of the snout to the base of the first anal fin-ray (anal-fin length) in half-cm intervals.*

5. Modification of the Subarea 4/5 Boundary

In light of the proposal to modify the boundary between Subareas 4 and 5 (GC Doc. 86/2), the Council reviewed the September 1985 discussion of this matter (NAFO Sci. Coun. Rep., 1985, pages 104-105). It was noted that historical catches in areas involved in the modification were insignificant, and STACREC agreed that the proposal to modify the boundary between Subareas 4 and 5 in the area from 42°20'N to 43°50'N should be accepted.

For the reporting of catches in Subdiv. 5Ze on either side of the Canada-USA boundary, STACREC

recommends

that catches in Subdiv. 5Ze be reported as from two subdivisions, 5Zc (east of Canada-USA boundary) and 5Zu (west of Canada-USA boundary) and that those submitting data to NAFO using numeric coding should designate 5Zc as 55 and 5Zu as 56 where appropriate.

The Canada-USA boundary is defined by geodetic lines connecting the points with the following coordinates:

A.	44°11'12"N	67°16'46"W
B.	42°53'14"N	67°44'35"W
C.	42°31'08"N	67°28'05"W
D.	40°27'05"N	65°41'59"W

6. Acknowledgements

There being no further business, the Chairman thanked the participants for their contributions and to the Secretariat for continued excellent work and to the rapporteurs for their assistance.

APPENDIX III. REPORT OF STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

Chairman: J. S. Beckett Rapporteurs: Sv. Aa. Horsted

The Committee met at the NAFO Headquarters in the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada on 9, 16 and 18 June 1986. In attendence at all session were J. S. Beckett (Chairman), Sv. Aa. Horsted (Denmark-Greenland) and S. Kawahara (Japan) while R. Halliday (Canada) attended the first session and A. T. Pinhorn (Canada) the last two sessions. The Chairman of the Scientific Council attended the last two sessions. Also in attendance were the Executive Secretary (Capt. J. C. E. Cardoso) at the second and third sessions, the Assistant Executive Secretary (V. M. Hodder) at all sessions, and the Administrative Assistant (W. H. Champion) at the first and second.

1. Review of Scientific Publications Since June 1985

a) Journal of Northwest Atlantic Fishery Science

i) Volume 6, containing a total of 17 papers, a letter to the Editor, an obituary, and two notices (180 pages), was completed in early 1986, the publication dates being given as June and December 1985 for No. 1 and 2 respectively.

ii) The Committee was informed that so far no manuscripts for Vol. 7 have been received by the Secretariat from the Editor. This volume should have been ready for printing in June 1986.

b) NAFO Scientific Council Studies

i) Number 9, containing a synopsis, 15 papers, a bibliography, and the titles and abstracts of 11 other papers that were presented at the Special Session on Squids in September 1984 (180 pages), was published in September 1985.

ii) Number 10, which will likely contain 8-10 papers, is expected to be published in July.

c) NAFO Scientific Council Reports

The volume for 1985 containing reports of meetings in January, June and September 1985 (146 pages), was completed and distributed in March 1986.

d) NAFO Statistical Bulletin

i) Publication of Volumes 28 and 27 (revised editions) in September and December 1985 respectively completed the reissue of 5 volumes (27-31) which became necessary due to reported errors in fishing effort data.

ii) Volume 33 for 1983 (279 pages) was published in December 1985, about 8 months delayed due to late receipt of some data.

e) Inventory of Sampling Data, 1967-78

This volume (269 pages), containing lists of ICNAF sampling data available in computerized format for 1967-78, was printed and distributed in April 1986.

f) Index and Lists of Titles

Subject and author indexes and the list of titles of 114 research (SCR) and 29 summary (SCS) documents that were issued in 1985 are given in SCS Doc. 86/7 (29 pages).

2. Editorial Matters Regarding Scientific Publications

a) Editorial Board activities

Receipt of papers for the Journal of Northwest Atlantic Fishery Science and their subsequent disposition were reviewed:

There was a continued declined in the number of papers that were received for possible publication in the Journal to 13 in 1985 from 22 in 1984 and an average of 31 for 1982-83. This was a significant element in the delay in publication of the two Numbers of Volume 6.

During the overall period, the processing of 118 papers was completed, of which 81 were published in the Journal and the remainder (37) were rejected. Twelve of these Journal rejects were published in Studies.

b) Editorial Board appointments

i) With the appointment of B. E. Skud (USA) as Editor of the Journal and G. A. Robinson (UK) as Associate Editor, as a result of recommendations from the June 1985 Meeting, the Editorial Board on 1 August 1985 consisted of the following:

Editor:	B. E. Skud
Assoc. Editor:	W. G. Doubleday (Biomathematics)
	G. P. Ennis (Invertebrate Fisheries Biology)
	M. D. Grosslein (Vertebrate Fisheries Biology)
	R. G. Halliday (Vertebrate Fisheries Biology)
	G. A. Robinson (Biological Oceanography)

ii) In April 1986, the Editor (B. E. Skud) indicated that he would not be able to continue as Editor. At the June 1986 Meeting the Chairman of the Committee (J. S. Beckett) discussed the matter by telephone with the Editor who then indicated that he would not be able to serve further except for a month or so.

Having discussed the matter and not being able to come up with an immediate long-term solution to the difficulties regarding a new editor of the Journal the Committee agreed that

1. the economical and practical possibilities of a professional editor on contract should be explored, and

2. that as a short-term solution the Associate Editors should be informed that the manuscripts already passed to them would be published in the form in which they returned them. It was, thereby, hoped that the Associate Editors would, in fact, undertake the complete editing of "their" manuscripts. This would also indicate whether this short-term solution could be the long-term solution of editing the Journal, in which case the role and title, of the associate editors might need to be revised.

3. It was further agreed that the Associate Editors and some other scientists suggested by STACPUB members should be asked to consider appointment of Editor. Furthermore, directors of relevant laboratories would be asked to suggest nominees for an Editor.

3. Promotion and Distribution of Scientific Publications

The Committee was concerned both about the continued decline in the numbers of papers received for possible publication in the Journal (see item 2(a) above) and about the limited distribution of the Journal. The Journal does not seem sufficiently attractive to scientists for publication of their results although a high-standard policy is followed. Thus, no manuscripts for Vol. 7 have been received by the Secretariat from the Editor. This volume should have been ready for printing in June 1986.

The Committee agreed that an active advertising policy should be established and pointed to the following actions:

a) Brochure for Journal

The Committee agreed that the Executive Secretary should produce an attractive brochure to be widely distributed.

A list for distribution of the brochure could possibly be obtained through the office of the Editor, Dept. of Fisheries and Oceans, Ottawa. It was further agreed that in order to establish a list for distribution, extracts of International Directory of Marine Scientists should be sent to national council representatives with a request for deletion or addition of addresses. Expenditures for production and mailing of the brochure should be explored and discussed at the September 1986 Meeting of STACPUB.

b) Advertising of Journal

The Committee also agreed that the Journal should be advertised through the Allen Subscription Catalogue. This was proposed on the provision that about 2,500 addresses are reached this way. The coats (about US $350 annually) were estimated to be equivalent to mailing costs for distribution of 500 brochures.

c) Abstract practices

The Committee was informed by the Assistant Executive Secretary that Journal papers are abstracted in Biological Abstracts.

d) Invitational papers

At its meeting in September 1985 the Committee agreed that the Chairman of STACPUB should correspond with the Editor concerning his proposal to solicit review papers from recognized authorities in particular fields, explore suggestions as to what types of papers should be solicited and who should be approached to provide such review papers.

The Chairman reported that no progress in this field had been made. The Chairman, at the present Council meeting, circulated a letter to participants in the meeting seeking their advice on proposals for items and authors for invitational review papers.

It was agreed that the Executive Secretary should write to the Associate Editors seeking their advice for subjects which might be suitable and for potential authors.

e) Cooperation with ICES

At its September 1985 Meeting the Committee agreed that the Editors of the ICES and NAFO scientific publications should explore joint arrangements and forward suggestions to STACPUB at its present meeting. No progress was reported. The Committee agreed that the matter be postponed pending resolution of editorial activities.

f) Production costs and revenues for council publications

Publication costs and revenues for the various publications related to the activities of the Scientific Council were reviewed. It was noted that the Journal, the Studies, the Scientific Council Reports and the Statistical Bulletin each were distributed free of charge to numbers between 450 and 500 per volume, whereas the subscription distribution was much lower (64, 27, 17 and 30, respectively for the last volume of the four series mentioned). No charges were made for the revised volumes of Statistical Bulletin (Vol. 27-31).

4. Progress Report on Microfiche Project

The completion of the project to record all research-related ICNAF meeting documents (i.e. up to and including 1979) on microfiche will be completed before the end of 1986. Total costs are not yet settled, but there has been increasing interest for the series.

The question was raised whether NAFO documents should also be placed on microfiche. It was agreed that the Executive Secretary explore the interest for this when announcing the availability of the ICNAF microfiche series.

5. Papers for Possible Publication

a) Review of proposals from 1985 meetings

The disposition of papers identified in 1985 as potentially suitable for publication by the Council was reviewed. Of the 33 so identified, 7 have been received for publication while 7 others still are under review by the authors leaving 19 papers not submitted for publication.

b) Proposals for publication from 1986 and deferred 1985 documents

The Committee reviewed four research documents deferred from the 1985 Meeting to this meeting and those which were presented to the Council so far in 1986 (up to SCR Doc. 86/89). Furthermore, two manuscripts submitted directly to Studies rather than at a meeting were reviewed and accepted for publication. The Committee requested the Assistant Executive Secretary to invite the authors of the following documents to submit suitable revised manuscripts for possible publication in the Journal or Studies series: SCR Doc. 85/109, 86/33, 43, 68, 72 and 80.

The author of SCR Doc. 86/44 and 86/45 should be invited to combine the two manuscripts and to co-operate with the author of SCR Doc. 86/81 on a joint manuscript on the content of these three documents. The authors of SCR Doc. 86/48 and 86/73 should be invited to submit their papers as a joint manuscript. The author of SCR Doc. 86/67 should be invited to submit his paper after inclusion of a discussion of changes in abundance in recent years and its possible dependency, especially for roundnose grenadier and Greenland halibut, upon migration by age towards greater depths. The Committee agreed that it would give further consideration to SCR Doc. 86/32 at its meeting in September 1986.

6. Acknowledgements

APPENDIX IV. AGENDA FOR THE JUNE 1986 MEETING

I. Opening (Chairman: J. Messtorff)

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

II. Fishery science (STACFIS Chairman: W. R. Bowering)

1. General review of catches and fishing activity in 1984

2. Consideration of some important recommendations from 1985 meetings (Sci. Coun. Rep. 1985, p. 144)

   a) Arrangements for conducting stock assessments
   b) Database improvement for cod in Subdiv. 3Ps
   c) Variation in catch rates for redfish in Div. 3LN
   d) Research requirements for silver hake in Div. 4VWX
   e) Analysis of available data for capelin stock in Div. 3NO

3. Assessment of finfish and invertebrate stocks

   a) Stocks within or partly within the Regulatory Area, as requested by the Fisheries Commission with the concurrence of the Coastal State (Annex 1):

      - Cod (3M, 3NO)
      - Redfish (3M, 3LN)
      - American plaice (3M, 3LNO)
      - Witch flounder (3NO)
      - Yellowtail flounder (3LNO)
      - Capelin (3L, 3NO)
      - Squid-*Illex* (2+3)

   b) Stocks within the 200-mile fishery zone in Subareas 2, 3 and 4, as requested by the coastal states involved (Annexes 2 and 3):

      - Cod (2J+3KL, 3Ps)
      - Silver hake (4VWX)
      - Greenland halibut (2+3KL)
      - Roundnose grenadier (2+3)

   c) Stocks overlapping the fishery zones in Subareas 0 and 1, as requested by Canada (Annex 2) and Denmark on behalf of Greenland (Annex 4):

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

   d) Stocks within the fishery zones in Subarea 1 and at East Greenland, as requested by Denmark on behalf of Greenland (Annex 4):

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

   e) Specific questions by the Fisheries Commission on the following stocks (Annex 1):

      - Cod (2J+3KL, 3M)
      - Greenland halibut (2+3KL)
      - Roundnose grenadier (2+3)
      - Capelin (3L)
      - Squid-*Illex* (3+4)

4. Environmental Research (Subcommittee Chairman: M. Stein)

   a) Marine Environmental Data Service report for 1985
   b) Review of environmental studies in 1985
   c) Overview of environmental conditions in 1985
   d) Update of remote-sensing activities
   e) Squid larvae and juveniles re oceanography
   f) Marine Environmental Ecosystems Subcommittee of CAFSAC

g) Environmentally-induced variations to stock assessments
h) Environmentally-related aspects of Special Session in September 1987 on "Biology of demersal resources of the North Atlantic continental slopes with emphasis on Greenland halibut and grenadiers"
i) Other matters

5. Flemish Cap and Georges Bank projects

a) Analysis of previously unreported data (*NAFO Sci. Coun. Rep.*, 1985, page 115)
b) Progress report on relevant papers for the Special Session in September 1986
c) Other relevant activities

6. Ageing techniques and validation studies

a) Ageing of cod and redfish in Div. 3M (*NAFO Sci. Coun. Rep.*, 1985, page 115)
b) Verification of shrimp age determinations (SCS Doc. 86/1, page 12)
c) Proposal for second workshop on ageing shrimp
d) Other relevant studies

7. Gear and selectivity studies

a) Escapement and selectivity problems associated with the use of strengthening ropes, splitting straps and codend floats (NAFO FC Doc. 84/6 (rev.), para. 21; FC 82/2 (rev.))
b) Selectivity studies for shrimp in Davis Strait (NAFO SCS Doc. 86/1, page 12)
c) Trawl catchability (SCR Doc. 85/112)
d) Other relevant studies

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

a) Papers deferred from 1985 (SCR Doc. 85/109, 113, 114)
b) Papers documented for present meeting

9. Other matters

a) Combined assessment of cod stocks at West and East Greenland
b) Reconsideration of the justification for a midterm shrimp meeting in January 1987
c) Progress report on contributions for the Special Session in September 1986 on "Recent advances in understanding recruitment in marine fishes with particular emphasis on Georges Bank herring and Flemish Cap cod and redfish stocks" (M. D. Grosslein, Convener)
d) Preparation for Special Session in September 1987 on "Biology of demersal resources of the North Atlantic continental slope with emphasis on Greenland halibut and grenadiers"
e) Proposed theme for Special Session in September 1988
f) Review of new arrangements for conducting stock assessments
g) Other business

III. Research Coordination (STACREC Chairman: R. Dominguez)

1. Statistics and sampling

a) CWP activities relevant to NAFO

i) Report of Inter-agency Consultation on Atlantic Fishery Statistics, London, 5-6 October 1985
ii) Participation in 13th session of CWP at Rome in February 1987

b) Fishery statistics

i) Progress report on activities in 1985/86
ii) Updating of fishery statistics database
iii) Review of reporting requirements (STATLANT 21A and 21B)
iv) Effort data and prorating

c) Biological sampling

i) Progress report on activities in 1985/86
ii) Updating of sampling database
iii) Forms and deadlines for submission of sampling data

2. Biological surveys

a) Review of survey activity in 1985
b) Survey plans for 1986 and early 1987
c) Review of stratification schemes
d) Coordination of surveys in 1986 and 1987 (if requested)
e) Documentation of survey design and procedures (*NAFO Sci. Coun. Rep.*, 1985, pages 95 and 104)
f) Other activities

3. Other matters

   a) Review of scientific observer program
   b) List of fishing vessels (1986)
   c) Tagging activities reported for 1985
   d) Review of relevant documents
   e) Other business

IV. Publications (STACPUB Chairman: J. S. Beckett)

1. Review of scientific publications since June 1985

2. Editorial matters regarding scientific publications

   a) Editorial board activities
   b) Editorial board appointments

3. Promotion and distribution of scientific publications

   a) Brochure for Journal
   b) Abstract practices
   c) Invitational papers
   d) Cooperation with ICES
   e) Other promotional initiatives
   f) Production costs and revenues for Council publications

4. Progress report on microfiche project

5. Papers for possible publication

   a) Review of proposals from 1985 meetings
   b) Proposals for publication from 1986 and deferred 1985 documents

6. Other matters

V. Amendments to Rules of Procedure

1. Report of Executive Secretary on Results of vote on amendments by mail

VI. Collaboration with other organizations

1. Future activities of NAFO/ICES Study Group on redfish off Greenland (if any)

2. Combined assessment of the cod stocks at West and East Greenland

3. Questions of Joint ICES/NAFO Working Group on Seals

4. Inter-agency Consultation on Atlantic Fishery Statistics, London, UK, 5-6 October 1985

5. Thirteenth Session of CWP, Rome, Italy, February 1987

VII. Adoption of Reports

1. Provisional report of January 1986 Meeting (SCS Doc. 86/1)

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

VIII. Future Scientific Council Meetings, 1986 and 1987

IX. Special Sessions

1. Arrangements for Special Session on "Biology of demersal resources of the North Atlantic continental slope with emphasis on Greenland halibut and grenadiers", to be held in September 1987

2. Theme for Special Session in September 1988

X. Other Matters

XI. Adjournment

ANNEX 1. FISHERIES COMMISSION REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1987 OF CERTAIN STOCKS IN SUBAREAS 2 TO 4

1. The Fisheries Commission with the concurrence of the Coastal State requests that the Scientific Council, at a meeting in advance of the 1986 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 1987:

   Cod (Div. 3N and 3O; Div. 3M)
   Redfish (Div. 3L and 3N; Div. 3M)
   American plaice (Div. 3L, 3N and 3O; Div. 3M)
   Witch flounder (Div. 3N and 3O)
   Yellowtail flounder (Div. 3L, 3N and 3O)
   Capelin (Div. 3L; Div. 3N and 3O)
   Squid (Subareas 3 and 4)

2. The Commission and the Coastal State request the Scientific Council to consider the following options in assessing and projecting future stock levels for those stocks listed above:

   a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As general reference points the implications of fishing at $F_{0.1}$, F_{1985}, F_{1985} plus and minus 25%, F_{max} and of maintaining catch levels at the 1985 level in 1987 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options. Opinions of the Scientific Council should be expressed in regard to stock size, spawning stock sizes, recruitment prospects, catch rates, and TACs implied by these management strategies for 1987 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 points should be the level of fishing effort (F) which is calculated to be required to take the MSY catch in the long term and two-thirds of that effort level.

   c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence of stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stock.

   d) Values of F corresponding to the reference points should be given and their accuracy assessed.

   e) Spawning stock biomass levels that might be considered minimal for maintenance of sustained recruitment should be recommended for each stock.

   f) Presentation of the result should include the following:

      i) for stocks for which analytical dynamic-pool type assessments are possible:
         - a graph of yield and fishing mortality for the past 10 years,
         - a graph of spawning stock biomass levels and subsequent recruitment for the past 10 years,
         - a graph of catch options for the year 1987 over a range of fishing mortality rates (F) at least from -25% to 25% of F in 1985,
         - a graph showing spawning stock biomasses at 1.1.1988 corresponding to each catch option,
         - graphs showing the long-term average catches, catch per unit effort and spawning stock biomass against fishing mortality rate,

      ii) for stocks for which advice is based on general production models, the relevant graph of production on fishing mortality rate.

      In all cases the three reference points, actual F, F_{max} and $F_{0.1}$ should be shown.

3. In addition the following specific questions should be addressed:

For cod in Divisions 2J, 3K and 3L

a) What is the evidence for stock separation of cod in Divisions 2J, 3K and 3L i.e. what stock divisions exist, if any?

b) What proportion of the biomass of the cod stock(s) in Divisions 2J, 3K and 3L, is available, on average, seasonally and annually, in the Regulatory Area?

c) What proportion of the biomass of the cod stock(s) in Division 3L, is available, on average, seasonally and annually, in the Regulatory Area?

d) What would be the catch associated with fishing mortality levels of $F_{0.1}$ and F_{max} for the cod stock(s) in Division 3L?

e) What programme of research will be necessary to answer these questions on an ongoing basis?

For capelin in Division 3L

What proportion of the biomass of capelin is available, on average, seasonally and annually, in the Regulatory Area?

For squid in Subarea 3 and 4

What proportion of the biomass of squid (Illex) is available to be fished, on average seasonally and annually, in the Regulatory Area?

For cod in Division 3M

What will be the effect on stock status if the fishing mortality on cod younger than 3 years is reduced by 50%? The Council should consider options for achieving such a reduction.

For Greenland halibut in Subarea 2 and Divisions 3K and 3L

a) What is the evidence for stock separation of Greenland halibut in Subarea 2 and Divisions 3K and 3L, i.e. what stock divisions exist, if any?

b) What proportion of the biomass of the Greenland halibut stock(s) in Subarea 2 and Divisions 3K and 3L is available, on average, seasonally and annually, in the Regulatory Area?

c) What proportion of the biomass of the Greenland halibut stock(s) in Division 3L, is available, on average, seasonally and annually, in the Regulatory Area?

d) What would be the catch associated with fishing mortality levels of $F_{0.1}$ and F_{max} for the Greenland halibut in Division 3L?

e) What programme of research will be necessary to answer these questions on an ongoing basis?

For roundnose grenadier in Subareas 2 and 3

a) What is the evidence for stock separation of roundnose grenadier in Subareas 2 and 3, i.e. what stock divisions exist, if any?

b) What proportion of the biomass of the roundnose grenadier stock(s) in Subareas 2 and 3, is available, on average, seasonally and annually, in the Regulatory Area?

c) What proportion of the biomass of the roundnose grenadier stock(s) in Division 3L, is available, on average, seaspnally and annually, in the Regulatory Area?

d) What would be the catch associated with fishing mortality levels of $F_{0.1}$ and F_{max} for the roundnose grenadier in Division 3L?

e) What programme of research will be necessary to answer these questions on an ongoing basis?

[Appendix VII in Report of the Fisheries Commission, NAFO FC Doc. 85/8 (revised)]

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1987 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1986 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1987:

   Cod (Div. 2J, 3K and 3L; Div. 3Ps)
   Greenland halibut (Subarea 2 and Div. 3K and 3L)
   Roundnose grenadier (Subareas 2 and 3)
   Silver hake (Div. 4V, 4W and 4X)

   It is further suggested that, subject to the concurrence of Denmark (Greenland), the Scientific Council, prior to the 1986 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1987 of the following stocks:

   Shrimp (Subareas 0 and 1)
   Greenland halibut (Subareas 0 and 1)
   Roundnose grenadier (Subareas 0 and 1)

2. Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for those stocks listed above:

   a) For those stocks subject to analytical dynamic-pool 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 1987 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 1987 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 (Science)
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 3. EEC REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1987 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 1987 given. Where possible, these should be expressed graphically in terms of catch in 1987 and the size of the spawning stock biomass on 1 January 1988 for a range of values of F which covers at least -50% to +25% of F in 1984, with the inclusion of the F_{max} value.

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

ANNEX 4. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT OF CERTAIN STOCKS IN 1987

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1986 Meeting to provide advice on the status of the stocks and on the scientific basis for management in 1987 and as many years onward as the data allow for the following stocks:

   a) Stocks occurring in Subarea 1

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

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

      i) Greenalnd halibut
      ii) Roundnose grenadier
      iii) Northern shrimp (Pandalus borealis)

2. In the analyses on which management advice will be based, the following should be included:

   a) For cod in Subarea 1, the current stock size and its 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 1987 onward
      ii) F = F(max) from 1987 onward
      iii) F = F(1985) from 1987 onward
      iv) A steady catch level from 1987 onward with the annual catch level equal to (1) the TAC for 1985, and (2) the catch for 1986 calculated by the above options for F(1987).

      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 1988 for any given catch level between zero and that for F(max), assuming that the catch level in 1986 is equal to the above-mentioned TAC for that year.

      The report of the ICES Working Group on Cod Stocks off East Greenland, January 1986, indicates that year-classes 1984 and 1985 may be better than other year-classes in the present stock. The size of these year-classes should, if possible, be quantified and their expected spatial distribution in 1987 and 1988 described. The expected length and weight distribution of the catches calculated for 1987 and 1988 in the above-given options should be given, if possible by gear types.

   b) For redfish and wolffish in Subarea 1, options for management should, if possible, be expressed graphically in terms of catches in 1987 and the stock and spawning stock biomass by 1 January 1988 for a range of F-values covering at least for wolffish one-half to two times that in 1985 and for redfish one-half to four times that in 1985.

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

   d) For northern shrimp in Subares 0+1, advice is requested on stock size and management options. As previously, it is further requested, in the possible extent, to include into the advice a statement on size composition of the actual catch in relation to the supposed composition of the stock.

   e) Furthermore, we request a separate assessment of the shrimp stock north of 70°52.5'N on the northwest coast of Greenland (i.e. only in Subarea 1).

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.

4. 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.

Einar Lemche
Greenland Home Rule Authorities
Nuuk, Greenland

APPENDIX V. LIST OF PARTICIPANTS

CANADA

Atkinson, D. B.	Northwest Atlantic Fisheries Centre, P. O. Box 5667, St. John's, Nfld.
Baird, J. W.	" " " " " "
Bishop, C. A.	" " " " " "
Bowering, W. R.	" " " " " "
Brodie, W. B.	" " " " " "
Carscadden, J.	" " " " " "
Lilly, G.	" " " " " "
Miller, D.	" " " " " "
Nakashima, B. S.	" " " " " "
Pinhorn, A. T.	" " " " " "
Power, D.	" " " " " "
Rice, J. C.	" " " " " "
Wells, D.	" " " " " "
Winters, G. H.	" " " " " "
Fanning, P.	Marine Fish Division, Bedford Institute of Oceanography, Dartmouth, N. S.
Halliday, R. G.	" " " " " "
Koeller, P. A.	" " " " " "
Sinclair, A.	" " " " " "
Waldron, D. E.	" " " " " "
Zwanenburg, K.	" " " " " "
Drinkwater, K. F.	Marine Ecology Lab., Bedford Institute of Oceanography, Dartmouth, N. S.
Frank, K.	" " " " " "
Trites, R. W.	" " " " " "
Rowell, T. W.	Invertebrates and Marine Plants Div., P. O. Box 550, Halifax, N. S.
Young, J. H.	" " " " " "
Gavaris, S.	Marine Fish Division, Biological Station, St. Andrews, N. B.
Perry, R. I.	" " " " " "
Chouinard, G. A.	Fisheries Research Branch, Gulf Region, P. O. Box 5030, Moncton, N. B.
Frechet, A.	Dept. of Fisheries and Oceans, P. O. Box 15500, Quebec City, Quebec
Beckett, J. S.	Fisheries Research Branch, DFO, 200 Kent Street, Ottawa, Ontario
Keeley, J. R.	Marine Environmental Data Service, 200 Kent Street, Ottawa, Ontario

CUBA

Dominguez, R.	Flota Cubana de Pesca, Ave. Pesquera esq. Desamparados, Havana
Valdes, R.	Centro de Investigaciones Pesqueras, Esq. Av. Primera, 2406 Miramar, Havana
Varea, J. A.	Direccion de Relaciones Internacionales, Ministerio de la Industria Pesquera, Havana

DENMARK (GREENLAND)

Horsted, Sv. Aa.	Greenland Fisheries Institute, Tagensvej, 135, Copenhagen, Denmark
Riget, F.	" " " " " "
Sorensen, E. F.	" " " " " "

EUROPEAN ECONOMIC COMMUNITY (EEC)

Noe, R.	Commission of European Communities, 200 rue de la Loi, 1049 Brussels, Belgium
Poulard, J. C.	IFREMER, B. P. 4240, 97500 Saint Pierre et Miquelon, France
Maucorps, A. M.	IFREMER, B. P. 1049, F-44037 Nantes-Cedex, France
Messtorff, J.	Sea Fisheries Institute, Bremerhaven, Federal Republic of Germany
Schumacher, A.	Sea Fisheries Institute, Hamburg, Federal Republic of Germany
Stein, M.	" " " " " "
Borges, M. D.-F.	Instituto Nacional de Investigacao das Pescas, Av. Brasilia 1400, Lisboa, Portugal
Coelho, M. L.	" " " " " " "
Vazquez, A.	Instituto de Investigaciones Pesqueras, Muelle de Bouzas, Vigo, Spain
Cross, D.	EUROSTAT, B. P. 1907, Batiment J. Monnet, Luxembourg (Grand Duchy)

GERMAN DEMOCRATIC REPUBLIC

Vaske, B.	Institut fur Hochseefischerei und Fischverarbeitung, 251 Rostock-Marienehe, (Haus 2)

JAPAN

Kawahara, S.	Far Seas Fisheries Research Laboratory, 5-7-1 Orido, Shimzu 424

UNION OF SOVIET SOCIALIST REPUBLICS (USSR)

Kovalev, S.	PINRO, 6 Knipovich Street, Murmansk 183763
Rikhter, V. A.	AtlantNIRO, 5 Dmitry Donskoy Street, Kaliningrad 236000
Riazantsev, Y.	VNIRO, 17 V. Krasnoselskaya, Moscow B-140, 107140

OBSERVERS

Grosslein, M. D.	National Marine Fisheries Service, Woods Hole, Massachusetts, USA
Palmer, J.	" " " " " " "

PLEASE REPORT ANY ERRORS OR OMISSIONS TO THE SECRETARIAT

APPENDIX VI. LISTS OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS (SCR)

A. January 1986

86/1	N1099	I. HALLIGRIMSSON, and U. SKULADOTTIR. The Icelandic shrimp (Pandalus borealis) fishery in Denmark Strait in 1985.
86/2	N1100	I. SKULADOTTIR, and I. HALLIGRIMSSON. Sustainable yield of shrimp (Pandalus borealis) in the Denmark Strait area, 1978 to 1984.
86/3	N1101	PER. KANNEWORFF. Biomass of shrimp (Pandalus borealis) in Subarea 1 in 1981-85 estimated by means of bottom photography.
86/4	N1102	D. G. PARSONS, and P. J. VEITCH. The northern shrimp (Pandalus borealis) fishery in Division 0A, 1985.
86/5	N1103	D. M. CARLSSON. Data on the shrimp fishery at East Greenland in 1985 compared to earlier years.
86/6	N1104	J. C. POULARD, B. FONTAINE, A. BATTAGLIA, and P. DERIBLE. Catch, effort and biological data of shrimp (Pandalus borealis) in the French fishery off East Greenland in 1985.
86/7	N1105	J. C. POULARD. Data on French shrimp fishery off West Greenland in 1985.
86/8	N1106	O. M. SMEDSTAD. Preliminary report of a cruise with M/T "MASI" to East Greenland waters in September 1985.
86/9	N1107	O. M. SMEDSTAD, and S. TORHEIM. Investigations of shrimp (Pandalus borealis) in the Norwegian fishery off East Greenland in 1985.
86/10	N1108	D. M. CARLSSON. Data on the shrimp fishery in NAFO Subarea 1 in 1984 and 1985.

B. June 1986

86/11	N1113	A. YU. BULATOVA, and D. I. SAVVATIMSKY. Distribution of cod on the Labrador-Newfoundland shelf in the fishery zone of Canada and outside it.
86/12	N1120	D. W. KULKA. Estimtes of discarding by the Newfoundland offshore fleet in 1984 with reference to rends over the past four years.
86/13	N1122	V. S. BAKANEV, and V. S. MAMYLOV. Acoustic estimation of capelin abundance and biomass in NAFO Div. 2J+3K in 1985.
86/14	N1126	B. S. NAKASHIMA. School surface area of capelin schools from aerial photographs as an index of relative abundance.
86/15	N1127	B. S. NAKASHIMA, and R. W. HARNUM. The 1985 inshore capelin fishery in Div. 3L.
86/16	N1128	R. G. HALLIDAY, and A. F. SINCLAIR. Fishing grounds of groundfish longliners from Cape Sable Island area (southwestern Nova Scotia) in 1982-84.
86/17	N1129	P. C. BECK, E. G. DAWE, and J. DREW. The 1985 fishery for squid (Illex illecebrosus) in the Newfoundland area, with length, sex and maturity composition from inshore commercial samples.
86/18	N1131	J. J. HUNT. Results of Canada-USSR silver hake otolith exchange.
86/19	N1132	M. STEIN, and J. MESSTORFF. An attempt to estimate environmental infleunces on the distribution of cod (Div. 2J).
86/20	N1133	M. STEIN. Again warm water off West Greenland.
86/21	N1134	W. R. BOWERING, and W. B. BRODIE. An evaluation of the status of Greenland halibut (Reinhardtius hippoglossoides) in NAFO Subarea 2 and Divisions 3KL.
86/22	N1135	W. R. BOWERING. An evaluation of the witch flounder resource in NAFO Div. 3NØ.
86/23	N1137	A. T. PINHORN. Relationship between inshore cod catch and abundance in the 2J3KL cod stock.

86/24 N1138 A. T. PINHORN. The use of fishing effort as a basis for estimating fishing mortality in 2J3KL cod.

86/25 N1139 S. A. AKENHEAD. The decline of summer subsurface temperatures on the Grand Bank, at 47°N, 1978-1985.

86/26 N1140 T. W. ROWELL, and F. G. SCATTOLON. The 1985 fishery and biological characteristics of Illex illecebrosus in Subarea 4.

86/27 N1141 D. POWER and D. B. ATKINSON. An estimate of redfish year-class strength from surveys to the Flemish Cap.

86/28 N1142 D. POWER and D. B. ATKINSON. An update of the status of redfish in NAFO Div. 3M.

86/29 N1143 D. B. ATKINSON, and D. POWER. An update of the status of roundnose grenadier in SA 0+1 and 2+3.

86/30 N1144 J. RICE, and G. EVANS. Re-examining target spawning biomass for the cod stock in NAFO divisions 2J+3KL.

86/31 N1145 W. B. BRODIE, and J. W. BAIRD. An annotated bibliography of environmental factors affecting assessment of some fish stocks in the Newfoundland area during 1972- 85.

86/32 N1146 W. H. LEAR. The stock complex of Atlantic cod (Gadus morhua) in NAFO Divisions 2J, 3K, and 3L.

86/33 N1147 W. H. LEAR, and D. E. STANSBURY. Estimates of mortality from cod tagged in NAFO divisions 2J+3KL during the winter-spring of 1978-82.

86/34 N1154 J. C. POULARD. Contribution to the assessment of the cod stock in Subdivision 3Ps.

86/35 N1149 C. A. BISHOP, and J. W. BAIRD. An assessment of the cod stock in NAFO subdivisions 3NO.

86/36 N1150 C. A. BISHOP, and J. W. BAIRD. An assessment of the cod stock in NAFO subdivisions 3Ps.

86/37 N1151 D. B. ATKINSON, and D. POWER. The status of redfish in NAFO division 3LN.

86/38 N1152 D. B. ATKINSON, and D. POWER. The stock complex of redfish in NAFO divisions 3KLNOPs.

86/39 N1153 S. J. WALSH. Juvenile yellowtail surveys on the Grand Bank (NAFO Divisions 3LNO).

86/40 N1156 W. B. BRODIE. An assessment of yellowtail flounder in NAFO Div. 3LNO.

86/41 N1157 W. B. BRODIE. An assessment of the American plaice stock on the Grand Bank (NAFO Divisions 3LNO).

86/42 N1158 H. H. HANSEN, and K. M. LEHMANN. Distribution of young cod in coastal regions of West Greenland, 1985.

86/43 N1159 H. H. HANSEN. Changes in size at age of cod off West Greenland, 1979-84.

86/44 N1160 F. RIGET. Distribution pattern of Atlantic wolffish (Anarhichas lupus L) and spotted wolffish (A. minor Olafsen) in offshore waters of southwest Greenland.

86/45 N1161 F. RIGET. Migrations of spotted wolffish (Anarhichas minor Olafsen) in West Greenland.

86/46 N1162 E. BUCH. Fluctuations in Climate over Greenland and their influence on the marine environment and the cod stock.

86/47 N1163 J. W. BAIRD, and C. A. BISHOP. Assessment of the cod stock in NAFO Divisions 2J+3KL.

86/48 N1164 E. BUCH. A review of the hydrographic conditions off West Greenland in 1980-85.

86/49 N1165 E. F. SØRENSEN. Horizontal distribution of capelin (Mallotus villosus) during the spawning season in inhsore areas off West Greenland.

86/50 N1167 J. W. BAIRD, and R. WELLS. An update on the status of the cod stock in division 3M.

86/51 N1168 J. W. BAIRD, and W. R. BOWERING. Biomass estimates for cod and Greenland halibut beyond the Canadian 200-mile economic zone in NAFO division 2J+3KL.

86/52	N1169	T. W. ROWELL, and J. H. YOUNG. Biological characteristics and biomass estiamtes of the squid (Illex illecebrosus) on the Scotian Shelf (Div. 4VWX) in 1985.
86/53	N1170	J. CARSCADDEN. The Southeast Shoal (Div. 3NO) capelin stock.
86/54	N1171	P. A. KOELLER, P. PERLEY, and J. D. NEILSON. Canadian juvenile silver hake abundance estimates from joint Canada-USSR surveys on the Scotian Shelf.
86/55	N1172	SV. AA. HORSTED, F. F. RIGET, J. MESSTORFF, and A. SCHUMACHER. Status of Subarea 1 cod and the fisheries.
86/56	N1173	M. A. SHOWELL, and D. E. WALDRON. Investigations into the relationship between shelf bottom temperature and the silver hake catch rate on the Scotian Shelf.
86/57	N1174	V. A. RIKHTER, V. F. TUROK, and I. K. SIGAEV. Distribution of silver hake and other numerous fish species on the Scotian Shelf slopes in 1985 from the data of Soviet observers.
86/58	N1175	V. A. RIKHTER, and V. V. PETEROPSH. Estimating of total instantaneous mortality rate for fishes using the weighting procedure by an example of division 4VWX silver hake.
86/59	N1176	A. P. SENINA, and L. I. STULOVA. Comparison of the results of silver hake ageing from the USSR and Canada data.
86/60	N1177	A. S. NOSKOV. Assessment of the silver hake (Merluccius bilinearis) stocks and allowable catch on the Scotian Shelf (Div. 4VWX) in 1987.
86/61	N1178	A. P. BAJDALINOV, R. S. DOROSKIKH, and L. I. STULOVA. On the transition to a new system of measurement of the North Atlantic roundnose grenadier (Coryphaenoides rupestris) length.
86/62	N1187	D. E. WALDRON, and L. P. FANNING. Assessment of the Scotian Shelf silver hake population in 1985.
86/63	N1180	T. A. AKHTARINA, and S. V. CHECHENIN. Results of ichthyoplankton survey on the Flemish Cap Bank in May-June 1985.
86/64	N1181	N. I. EFIMOV, A. N. SAVATEEVA, and V. L. TRETYAK. On a feasible formal description of the natural mortality rate variation in relation to age of beaked redfish and capelin from the Northwest Atlantic.
86/65	N1182	V. S. BAKANEV, L. N. KOROL, and V. S. MAMYLOV. Size of the Newfoundland capelin stock according to the results of acoustic surveys in Divisions 3LNO in May-June 1985.
86/66	N1183	A. YU. BULATOVA, and A. D. CHUMAKOV. USSR trawl surveys in NAFO subareas 0, 2, 3.
86/67	N1184	P. I. SAVVATIMSKY. Changes in composition of the bottom fish catches at different depths along the continental slope in NAFO subareas 0, 2 and 3 in 1970-85.
86/68	N1185	L. K. ALBIKOVSKAYA, and G. B. RUDNEVA. Some aspects of reproduction, growth and distribution of Benthosema glaciale in the Grand Bank and Flemish Cap slope areas.
86/69	N1186	E. M. KAROSIOVA, and A. I. SHERSTYUKOV. Species compositions and abundance of ichthyoplankton in the area of the Atlantic Corner Seamounts.
86/70	N1188	R. DOMINGUEZ, and J. A. VAREA. Results of silver hake otolith exchange between Cuba, Canada and USSR.
86/71	N1190	K. F. DRINKWATER. Mean temperature and salinity conditions at the mouth of the Bay of Fundy 1951-1980.
86/72	N1191	K. F. DRINKWATER, and R. W. TRITES. Overview of environmental conditions in the Northwest Atlantic in 1985.
86/73	N1192	M. STEIN. Some comments on paper by E. Buch entitled "Review of the hydrographic conditions off West Greenland in 1980-85" (NAFO SCR Doc. 86/48)
86/74	N1194	R. S. ARMSTRONG. Variation in the shelf water front position in 1985 from Georges Bank to Cape Romain.
86/75	N1195	M. C. INGHAM. Sea surface temperatures in the Northwestern Atlantic in 1985.

86/76 N1196 R. L. BENWAY. Water column thermal structure across the shelf and slope Southeast to Sandy Hook, New Jersey in 1985.

86/77 N1197 C. A. PRICE, and K. W. BARTON. Anticyclonic warm core Gulf Stream rings off the Northeastern United States during 1985.

86/78 N1198 J. R. KEELEY. Marine Environmental Data Service report for 1985/86.

86/79 N1200 D. S. MILLER. Estimates of capelin (Mallotus villosus) biomass from hydroacoustic surveys in divisions 3LNO in 1985 and 1986.

86/80 N1201 G. R. LILLY. Variability in the quantity of capelin and other prey in stomachs of Atlantic cod off southern Labrador and northeastern Newfoundland (NAFO Division 2J+3K) during the autumns of 1978-85.

86/81 N1203 J. MESSTORFF. Biomass and abundance estimates for Atlantic wolffish (Anarhichas lupus L.) and Spotted wolffish (Anarhichas minor Olafson) in NAFO Subarea 1 from stratified-random bottom trawl survey results, 1982-1985.

86/82 N1204 D. E. WALDRON and J. PARNELL. Comparison of Division 4VWX silver hake catch rates from the Scotian Shelf small meshed fishery.

86/83 N1205 R. WELLS. Declines in the average length at age of cod in Divisions 2J and 3K during 1977-1985.

86/84 N1206 G. R. LILLY, and J. CARSCADDEN. Capelin in Division 3L and their occurrence in the NAFO regulatory area.

86/85 N1207 D. E. WALDRON, P. FANNING, and J. PARNELL. Standardization of 4VWX silver hake catch rates from the Scotian Shelf small meshed fishery.

86/86 N1208 Sv. Aa. HORSTED, and A. SCHUMACHER. Further analysis of Subarea 1 cod, 1985 and projections for subsequent years.

86/87 N1211 J. C. RICE. Report of the 1985 Meeting of Marine Environment and Ecosystems Subcommittee of CAFSAC.

86/88 N1213 D. E. WALDRON, and L. P. FANNING. Calibration of Division 4VWX silver hake VPA including calculations of yield per recruit.

86/89 N1214 P. FANNING. Correlations of silver hake abundance indices.

86/90 N1215 R. WELLS. On the validity of age determinations of cod form the Canadian research vessel cruises to the Flemish Cap, 1977-85.

SUMMARY DOCUMENTS (SCS)

86/1 N1109 NAFO. Provisional report of scientific council, January 1986 meeting.

86/2 N1112 NAFO SECRETARIAT. Historical catches of selected species by stock area and country for the period 1963-84.

86/3 N1114 NAFO SECRETARIAT. Tagging activities reported for the Northwest Atlantic in 1985.

86/4 N1115 CWP SECRETARY. Report of the ad hoc inter-agency consultation on Atlantic fishery statistics.

86/5 N1116 E. CALLAGHER. EEC request for scientific advice on management in 1987 of the cod stock in Subdivision 3Ps.

86/6 N1117 L. S. PARSONS. Canadian request for scientific advice on management in 1987 of certain stocks in Subareas 0 to 4.

86/7 N1118 NAFO SECRETARIAT. Provisional index and list of titles of research and summary documents for 1985.

86/8 N1121 L. W. COADY, J. S. SCOTT, J. S. LOCH, and L. CLEARY. Canadian research report, 1985. (Section I, II, III and IV).

86/9 N1123 R. O. MAURER, S. MURAWSKI, and F. M. SERCHUK. United States research report for 1985.

86/10 N1124 NAFO SECRETARIAT. ICES proposal for joint working group on harp and hooded seals.

86/11	N1125	NAFO SECRETARIAT. Solicited comments on proposal for second ageing workshop on shrimp.
86/12	N1130	E. LEMCHE. Denmark (Greenland) request for scientific advice on management of certain stocks in 1987.
86/13	N1136	A. VAZQUEZ. Spanish research report, 1985.
86/14	N1148	S. KAWAHARA. Japanese research report for 1985.
86/15	N1155	J.-C. POULARD. French research report for 1985.
86/16	N1166	K. LEHMANN. Denmark (Greenland) research report for 1985.
86/17	N1179	A. K. CHUMAKOV, and V. A. BOROVKOV. USSR fishery and investigations in NAFO Area in 1985.
86/18	N1189	R. DOMINQUEZ, and J. A. VAREA. Cuban research report for 1985.
86/19	N1193	M. L. GODINHO. Portuguese research report, 1985.
86/20	N1199	NAFO SECRETARIAT. Preliminary list of sampling data, 1985.
86/21	N1209	NAFO SECRETARIAT. Notes on statistical activities and publications since June 1985.
86/22	N1210	NAFO SECRETARIAT. Provisional nominal catches in the Northwest Atlantic, 1985.
86/23	N1212	NAFO SECRETARIAT. Notes on NAFO sampling program.
86/24	N1216	NAFO. Provisional Report of Scientific Council, June 1986 Meeting.