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SCIENTIFIC COUNCIL MEETING - JUNE 1987

Provisional Report of Scientific Council, June 1987 Meeting

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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

June 1987 Meeting

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

The Scientific Council, with its Standing Committees on Fishery Science (STACFIS), Research Coordination (STACREC) and Publications (STACPUB) met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 3-17 June 1987, to consider and report on various matters listed in its agenda (see Appendix IV). In addition to matters of general scientific interest, the Council considered the requirements of the Fisheries Commission and the requests of coastal Contracting Parties (Canada and Denmark on behalf of Greenland) for scientific advice on management in 1988 of certain fish and invertebrate stocks in Subareas 0 to 4. The Council noted the request of the Fisheries Commission (as recommended by its Working Group on Conversion Factors) for scientific evaluation of a Canadian study on conversion factors and referred the matter to STACREC for consideration. The Executive Committee met briefly prior to the opening session of the Council and recommended a plan of work which was adopted at the opening session.

Representatives attended the various sessions of the Council and its Committees, including the Environmental Subcommittee, from Canada, Cuba, Denmark (Greenland), European Economic Community (EEC), Japan, and Union of Soviet Socialist Republics (USSR), and observers were present from the United States of America (USA) (see Appendix V). The Executive Secretary informed the Council that he held proxy votes of abstention for five Contracting Parties (Bulgaria, Iceland, Norway, Poland and Romania) in case the need arose for a formal vote.

The reports of the Standing Committees, as adopted by the Council on 17 June 1987, are given in Appendix I (STACFIS), Appendix II (STACREC), and Appendix III (STACPUB). Lists of research (SCR) and summary (SCS) documents are given in Appendix VI. Brief summaries of the committee reports and other matters considered by the Council follow in Sections I to VIII.

I. FISHERY SCIENCE (APP. I)

1. General Fishery Trends

From provisional statistics for 1985 and 1986, the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) increased (6.7%) from 2.70 million (metric) tons in 1985 to 2.88 million tons in 1986. For the same years, the "groundfish" catch increased by 9% to 1.33 million tons, the "pelagic fish" catch decreased by 15% to 518,000 tons, the "other finfish" catch increased by 59% to 154,000 tons, and the "invertebrates" catch increased by 13% to 876,000 tons. With respect to the nominal catches by subarea, increases from 1985 to 1986 were recorded for Subarea 1 (82,000 to 89,000 tons), Subarea 2 (41,000 to 50,000 tons), Subarea 3 (608,000 to 764,000 tons), and Subarea 4 (766,000 to 781,000 tons), and there was little or no change in the catch from Subarea 0 (3,000 tons), Subarea 5 (399,000 to 397,000 tons) and Subarea 6 (803,000 to 800,000 tons).

2. Assessment of Finfish and Invertebrate Stocks

The Council noted that STACFIS has reviewed the status of certain stocks in Subareas 0 to 4, as requested by Canada, Denmark (Greenland) and the Fisheries Commission, and has advised on catch levels corresponding to reference levels of fishing mortality of $F_{0.1}$ or 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 several stocks due to insufficient data. For the capelin stocks, different management criteria were used which were consistent with those of recent years. No data were available to provide advice on the squid stock. 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 the Report of STACFIS

Table 1. Summary of recent catches (1981-86) and TACs (1981-87) for stocks reviewed at the June 1987 Meeting of STACFIS, with advised TACs for 1988.

Species	Stock area	Nominal catches (000 tons)						TACs (000 tons)							
		1981	1982	1983	1984	1985[1]	1986[1]	1981	1982	1983	1984	1985	1986	1987	1988
Cod	1	53	56	63	33	15	7	50	62	62	68	28.3	12.5	12.5	( )[2]
	3M	14	13	10	13	14	15	12.7	12.4	12.4	13	13	13	13	(0)[3]
	3NO	24	32	32	27	41	50	26	17	17	26	33	33	33	( )[2]
Redfish	1	6	8	8	6	2	5	...	...	...	...	...	...	...	(...)[4]
	3M	14	15	20	20	20	29	20	20	20	20	20	20	20	(20)
	3LN	24	22	20	15	21	42	25	25	25	25	25	25	25	(25)
Silver hake	4VWX	45	60	36	74	76	83	80	80	80	100	100	100	100	(167)
A. plaice	3M	1	1	2	1	2	4	2	2	2	2	2	2	2	(2)
	3LNO	50	50	38	38	51	56	55	55	55	55	49	55	48	( )[2]
Witch flo.	3NO	2	4	4	3	9	9	5	5	5	5	5	5	5	(5)
Yellowtail	3LNO	15	12	9	15	27	23	21	23	19	17	15	15	15	(15)
G. halibut	0+1	10	9	9	7	9	9	25	25	25	25	25	25	25	(25)
	2+3KL	31	26	28	25	17	15	55[5]	55[5]	55[5]	55[5]	75	100	100	(100)
R. grenadier	0+1	+	+	+	+	+	+	8	8	8	8	8	8	8	(8)
	2+3	7	4	4	4	5	7	27	27	11	11	11	11	11	(11)
Wolffishes	1	4	4	3	2	2	2	...	...	...	5-6	5-6	5-6	5-6	(5-6)
Capelin	3LNO	24	27	25	33	26	48	30[6]	30[6]	60[6]	38[6]	60[6]	130[6]	293[7]	(100)[7]
Squid-Illex	3+4	33	13	+	1	1	+	150	150	150	150	150	150	150	(150)
Shrimp	0+1	46	44	47	43	53	63	35	35	35	35	42	42	42	( )[8]

[1] Provisional statistics.
[2] See STACFIS report for options
[3] No directed fishery.
[4] No firm assessment of stock
[5] TACs pertain to Div. 2J+3KL.
[6] Advised TACs pertain to Div. 3L only.
[7] Advised TACs include 10,000 tons for Div. 3NO and remainder for Div. 3L.
[8] Deferred to September 1988 Meeting.

at Appendix I. Some general observations are as follows:

a) The cod stock in Subarea 1 has declined drastically in recent years, but there is evidence that the 1984 year-class is very strong and the 1985 year-class is the third highest since 1973, although considerably lower than those of 1973 and 1984. The 1986 year-class is believed to be poor. Management options at various levels of fishing mortality are presented as well as yield-per-recruit considerations (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 very low level (probably less than 30,000 tons) relative to the target biomass of 85,000 tons which was set by the Fisheries Commission. This target biomass is unlikely to be reached in the near future, because the year-classes of cod older than the 1980 year-class are at very low levels and the fishery exploits incoming year-classes at too early an age. To achieve the target level of biomass as quickly as possible, cessation of fishing is advised.

c) Analytical assessment of the cod stock in Div. 3NO indicated a catch of 40,000 tons at $F_{0.1}$ in 1988, if the catch in 1987 is equal to the TAC of 33,000 tons. If the catch in 1987 is 50,000 tons (as in 1986), the catch at $F_{0.1}$ in 1988 would be 37,000 tons. The Council noted that an updated yield-per-recruit analysis will be considered at the September 1987 Meeting prior to the meeting of the Fisheries Commission, and any changes in the predicted catches for 1988 will depend on the results of the updated analysis.

d) For American plaice in Div. 3LNO, the advised TAC at $F_{0.1}$ is 33,000 tons for 1988, compared to 48,000 tons in 1987. The projected 1988 TAC is the lowest that has been advised since the stock came under quota regulation. The Council was concerned about the magnitude of the decline in population size, as indicated by the present assessment. Since the decline may reflect changes in availability rather than abundance, other management options were provided for consideration.

e) For witch flounder in Div. 3NO, both the 1985 and 1986 catches were nearly twice the TAC of 5,000 tons, with most of the increase being taken in Div. 3N. However, the lack of data prevented STACFIS from assessing the status of the stock component in Div. 3N, and there was no basis for advising a change in the current TAC of 5,000 tons for Div. 3NO. The Council was concerned that the stock would unlikely sustain such high catch levels without declining in abundance.

f) For yellowtail flounder in Div. 3LNO, the catches in both 1985 and 1986 were about twice the TAC level of 15,000 tons. It is unlikely that the stock can sustain such high catches without declining in abundance, but it is believed that the stock could rebuild if the catch level returns to the present TAC of 15,000 tons.

g) For capelin in Div. 3L, the advised TAC for 1988 is 90,000 tons, which is about one-third of the TAC that was advised for 1987. This is largely the result of the passing through the fishery of the very strong 1983 year-class. The stock in Div. 3NO is considered to have recovered sufficiently to sustain a fishery which is similar to that advised for 1987. Therefore, a TAC of 10,000 tons is advised for 1988.

h) The first analytical assessment of the silver hake stock in Div. 4VWX for several years indicated that, if the 1987 TAC of 100,000 tons if fully utilized, the projected TAC at $F_{0.1}$ for 1988 is 148,000 tons. If the 1987 catch is similar to the 1986 catch of 83,000 tons, the projected TAC at $F_{0.1}$ would be 167,000 tons.

i) No change in TAC was advised for redfish in Div. 3M and 3LN, American plaice in Div. 3M, witch flounder in Div. 3NO, yellowtail flounder in Div. 3LNO, Greenland halibut in Subareas 0+1 and Div. 2GHJ+3KL, roundnose grenadier in Subareas 0+1 and 2+3, and short-finned squid in Subareas 3+4.

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

k) Advice for management in 1988 of the shrimp stocks in Subareas 0+1 and in Denmark Strait could not be provided at this meeting. It was agreed that the status of these stocks be considered at the September 1987 Meeting.

3. Response to Questions by the Fisheries Commission

The Council concurred with the information provided by STACFIS in response to specific questions regarding discrimination of the cod stock in Div. 2J+3KL and the proportion of biomass outside of the 200-mile fishery zone in Div. 3L of the Regulatory Area.

4. Environmental Research

The Council noted that the Environmental Subcommittee (M. Stein, Convener) had met on 9 June 1987 and had considered 16 research documents which dealt with a variety of environmental topics. The full report of the Subcommittee is Annex 1 to the Report of STACFIS (Appendix I).

5. Ageing Techniques

The Council noted the opinions of national experts that there has been insufficient progress to warrant a second workshop on the ageing of shrimp at this time. It was agreed, however, that a meeting of some experts to evaluate West Greenland shrimp samples would be profitable in advance of such a workshop. The Council was pleased that ageing studies were being carried out on Atlantic wolffish from West Greenland waters and encouraged the continuation of the work. It was further noted that age validation studies are continuing on silver hake.

6. Gear and Selectivity

The Council welcomed the initiative of STACFIS to have Dr. H. Bohl (Federal Republic of Germany) compile information on trawl escapement and selectivity problems relevant to the recent request of the Fisheries Commission.

7. Review of Scientific Papers

The Council noted that six research papers, which were not considered adequately during the stock assessments, were reviewed by STACFIS.

8. Other Matters

a) Special session in September 1987

The Council noted that about 28 papers were expected for the special session during 9-11 September 1987 on "Biology and Ecology of Demersal Resources of the North Atlantic Continental Slopes, with Emphasis on Greenland Halibut and Grenadiers", which will be convened by W.R. Bowering (Canada).

b) Special session in September 1988

The Council concurred with the nomination of J. C. Rice (Canada) as organizer and convener of the special session in September 1988 on "Impact of Changes in Environmental Conditions in the North Atlantic on the Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Regions in the Early 1980's".

c) Topics deferred for consideration in September 1987

i) Reanalysis of yield-per-recruit for cod in Div. 3NO.

ii) Necessity of a midterm meeting in early 1988 to assess the shrimp stocks in Davis Strait and Denmark Strait.

iii) Outline of topics for special session in September 1988 (to be provided by J. C. Rice).

iv) Proposed theme for special session in September 1989.

II. RESEARCH COORDINATION (APP. II)

1. Fishery Statistics

a) CWP activities relevant to NAFO

The Council noted that STACREC had reviewed the report of the 13th session of the CWP (Coordinating Working Party on Atlantic Fishery Statistics), which was held at FAO, Rome, Italy, during 11-18 February 1987. The report was presented by D. G. Cross (EUROSTAT) who is Deputy Secretary of the CWP. Among the recommendations was one which dealt with the problem of discrepancies between databases of the various international organizations and the ways to minimize the differences. NAFO was represented at the 13th session by J. C. E. Cardoso (Executive Secretary) and by D. B. Atkinson (Canada).

b) NAFO statistical considerations

The Council was pleased to note that there had been continued improvement by national statistical officers in the timely submission of STATLANT 21A reports, which enabled the Secretariat to prepare the provisional inventory of nominal catches (SCS Doc. 87/20) during the present meeting. However, similar improvement was not noted in the submission of the more detailed STATLANT 21B reports. The work of the Council and the timely publication of Statistical Bulletin continue to be adversely affected by the late and incomplete submission of these reports by some Contracting Parties. The Council endorsed the recommendation of STACREC *that the document on the Council's requirements for fishery statistics (SCS Doc. 87/19) be brought to the attention of all Contracting Parties.*

The Council also noted that its recommendation at the June 1986 Meeting had not resulted in improvement on the submission of data from non-member countries which fish in the Regulatory Area and endorsed the recommendation of STACREC *that the Fisheries Commission and General Council take note that fishing by non-member countries in the Regulatory Area has become a significant factor in the exploitation of the resources there but that statistics on many of*

these activities are not available to the Scientific Council. This has an adverse effect on the ability of the Scientific Council to provide advice, and the General Council and Fisheries Commission are requested to make further efforts to resolve this problem.

The Council noted that its earlier proposals on effort prorating and statistical boundary changes in the Gulf of Maine-Georges Bank region have been implemented. The Council was informed that the description of the western end of the boundary between Div. 4S and 4T in the Gulf of St. Lawrence was unsatisfactory, and endorsed the proposal of STACREC *that, if the General Council wishes to resolve the issue of the boundary between Div. 4S and 4T, the coordinates of Pte. des Monts should be established and the boundary should be allowed to "run in an easterly direction along a rhumb line to a point at 49°25'N, 64°40'W...".*

2. Biological Sampling

The Council endorsed the proposal of STACREC *that the Secretariat contact the scientists who are responsible for the submission of sampling data to insure that previous lists of 1979-84 are verified prior to their collation into a single volume for publication. Outstanding data for 1985 and 1986 should also be included in the request.*

3. Biological Surveys

a) Stratification schemes

The Council was informed that two new stratification schemes had been developed: one for Div. 2G and 2H, and the other for Subarea 0 and adjacent parts of Subarea 1. Since these schemes were designed with priority on surveying deepwater species, the Council agreed *that analyses should be undertaken to evaluate the schemes with regard to the distribution of all groundfish species in the region.*

b) Survey design procedures

The Council noted that the *ad hoc* Working Group had begun its work at this meeting with plans for analyses of the available data to be considered at meetings in September 1987 and June 1988.

4. Other Matters

a) List of fishing vessels

The Council noted that some Contracting Parties were remissive in updating their lists to the status of 1986 and asked the Secretariat to again attempt to obtain the outstanding data.

b) Conversion factors

The Council noted the request of the Fisheries Commission for comment on a paper which summarized a recent study on conversion factors for salted cod. Mr. R. Wells (Canada) agreed to make arrangements for presentation of the results of the study in September 1987.

The Council emphasized that, when the Fisheries Commission establishes working groups (such as the one on conversion factors) to study matters requiring scientific advice, benefit would

be gained by having a representative of the Scientific Council present at meetings of such a group. The Council agreed to bring this matter to the attention of the Fisheries Commission.

c) Scientific observer program

Details of the current scientific observer program were developed by the Scientific Council in 1980. The history of the program predates 1975, when ICNAF adopted a similar scheme, but it was not implemented for logistical reasons until NAFO agreed that the scheme should be implemented on a bilateral basis.

In 1980, the Council noted that the level of sampling on an aggregated basis appeared to exceed the minimum levels established in 1974, but, in fact, there were major discrepancies in many stock, vessel class, country, and quarter-of-year categories. It was considered that these deficiencies reflected, in many cases, the difficulties of assigning national observers to the fishing fleets on a year-long basis. In developing the observer program, the Council described the data to be collected, the general format of the data records, and the methods of data exchange, but the fisheries to be covered were not identified. The Council considered that this was a matter to be resolved in discussions between the bilateral parties to each agreement.

The Council was concerned about the decline in coverage during 1983-86 from 145 to 34 observer days and that reports were presented only by Canada. It was indicated that a much higher level of international support is required.

III. PUBLICATIONS (APP. III)

1. Review of Scientific Publications

The Council noted that only one issue of the Journal (Vol. 7, No. 1) was possible in 1986, due to the low level of manuscript submissions, and that the second part of the volume would be published in 1987. The Council's Studies (No. 10 and 11) and Reports (for 1986) were published as planned, but the Statistical Bulletin (Vol. 34) was not available until December 1986 due to delays in the acquisition of some national statistics for 1984.

2. Editorial Matters Concerning Publications

The Council was pleased to learn that Dr. J. M. Colebrook was appointed Associate Editor for Biological Oceanography earlier in the year, but was saddened that this was necessary because of the untimely death of Dr. G. A. Robinson. The Council accepted STACPUB's proposal to continue the present situation of not having a senior editor but to rely on Associate Editors for full scientific editing of Journal papers.

In view of the impending retirement of the Assistant Executive Secretary, the Executive Secretary is requested to take into account the Council's wishes that the replacement should be qualified to assume the editorial responsibilities for the Studies and Journal publication series, currently being discharged by Mr. Hodder, and that these duties be a part of the job responsibilities.

3. Promotion and Distribution of Publications

The Council encouraged STACPUB and the Secretariat to pursue further the initiatives that are associated with invitational papers, clarification of editorial policy regarding review papers, and advertizing of the Journal.

4. Papers for Possible Publication

The Council noted that positive response from authors, whose papers were nominated by STACPUB for possible publication, averaged 65% during 1980-84 but declined to 47% in 1985 and remained at that low level in 1986. Selection of papers from the 1987 SCR documents presented at the January and June 1987 Meetings resulted in 11 papers being identified by STACPUB as appropriate for the Journal or Studies.

5. Other Matters

a) The Council agreed that a proposal to microfiche the NAFO documents should be considered as soon as income from the sale of ICNAF microfiche approaches the production cost.

b) The Council noted STACPUB's appreciation to the Assistant Executive Secretary (V. M. Hodder) for his role in fostering the Journal and Studies.

IV. RULES OF PROCEDURE

1. Implementation of Amended Rules

The Council's Rules of Procedure were amended at the Annual Meeting in September 1986 to allow for the existence of a quorum whenever formal voting is necessary (SCS Doc. 86/28). Regarding implementation of amended Rules, the Executive Secretary reported that he had received five proxy votes of abstention (Bulgaria, Iceland, Norway, Poland and Romania), if the need should arise for a quorum and a formal vote at this meeting.

2. Formulation of Rules Common to the Three Main Components of NAFO

The Executive Secretary noted that discussions were initiated by the General Council at the 1986 Annual Meeting (GC Doc. 86/4) but had not yet been finalized. If and when such common rules are developed and approved by the General Council, they would then be presented to the Scientific Council and the Fisheries Commission for consideration.

V. COLLABORATION WITH OTHER ORGANIZATIONS

1. Combined Assessment of Cod Stocks off West and East Greenland

The Council noted that the ICES Working Group on Cod off East Greenland met in early 1987 and undertook a combined assessment of the East and West Greenland cod stocks (without management advice for the West Greenland stock). Relevant sections of the report of the ICES Working Group were extracted (SCR Doc. 87/55) and used as the basis for developing management advice for Subarea 1 cod at this meeting. Because this procedure will be continued routinely in future years, its inclusion in future agenda was considered unnecessary.

2. Proposal for Joint ICES/NAFO Working Group on Seals

The Council reviewed the long-standing invitation from ICES that there be a joint ICES/NAFO working group on seals. It was noted that consideration of a number of possible topics concerning seals would involve information from both the NAFO and ICES areas and that a joint working group would be an appropriate forum for such consideration. The Council was, however, of the opinion that, before accepting the invitation of ICES, it would be desirable to explore the mechanism for referring topics to the working group, particularly questions that might relate predominantly to the NAFO Area and/or to areas of coastal state jurisdiction.

3. Thirteenth Session of the CWP, February 1987

The Council was informed that the CWP (Coordinating Working Party on Atlantic Fishery Statistics) met in February 1987 at FAO, Rome, Italy, and that the Executive Secretary (J. C. E. Cardoso) and the country representative (D. B. Atkinson, Canada) attended on behalf of NAFO. Matters of relevance to NAFO were dealt with by STACREC (see Appendix II).

VI. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting and Special Session in September 1987

The Scientific Council will meet in conjunction with the Annual Meeting of NAFO during 14-18 September 1987 at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada. That meeting will be preceded on 9-11 September 1987, also at the Lord Nelson Hotel, by the special session on "Biology and Ecology of Demersal Resources of the North Atlantic Continental Slopes, with Emphasis on Greenland Halibut and Grenadiers".

2. Scientific Council Meeting, June 1988

It was tentatively agreed that the Council and its Standing Committees, including the Environmental Subcommittee, will meet at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 1-16 June 1988.

3. Annual Meeting and Special Session in September 1988

The Scientific Council, considering that the Annual Meeting is scheduled for 6-10 September 1988, reaffirmed its earlier tentative decision that the special session be held on 12-14 September 1988. The theme for that session is "Impact of Changes in Environmental Conditions in the North Atlantic on Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Regions during the Early 1980's".

4. Scientific Council Meeting, June 1989

Considering the need for the Secretariat to arrange for meeting facilities at the Bedford Institute of Oceanography well in advance of scientific meetings, the Council tentatively agreed to meet during 7-21 June 1989.

VII. ELECTION OF OFFICERS

1. Officers for 1987-89

The Chairman appointed a small *ad hoc* nominating group (R. G. Halliday, V. A. Rikhter and A. Schumacher) to solicit the views of representatives of the Contracting Parties at this meeting regarding potential candidates for the offices open for election. The nominating group proposed that the following slate of candidates be put forward for election to the respective offices:

Chairman of Scientific Council	:	J. S. Beckett (Canada)
Vice-chairman of Scientific Council	:	Sv. Aa. Horsted (Denmark-Greenland)
Chairman of STACFIS	:	A. Maucorps (EEC)
Chairman of STACREC	:	A. Vazquez (EEC)
Chairman of STACPUB	:	The Vice-chairman of the Scientific Council becomes ex officio Chairman of this Committee)

There being no further nominations, the Chairman noted that the six Contracting Parties present (Canada, Cuba, Denmark-Greenland, EEC, Japan and USSR) and the five proxies held by the Executive Secretary (Bulgaria, Iceland, Norway, Poland and Romania) constituted a quorum in accordance with the Rules of Procedure. The Chairman proceeded with the roll-call, which resulted in the above slate of officers being elected unanimously to take office at the end of the Annual Meeting in September 1987.

VIII. OTHER MATTERS

1. STACPUB Membership

The Council, noting the resignation of A. T. Pinhorn (Canada) from STACPUB, expressed its appreciation to him for serving the Committee continuously since June 1979. It was unanimously agreed that V. A. Rikhter (USSR) be appointed as a replacement. Current membership is as follows: J. S. Beckett (Chairman), R. G. Halliday (Canada), Sv. Aa. Horsted (Greenland-Denmark), S. Kawahara (Japan), M. G. Larraneta (EEC) and V. A. Rikhter (USSR).

2. Question of Midterm Meetings for Shrimp

The Council expressed regret that progress in determining reliable abundance and recruitment estimates of shrimp was proving to be difficult, and that the previously-used indices (commercial catch rates and photographic survey results) were now regarded less useful. It has become increasingly clear that only general guidance on potential shrimp yields is possible at present. Under these circumstances, the special meetings of the Council in January do not seem to allow more precise advice to be provided than would be possible in the previous June. Discussion centered on whether advice for shrimp management in the coming year should, in future, be provided at the June meeting of STACFIS, as for other species, or at a special meeting. The Council's clients would no doubt be pleased to receive the more timely advice in June. Also, this would allow shrimp biologists more time to analyze the previous year's data before the meeting and provide for more interaction with other participants in the Council meetings. Expenses of the Secretariat would be reduced. However, there are two outstanding concerns: one is how best to

effect the transition to provision of advice in June, and the other is to ensure that the Scientific Council would respond in a timely fashion if there should be a sudden signfiicant downward trend in stock size and catch or an evident risk of that occurring.

With regard to the transition, advice could be provided at the September 1987 Meeting of the Council for the 1988 fishing season and at the June 1988 Meeting for the 1989 fishing season, and so on. Alternatively, one more special meeting could be held in January 1988 to provide advice for both 1988 and 1989, after which advice would be provided at June meetings. The Council prefers the first alternative, if it should prove to be practical, and therefore recommends *that national representatives of the Scientific Council ensure that all views, relevant to provision of management advice for shrimp in Subareas 0+1 and in Denmark Strait for 1988, are made available to the September 1987 Meeting.* The Council would prefer that the shrimp experts attend that meeting, but, in any case, the representative should come prepared to deal with this item. Only if agreement cannot be reached on advice for 1988 will the Council make provision for a special meeting on shrimp in January 1988.

The second concern about assessing the stocks in June is that events in the current fishing season cannot be adequately taken into account when formulating advice for the next season. Shrimp is a short-lived species, and the fisheries depend heavily on recruiting year-classes. Recruitment failure could result in rapid decline in stock abundance. A rapid curtailment of the fishery may be the necessary response to such an event if future resource productivity is to be protected.

In actual fact, it is questionable how quickly biologists can detect a recruitment failure, when the limitations of present abundance indices are considered. However, the shrimp resources in the NAFO Area lie within coastal state jurisdiction, and these states have full authority to curtail fishing at any time. Such action need not be contingent upon advice from the Scientific Council. If the advice of the Council is required, however, the Chairman has the authority to convene a special meeting at any time upon the request of the coastal state (Article IX(3) of the NAFO Convention). It does not appear, therefore, that this concern in itself provides sufficient justification for continuing the January special meetings.

The Council may reconsider the situation, if there is sufficient improvement in methods and data to allow more precise advice to be given before the start of the fishing period, for which the TAC is set (calendar year at present). The Council will, therefore, discuss the likelihood of such improvement of data at its meeting in September 1987. It would also be relevant to know whether advice in June for the coming year could be managed by provisional TACs and quotas which could be adjusted, if the information during the year points to a need for such an adjustment.

3. Position of Assistant Executive Secretary

The Council discussed briefly the impending retirement of the Assistant Executive Secretary. The Chairman and Vice-chairman were requested to meet with the Executive Secretary to offer the

services of the Scientific Council in developing an updated job description for the position and in preselection procedures. It was noted that the General Council and Fisheries Commission should also be involved.

4. Agenda for September 1987 Meeting

The Council discussed and tentatively agreed on the provisional agenda for its meeting in September 1987.

IX. 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 convener of the Working Group on Survey Design Procedures (W. B. Brodie), the rapporteurs and 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 Chairman, on behalf of all members of the Council, especially addressed the Assistant Executive Secretary (V. M. Hodder) who will be retiring later in 1987 after serving ICNAF and NAFO for 16 years. He expressed sincere thanks to Mr. Hodder for the inestimable and eminent contribution that he has made to the Council's work since its institution in 1979, noting also his contribution to the Council's predecessor (ICNAF's Standing Committee on Research and Statistics) from 1971 to 1979, and wished Mr. Hodder a long and happy retirement.

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 3-16 June 1987 to consider and report on various matters that were referred to it by the Scientific Council, particularly with regard to the provision of scientific advice on the management of certain finfish and invertebrate stocks in Subareas 0 to 4 (see Agenda at Appendix IV). Representatives attended from Canada, Cuba, Denmark (Greenland), EEC, Japan and USSR, and observers were present from USA.

Discussions on all matters except environmental research took place within the Committee as a whole during the present meeting, and various scientists, designated by the Chairman of STACFIS, assisted in the initial preparation of draft reports on the various topics that were considered by the Committee. The report of the Subcommittee on Environmental Research (Chairman: M. Stein) is introduced in Section IV below and given in detail in Annex 1.

I. FISHERY TRENDS

1. Introduction

For the second year in succession, sufficient STATLANT 21A reports were available for the Secretariat to compile provisional nominal catches for the preceding year. The 1986 data are tabulated in SCS Doc. 87/20. The available data from France were not compatible with the STATLANT requirements and, therefore, could not be included in the computer-generated tabulations of the summary document. However, for the subarea tabulations in Table 1, French data for Div. 2J+3KL and Div. 3Pn+4RS were included under Subareas 3 and 4 respectively. Much of the 1985 data in Table 1 are based on final STATLANT 21B statistics, but the 1986 data are from provisional STATLANT 21A reports to the Secretariat since 15 April 1987.

Table 1. Provisional nominal catches (000 tons) by subarea for 1985 and 1986. (+ indicates less then 500 tons.)

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986
Atlantic cod	-	-	15	7	12	25	344	373	219	210	49	36	+	+	639	652
Haddock	-	-	-	-	-	-	12	13	27	33	11	9	+	-	50	54
Atlantic redfishes	+	-	4	5	1	4	78	112	41	47	4	3	-	-	128	171
Silver hake	-	-	-	-	-	-	+	1	75	83	14	14	8	4	97	102
Red hake	-	-	-	-	-	-	+	+	+	+	1	2	+	+	2	2
Pollock	-	-	-	-	-	-	2	7	42	43	21	27	+	+	66	77
American plaice	-	-	-	+	+	+	49	72	16	13	7	5	+	+	72	90
Witch flounder	-	-	-	-	+	+	9	15	4	5	6	5	+	+	19	24
Yellowtail flounder	-	-	-	-	-	-	17	23	1	1	6	8	1	+	26	32
Greenland halibut	1	+	9	9	9	8	10	7	2	7	-	-	-	-	30	31
Other flounders	-	-	+	+	+	+	2	3	7	10	18	15	8	8	36	37
Roundnose grenadier	+	+	+	+	+	+	5	7	-	+	-	-	-	-	5	7
White hake	-	-	-	-	-	+	5	6	12	12	7	6	+	+	24	24
Wolffishes	-	-	2	2	+	+	2	2	2	2	1	1	-	-	7	6
Other groundfish	-	-	+	4	+	+	+	1	3	5	13	10	5	5	21	25
Atlantic herring	-	-	-	+	+	+	3	5	186	173	26	32	+	+	215	210
Atlantic mackerel	-	-	-	-	-	+	16	12	15	14	3	7	37	28	70	61
Atlantic menhaden	-	-	-	-	-	-	-	-	-	-	20	17	291	215	312	232
Other pelagics	-	-	-	-	-	-	1	1	1	1	6	6	5	7	13	15
Capelin	-	-	-	1	17	10	32	69	3	4	-	-	-	-	52	84
Other finfish	+	-	1	1	+	1	11	24	12	13	10	9	11	22	45	70
Squids	-	-	-	-	-	-	+	+	+	+	6	9	17	14	23	24
Clams	-	-	-	+	-	-	-	-	5	6	59	51	338	335	402	391
Scallops	-	-	-	-	+	+	1	2	15	16	64	80	28	28	107	126
Other molluscs	-	-	-	-	-	+	-	+	2	3	20	19	29	81	51	103
Shrimp	2	3	51	60	2	2	+	-	9	10	4	5	+	1	68	79
Crabs	-	-	-	-	+	+	7	8	36	34	3	1	23	50	69	94
Lobsters	-	-	-	-	-	-	2	1	31	36	19	19	2	2	53	58
Other invertebrates	-	-	-	-	-	-	-	-	-	+	1	1	+	+	1	1
Total	3	3	82	89	41	50	608	764	766	781	399	397	803	800	2703	2882

2. General Trends for the Northwest Atlantic

The provisional overall catch (round fresh weight) of all finfish and invertebrates was 2.88 million (metric) tons in 1986, a 6.7% increase over the 1985 catch of 2.70 million tons. The total "groundfish" catch, which represented 46% of the overall catch in 1986, was 9% greater than in 1985 (1.22 and 1.33 million tons in 1985 and 1986 respectively), with significant increases being noted for haddock (8%), redfish (34%), silver hake (5%), pollock (17%) and flounders (17%). The total "pelagic fish" catch, which represented 18% of the overall catch in 1986, decreased significantly (15%) from 610,000 tons in 1985 to 518,000 tons in 1986, due to decreased catches of mackerel (13%) and menhaden (26%). The total "other finfish" catch, which represented about 5% of the overall catch in 1986, increased by 59% from 97,000 tons in 1985 to 154,000 tons in 1986, due largely to an increase (61%) for capelin. The total catch of "invertebrates', which represented 30% of the overall catch in 1986, increased (13%) from 774,000 tons in 1985 to 876,000 tons in 1986, due mainly to increased catches of scallops (18%), other molluscs (102%), shrimp (16%) and crabs (36%).

3. Fishery Trends by Subarea

a) Subarea 0

The total nominal catches of all species in 1985 and 1986 were about 3,000 tons and consisted mainly of shrimp.

b) Subarea 1

The total catch of all species increased (9%) from 82,000 tons in 1985 to 89,000 tons in 1986, due mainly to an increase for shrimp (18%), which represented 67% of the overall catch in 1986. The cod catch continued its decline from 15,000 tons in 1985 to only 7,000 tons in 1986. Greenland halibut has moved into second place with a catch of 9,000 tons.

c) Subarea 2

The total nominal catch of all species increased (22%) from 41,000 tons in 1985 to 50,000 tons in 1986, due mainly to a doubling of the cod catch (12,000 to 25,000 tons) despite a 41% decrease in capelin from 17,000 to 10,000 tons. Greenland halibut occupied third place at 8,000 tons.

d) Subarea 3

The total nominal catch of all species increased (26%) from 608,000 tons in 1985 to 764,000 tons in 1986, continuing the rise from 533,000 tons in 1984. Increases were noted for cod (8%), redfish (44%), flounders (38%) and other finfish (including capelin) (116%). In 1986, cod represented 49% of the overall catch in this subarea followed by redfish (15%), American plaice (9%) and capelin (9%).

e) Subarea 4

The total nominal catch of all species increased slightly (2%) from 766,000 tons in 1985 to 781,000 tons in 1986. Increased catches were noted for haddock (22%), redfish (15%), silver hake (11%), flounder (20%) and lobster (16%), and small decreases were recorded for cod (4%) and herring (7%). Cod (27%) and herring (22%) were the most significant components of the overall catch in the subarea, followed by silver hake (11%), redfish (6%) and pollock (6%).

f) Subarea 5

The total nominal catch of all species changed very slightly from 399,000 tons in 1985 to 397,000 tons, following a decline from 427,000 tons in 1984. The most significant changes in catches from 1985 to 1986 were increases for pollock (29%), herring (23%), scallops (25%) being offset by decreases for cod (27%), haddock (19%) and flounders (11%). In 1986, "invertebrate" species made up about 47% of the total catch (44% in 1985), followed by "groundfish" at 36% (40% in 1985) and "pelagic fish" at 16% (14% in 1985).

g) Subarea 6

The total nominal catch of all species was essentially the same in 1986 (800,000 tons) as in 1985 (803,000 tons). Significant changes in catches from 1985 to 1986 were increases for "other molluscs" (179%) and crabs (117%) and decreases for mackerel (24%), menhaden (26%) and squids (18%). Invertebrate and pelagic species comprised 63% and 31% respectively of the overall catch in 1986 (1985 values were 54% and 41% respectively).

II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 87/28, 30, 31, 32, 55, 70; SCS Doc. 87/5, 14)

a) Introduction

The fishery for cod in Subarea 1 is partly an offshore fishery, undertaken mainly by the large trawlers with bottom otter trawls, and partly a coastal and fjord fishery in which the major part of the catch is usually taken by poundnets. Longlines, gillnets and handlines are operated both inshore and offshore.

Due to the special stock situation in 1986, not least the expectation of many small cod (1984 year-class) in catches by poundnet and to some degree also by trawl, special fishery regulations were made in 1986 by Greenland. Besides setting an overall TAC of 12,500 tons, a ban was introduced on direct trawl fishery as well as on the poundnet fishery with possibilities of exemptions for poundnets in cases where catches could be expected to consist mainly of large fish.

The composition of the 1986 catch according to gear used thereby changed dramatically as compared to previous years. However, only trawler landings are recorded by gear. Trawlers accounted for only 16% of the total Subarea 1 cod catch in 1986, and cod was a by-catch in the fishery for redfish. The proportion of poundnet-caught cod is not known precisely, but it is estimated to be less than that for trawlers. Catches by trawlers were taken in Div. 1E and 1F exclusively, whereas catches by other gears were more evenly distributed in Div. 1B to 1F although relatively low in Div. 1C. Catches and TACs in recent years are listed in Table 2.

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

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Trawlers	46	53	57	16	14	29	42	20	7[1]	1[1]	-
Other vessels	27	20	42	38	39	27	21	13	8[1]	6[1]	-
Total (000 tons)	73	73[2]	99[2]	54[2]	53	56	63	33	15[1]	7[1]	-
TAC (000 tons)	31[3]	-[4]	-[4]	20[3]	50	62	62	68	28.5	12.5	12.5
CPUE (tons/hr)	1.29	3.33	2.38	1.24	3.26	2.21	1.36	0.99	0.7		

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

Since a directed trawl fishery was not allowed in 1986, the catch-per-unit-effort series could not be extended to include 1986. During the 1955-68 period, catches fluctuated between 234,000 and 451,000 tons (1962). Catches declined gradually after 1968 to a low of 33,000 tons in 1976, after a number of years with recruitment failure. Recruitment of the very abundant 1973 year-class in 1976-77 resulted in increased catches up to 1979. During 1980-83, catches fluctuated between 53,000 and 63,000 tons but decreased thereafter by about 50% for each of 1984-86 to reach a level of only 6,600 tons in 1986, the lowest catch on record since ICNAF began compiling statistics.

b) Commercial Fishery Data

i) Age composition

The commercial Greenland catch was rather poorly sampled in 1986, especially in terms of spatial coverage, whereas samples covered catches taken by all gear types used. Nevertheless, since catch statistics are not reported by gears other than trawl, the figures for catch-in-numbers by age-groups are very rough estimates. However, there is no doubt that the 1979 year-class continued its role as the most important year-class in the landings. This year-class made up some 40% by number and about 50% by weight of the 1986 nominal catch.

ii) Weight-at-age data

In the 1979-85 period, mean weight-at-age decreased, but the 1986 samples seem to show that the mean weight-at-age figures were higher in 1986 than in 1985. With the continued role of the 1979 year-class as the dominating one, the overall mean fish

weight in the landings, therefore, also increased in 1986, being 2.34 kg. The restrictions on the trawl and the poundnet fishery have most likely also influenced the overall mean weight, because these gears, especially poundnets, tend to catch smaller fish than the other gears.

c) Research Survey Data

i) Stock size

Stratified-random bottom-trawl surveys off West Greenland have been conducted since 1982 in late autumn by research vessels from the Federal Republic of Germany. Cod biomass and abundance estimates for the total survey area off West Greenland (19,864 nm^2 in 1982 and 1983, and 20,133 nm^2 after inclusion of stratum 4 in 1984) are given in Table 3. The confidence intervals are given at the 95% level of significance.

Table 3. Cod in Subarea 1: estimates of biomass and abundance (with 95% confidence limits) and mean weights from autumn research vessel surveys off West Greenland, 1982-86.

Year	Number of valid sets	Biomass (tonnes)	Abundance ('000)	$\bar{w}$ (kg)
1982	98	179,934 ± 37.0%	109,039 ± 36.1%	1.65
1983	142	98,843 ± 28.5%	59,362 ± 26.5%	1.67
1984	158	24,945 ± 39.7%	16,104 ± 39.1%	1.55
1985	114	35,213 ± 68.7%	55,886 ± 34.7%	0.63
1986	142	76,220 ± 30.8%	134,716 ± 31.8%	0.57

The surveys in 1982, 1983 and 1985 were carried out in November-December and those in 1984 and 1986 were undertaken in October-November. The *R/V Walther Herwig*, was used for all surveys except in 1984 when, for technical reasons, it was replaced by the *R/V Anton Dohrn*. However, experience from a 13-year time series of bottom trawl surveys in Div. 2J (Labrador) has confirmed that the fishing power of both vessels does not differ significantly if equal standard survey gears as well as towing speeds are used. From 1982 to 1984, the survey results reveal a drastic decline in cod biomass and abundance for all divisions. Confirmation of the reduced stock size in 1983 and 1984 was also obtained from continuous echo-sounder recordings throughout the survey area and from the trends in commercial catch and effort (Fig. 1). The survey results obtained at the end of 1985 and 1986 indicate a stabilization of the biomass (age 4+) at about the low level of 1984. The total stock biomass has increased since 1984 by a factor of 3 because of the good 1984 year-class and, to a lesser extent, the 1985 year-class.

ii) Age composition

According to the 1986 trawl survey results, the year-classes which predominated among the harvestable age-groups (4 and older) were the 1981 year-class (59% by number) followed by the 1979 year-class (24%). However, with respect to the total age distribution in the survey catches, about 80% (by number) were small cod of the 1984 year-class. This year-class seems to be most abundant in Div. 1B and 1C. Also, 1-year-old cod were caught (8%), whereas, in contrast to the 2 previous years, no 0-group cod were recorded in the survey catches of 1986.

An inshore gillnet survey, carried out by Greenland scientists in July-August 1986 in Div. 1B, 1D and 1F, also shows the 1984 year-class as a widely distributed and abundant year-class. The highest abundance of this year-class was observed in Div. 1B. The 1985 year-class was also observed but showed its highest abundance in Div. 1F and was generally less abundant than the 1984 year-class (17%).

iii) Maturity-at-age

Data from the 1986 groundfish survey were used to calculate the maturity ogive, which is different from the one previously used and also confirmed by 1985 data. It shows an increase in the maturation rate for age groups 5-8. The observed increase in growth of the respective age groups is interpreted as supporting evidence for this development because maturation is more related to fish length than to age (see Table 6 for 1986 maturity rates).

iv) Environmental data

The winter of 1985-86 was relatively mild at West Greenland, and the surface layer of

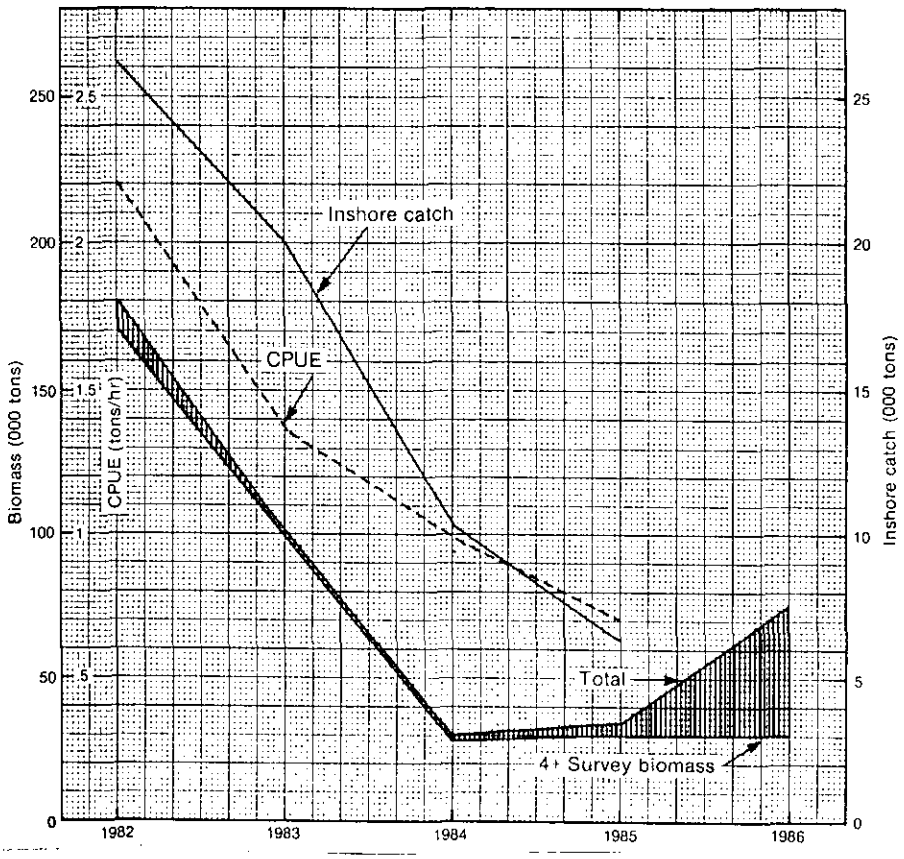

Fig. 1. Cod in Subarea 1: trends in total and age 4+ survey biomass, CPUE of Greenland trawlers, and inshore catches, 1982-86. (CPUE index not continued in 1986 due to restrictions on commercial fisheries.)

the West Greenland waters was, therefore, not cooled as much as normal. Surface temperatures were slightly above normal throughout the year. The mid-June temperature over the top of the Fylla Bank was 2.18°C.

The deeper layers (150-600 m) west of the fishing banks showed temperatures well above normal, indicating a strong influence of the Irminger Current component also in 1986.

d) Assessment Results (SCR Doc. 87/55, 70)

The results of the most recent stock assessment are presented in Table 4. The stock in numbers-at-age at the end of 1986 has been calculated from the abundance estimate of the October-November survey by applying 2/12 of the natural mortality and deducting the November-December catch in numbers-at-age. Total mortality (Z) was calculated from this estimate and the corresponding one from the 1985 survey for each age group. The total mortality estimates were apportioned to natural mortality (M = 0.2), fishing mortality (F) and the emigration coefficient (E).

The average fishing mortality in 1986 for age 6 and older was estimated to be 0.36, i.e. about 52% of that for the previous year (0.69). This reduction in F corresponds to the reduction in catch in 1986.

For the younger age groups (3-5), the emigration coefficients as well as the Z-values are negative. This can be interpreted as additional recruitment to the stock covered by the survey. The estimated emigration coefficients for ages 6-8 are higher than the value of 0.05 traditionally used in catch projections which were derived from earlier tagging experiments at a time when mature cod were more evenly distributed in all divisions of Subarea 1. In recent years, nearly the whole stock of mature cod has been found in the southernmost divisions. It has been shown from earlier tagging experiments that cod tagged in the southern area migrate out of the area to a much larger extent than cod in the northern part of the area. The combined estimate for age 6 and older cod in 1986 is 0.24, and this value was used to calculate the number of emigrants to East Greenland and Iceland in 1987 and 1988 in the projection.

Table 4. Cod in Subarea 1: assessment table for 1986 (Z = total mortality, F = fishing mortality, M = natural mortality, and E = emigration coefficient; coefficients in parentheses are unweighted means).

Age (yr)	Year-class	Survey stock	Nov-Dec catch	Stock (000) 1 Jan	Stock (000) 31 Dec	Catch 1986	Mortality coefficients Z	F	M	E	Losses due to M	Losses due to E
				(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
3	1983	3,667	4	1,001	3,543	11	-1.264	0.005	0.2	-1.469	402	-2,955
4	1982	574	16	618	539	112	0.137	0.194	0.2	-0.257	116	- 149
5	1981	7,621	107	7,137	7,266	701	-0.018	0.097	0.2	-0.315	1,440	-2,270
6	1980	920	57	2,360	834	317	1.040	0.216	0.2	0.624	293	916
7	1979	3,088	199	5,845	2,791	1,185	0.739	0.287	0.2	0.252	826	1,043
8	1978	104	2	281	99	12	1.043	0.069	0.2	0.774	35	135
9+	<1978	516	74	628	426	459	0.388	0.882	0.2	-0.694	104	- 361
Total 3+				17,870	15,498	2,797	(0.295)	(0.250)	0.2	(-0.155)	3,216	-3,641
Total 6+				9,114	4,150	1,973	(0.803)	(0.364)	0.2	(0.239)	1,258	1,733

Col. (B): Survey stock in October 1986 reduced by natural mortality and Nov-Dec catch.
Col. (D): $Z = ln\ [(A)/(B)]$.
Col. (G): E = Z - (F + M).
Col. (H): M loss = (A) x M/Z(1 - exp (-Z)).
Col. (I): E loss = (A) - (B) - (C) - (H).

The emigration coefficients referred to above are associated with about 1.7 million fish of age 6 and older emigrating in 1986. This order of magnitude is less than half the estimate from the assessment of the East Greenland stock which indicates that about 4.9 million cod immigrated to that stock from West Greenland. Part of the explanation for this difference is the variability in survey results, but the fact that the nearshore area where large cod are known to exist cannot be covered by the survey may also play a role.

Historically, there was a declining spawning stock biomass from the high level at the beginning of the 1960's to the very low level in the mid-1970's. This trend was reversed after 1976 when the very abundant 1973 year-class reached spawning size. However, the slight recovery of the spawning stock was terminated due to exploitation and emigration, particularly during 1983 and 1984. The results of the more recent assessments based on groundfish surveys are given in Table 5.

Table 5. Subarea 1 cod: trends in spawning stock biomass, fishing mortality, and catch, 1983-86.

Year	Jan 1 SSB (000 tons)	F (ages 6-9)	Catch (000 tons)
1983	110	0.46	58
1984	55	0.54	31
1985	15	0.69	15
1986	22	0.36	7
	26		

It was pointed out (SCR Doc. 87/30) that one source of error in using the Federal Republic of Germany offshore survey estimates is the fact that the survey does not include the area within the 3 nm coastal zone adjacent to the survey area. The proportion of the stock present in this zone is therefore not included in the estimates. The respective area is measured to be equivalent to about 40% of the offshore survey area. Longline surveys in four selected small nearshore areas demonstrated that small as well as large cod are present in the coastal zone. However, the CPUE estimates from these surveys cannot directly be compared with the results of the offshore trawl survey due to the different gears used.

Based on the assumption that cod density is the same in both the offshore and coastal areas, an additional assessment was carried out with the area extended by about 40%. Compared to the original assessment, the results show a slight decrease in total mortality and a decrease in fishing mortality by about 30%. The emigration rate increased by 37%. As a result of both the increased emigration rate and the higher initial stock size, the estimated number of emigrants of age 6 and older increased by about 77% to about 3 million cod. This approximates the corresponding estimate from the East Greenland assessment.

In evaluating the extended-area assessment, the basic assumption of equal density has to be remembered as well as the fact that the length distribution in the inshore survey and the offshore survey are fundamentally different. About 95% of the trawl catches are smaller than 35 cm, whereas 90% of the longline catches consist of fish above 55 cm. On these grounds, the original assessment was accepted as basis for management advice, keeping in mind that the results have to be considered as minimum estimates.

e) Recruitment prospects

Year-class of 1983. Although survey data indicate a higher abundance at age 3 for this year-class than that observed for the 1981 year-class, the 1983 year-class is still considered to be small.

Year-class of 1984. The 1986 survey results confirmed the 1984 year-class as being the strongest since the 1973 year-class. Survey abundance estimates increased from 37 million fish in 1985 to 108 million fish in 1986. The year-class was also observed to be highly abundant in inshore areas during 1985 and 1986. This year-class was not fully recruited to the survey gear and, therefore, the abundance estimate from the survey cannot be used directly for the projection. On these grounds, the conventional estimate for a good year-class of 200 million cod at age 3, which was derived from historical data, has been used.

Year-class of 1985. The observed abundance index of 0-group cod off East Greenland from the Icelandic 0-group survey in August 1985 was the third highest since 1973 but considerably lower than values for 1973 and 1984. The catches of 0-group cod in the bottom-trawl survey off West Greenland in November-December 1985 were four times higher than in 1984. The survey abundance estimate at age 1 in 1986 was, however, only one-third of the age 1 abundance estimate of the 1984 year-class. From inshore young cod surveys, the size of the 1985 year-class was estimated to be approximately 17% of the 1984 year-class. On that basis, the 1985 year-class was estimated to be 50 million cod at age 3 in 1988.

Year-class of 1986. The abundance index from the Icelandic 0-group survey off East Greenland in August 1986 was extremely low. No 0-group cod were observed in the bottom-trawl survey catches off East and West Greenland in the autumn of 1986.

f) Projections of catch and stock size for 1987-90

The parameters which were used to project catch and biomass of the cod stock (age 3+), as well as the spawning stock biomass (SSB), are given in Table 6. The numbers-by-age group at the beginning of 1987 were derived from results of the 1986 groundfish trawl survey. The relative fishing mortalities at ages 3 and 4 were estimated from a catch-curve analysis of the 1973 year-class, which simulates a situation similar to the present one when a strong year-class recruits to a depleted stock.

Table 6. Cod in Subarea 1: stock size at beginning of 1987 and other parameters used in projections of stock size and catch.

Age (yr)	Stock size 1 Jan 1987 (000)	Relative M[1]	Relative F[2]	Mean weight (kg)	Percent mature
3	200,000	1.0	0.216	0.65	-
4	3,543	1.0	0.721	1.04	3
5	539	1.0	1.0	1.86	27
6	7,266	2.2	1.0	2.09	81
7	834	2.2	1.0	2.71	98
8	2,791	2.2	1.0	3.16	100
9	99	2.2	1.0	4.59	100
10+	426	2.2	1.0	4.71	100

[1] Mean emigration coefficient for ages 6+ (0.24) is incorporated in the relative M values.
[2] Estimates of discards at age 3 (2/3) and age 4 (1/10) are incorporated in the relative F values.

Projections were carried out for three different catch levels in 1987: (i) 12,500 tons corresponding to the TAC set by Greenland; (ii) 6,250 tons corresponding to half the TAC and close to the 1986 catch; and (iii) 18,750 tons (i.e. 50% higher than the TAC) to illustrate the consequences of a higher catch.

Management options were selected to cover the range from $F = 0.2$ to $F_{max} = 0.62$. Fig. 2 illustrates the projected spawning stock biomass at the beginning of 1989 implied by catches in 1988 corresponding to fishing mortalities between 0 and 0.8 and assuming a catch of 12,500 tons in 1987. The results of the projections are given in Table 7. They show that with continued fishing at the $F_{0.1}$ level (0.34) in 1988 and 1989, spawning stock biomass would increase at the beginning of 1990 to levels between 100,000 tons and 120,000 tons depending on the exploitation of the stock in 1987.

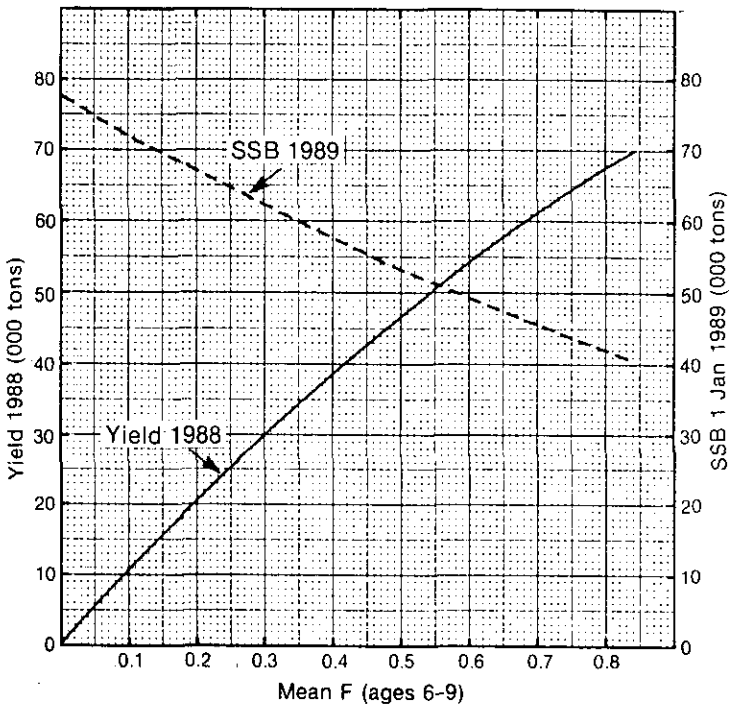

Fig. 2. Cod in Subarea 1: calculated yield in 1988 and spawning stock biomass (SSB) at beginning of 1989 for various levels of fishing mortality in 1988.

Table 7. Cod in Subarea 1: projections of age 3+ biomass and spawning stock biomass (SSB) at beginning of year and catch during the year for different management strategies (biomass and catch are in thousands of tons).

		1987 catch = 6,250 tons				1987 catch = 12,500 tons				1987 catch = 18,750 tons			
Year	Parameter	F=0.20 ($\approx F_{87}$)	F=0.34 ($F_{0.1}$)*	F=0.40	F=0.62 (F_{max})	F=0.20	F=0.34 ($F_{0.1}$)*	F=0.42 ($\approx F_{87}$)	F=0.62 (F_{max})	F=0.20	F=0.34 ($F_{0.1}$)*	F=0.40	F-0.62 (F_{max})
1987	B(3+)	163	163	163	163	163	163	163	163	163	163	163	163
	SSB	26	26	26	26	26	26	26	26	26	26	26	26
	F(6-9)	0.192	0.192	0.192	0.192	0.415	0.415	0.415	0.415	0.675	0.675	0.675	0.675
	Catch	6.25	6.25	6.25	6.25	12.5	12.5	12.5	12.5	18.75	18.75	18.75	18.75
1988	B(3+)	221	221	221	221	209	209	209	209	196	196	196	196
	SSB	27	27	27	27	22	22	22	22	18	18	18	18
	F(6-9)	0.20	0.34	0.40	0.62	0.20	0.34	0.415	0.62	0.20	0.34	0.40	0.62
	Catch	22	36	41	59	21	33	40	55	19	31	35	51
1989	B(3+)	276	253	244	213	264	242	231	204	250	230	222	195
	SSB	72	65	62	52	66	60	56	48	61	55	52	44
	F(6-9)	0.20	0.34	0.40	0.62	0.20	0.34	0.415	0.62	0.20	0.34	0.40	0.62
	Catch	41	60	66	80	39	57	64	76	37	54	59	72
1990	SSB	151	120	108	76	143	114	100	72	135	107	97	68

* $F_{86} = F_{0.1}$

Yield-per-recruit curves (Fig. 3) illustrate the effects of increasing the age at which exploitation starts from age 3 to ages 4 and 5. It can be seen that considerable gains in yield from the 1984 year-class can be achieved by not exploiting this year-class heavily in 1987. Depending on the level of fishing mortality, the gains in yield-per-recruit are of the order of 20% to 40% if exploitation is delayed by one year.

g) Expected distribution of the 1984 and 1985 year-classes in 1988 and 1989

In its request for advice last year, Denmark (on behalf of Greenland) requested that the expected spatial distribution of the 1984 and 1985 year-classes in 1987 and 1988 be described. STACFIS, in 1986, offered the following advice:

i) In the offshore area, the 1984 year-class could be expected to be abundant in all divisions from Div. 1B (southern part) to Div. 1F, probably gradually concentrating in

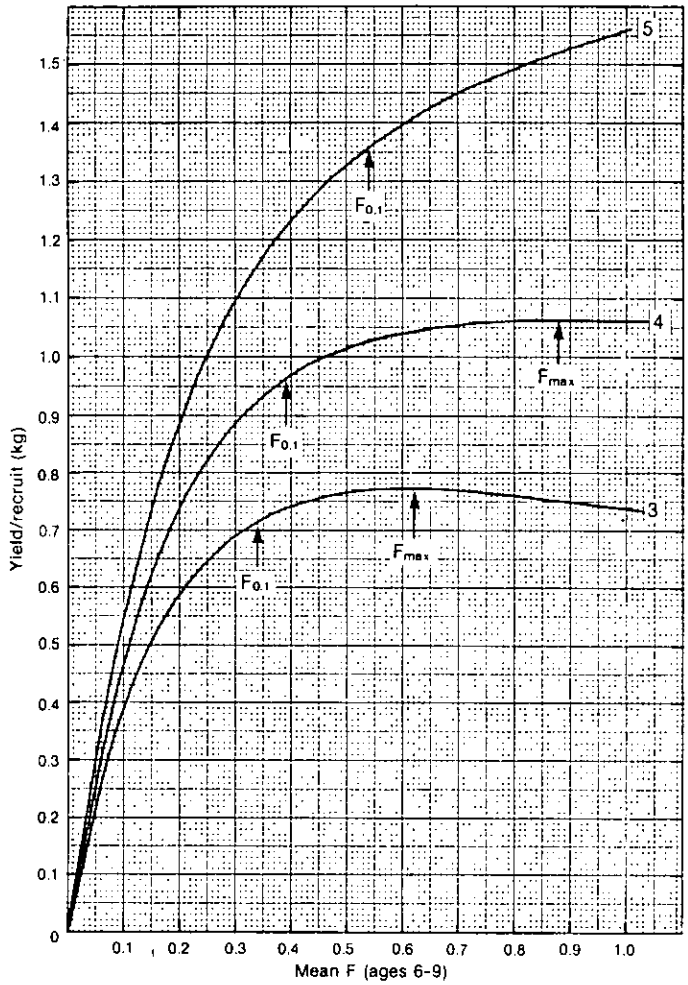

Fig. 3. Cod in Subarea 1: yield-per-recruit curves for first exploitation occurring at ages 3, 4 and 5.

Div. 1C and 1D in the first years of its exploitable phase (from 1988). The 1985 year-class was thought to have a more southerly distribution. The 1986 observations seem to point to the same advice.

ii) In the inshore area, the 1984 year-class was expected to be abundant in all divisions from Div. 1B to 1F. No advice was given on the expected inshore distribution of the 1985 year-class. The inshore gillnet survey seems to point to the year-class as becoming most important in the southern divisions (Div. 1F; Div. 1E was not covered by the survey).

h) Information on size composition of catches in 1987-88

In its request for advice last year, Denmark (on behalf of Greenland) also requested 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 at that time advised that for the offshore area more than half the cod of the 1984 year-class could be expected to be below 40 cm in 1987 and that a portion of the individuals would still be below that size in 1988. For the inshore area, STACFIS advised that even higher proportions would be expected to be small fish (below 40 cm) although big enough to be retained in poundnets. Also, in 1988 a considerable number of individuals of the 1984 year-class were not expected to have achieved a length of 40 cm.

Data collected in 1986 do not lead to a revision of that advice, although mean weight-at-age seems to be increasing recently (see Section 1.b.ii). In the assessment and for the projections, STACFIS has used partial recruitment values of 22% for 3-year-old cod and 72% for 4-year-old cod (the 1984 year-class in 1988).

i) Management considerations

It now seems evident that the 1984 year-class offers a chance to improve the stock situation for cod at West Greenland and also to improve the fishery. More good year-classes will have to follow rather soon if these improvements are to be maintained. In the present situation, management considerations have to concentrate on the use of the incoming recruits rather than on very imprecise catch projections. STACFIS advises that the potential benefits from the new recruits of the 1984 year-class will be improved both in terms of stock size and in terms of yield over the 1988-90 period as a whole if the exploitation of the 1984 year-class is kept at a minimum in 1987 and 1988.

Of the catches projected for 1987, the 1984 year-class accounts for about 80% in numbers (including expected discards). The corresponding figures for the 1984 and 1985 year-classes in 1988 are 85% and 9% respectively. The possible great amount of discards in 1987 and 1988, likely to occur especially in pound net catches, are not included in the yields projected and should also be part of the management considerations aiming at keeping discarding at a low level.

2. Cod in Division 3M (SCR Doc. 87/19; SCS Doc. 87/13, 15, 18)

a) Introduction

Nominal catches in the period 1963-1980 ranged from 20,000-58,000 tons with an average of 32,000 tons. Stock biomass at the end of this period had declined and the TAC for 1980 was reduced substantially in order to allow rebuilding. Recent catches and TAC's (000 tons) were as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	25	40	40	13	12.7	12.4[1]	12.4[1]	13	13	13	13
Catch	27	33	30	10	14	13	10	13	14[2]	15[2]	

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

b) Input Data

i) Commercial fishery data

Samples of age compositions from the commercial fishery in 1986, provided by Spain and Portugal, showed that cod of ages up to 6 years made up the bulk of the catches. The 1984 year-class (as 2-year-olds) accounted for 20-30% of the total in samples from Portuguese otter trawlers. Observations of gonads in June-August 1986 indicated that cod were maturing to spawn at smaller sizes than had been reported previously. Catch rates in 1986 in the Spanish pair-trawl fishery were at the 1983 level and somewhat below those of 1984 and 1985.

ii) Research survey data

Catches of cod in 1986 by USSR research otter trawl (codend with small-mesh liner) were composed mainly of age-groups 2-5 years. The 1984 year-class accounted for 47% of the total. Age 6 year and older cod made up about 2% of the total.

From the USSR ichthyoplankton survey in April-May 1986 over the standard grid of stations, cod eggs in 1986 (232 eggs) were much more numerous than in 1985 (37 eggs) but nevertheless at a low level of abundance. Largest concentrations were at the extreme western stations over depths greater than 1,000 m.

c) Estimation of Parameters

Cohort analysis was not attempted because of perceived inadequacies in the data base in the 1980's (NAFO Sci. Coun. Rep., 1986, page 51).

d) Assessment Results

From the following table, it is evident that biomass estimates from USSR surveys in 1983-86 were fairly stable but abundance estimates dropped sharply from 1984 to 1985:

	1983	1984	1985	1986
Abundance (millions)	65	61	37	37
Biomass (000 tons)	23	31	28	26

STACFIS noted that the average biomass (age 3+) was in the range of 30,000-35,000 tons in 1978-80 (NAFO Sci. Coun. Rep., 1984, page 41) in contrast with about 200,000 tons in the 1960-65 period. There is no evidence to indicate that the current average biomass has increased beyond the level of 30,000-35,000 tons.

e) Catch Projections

From the results of research vessel surveys and samples from the commercial fishery, the 1984 year-class may be stronger than average. In any case, this year-class will be predominant in the stock and the fishery in 1987 and 1988.

STACFIS has already expressed its concern about the early exploitation of 1980, 1981 and 1982 year-classes. The 1984 year-class has already been exploited in 1986 and will have been exploited for 2 years by the beginning of 1988. If fishing is continued at current fishing effort levels, the yield from this year-class will be considerably less than the potential yield. STACFIS notes that the management strategy of the Fisheries Commission is not to increase the TAC beyond 12,965 tons until a target biomass (age 3+) of 85,000 tons has been reached. An increase in biomass from the current level to 85,000 tons is unlikely to be reached in the near future, because the year classes of cod older than the 1980 year-class are now at a low level of abundance and the fishery exploits incoming year-classes at too early an age. To protect the remaining spawning stock biomass and to allow the present year-classes, particularly the 1984 year-class, to contribute towards rebuilding the target biomass, STACFIS advises that a cessation of fishing would be the most appropriate management action.

3. Cod in Divisions 3N and 3O (SCR Doc. 87/43, 53; SCS Doc. 87/13, 15, 18)

a) Introduction

Nominal catches declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Catches increased from 27,000 tons in 1984 to approximately 51,000 tons in 1986, the highest level since 1974, with approximately 85% of the 1986 catch being taken in Div. 3N. Canadian catches were similar in 1985 and 1986, while catches by Spain and Portugal increased substantially over the same period. Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	30	15	25	26	26	17[1]	17[1]	26	33	33	33
Catch	18	15	28	20	24	32	32	27	39[2]	51[2]	

[1] Excludes expected catch by Spain.
[2] Provisional data. Includes 4,700 tons estimated for non-members in 1985.

b) Input Data

i) Commercial fishery data

Catch and effort data were available from ICNAF and NAFO Statistical Bulletins for the 1959-84 period along with provisional data for 1985. Catch and effort data for the Canadian fishery in 1986 were provided by the Canadian Department of Fisheries and Oceans. Catch-rate indices for otter trawls and pair trawls were derived separately from a multiplicative model by using data for the 1977-86 and 1977-85 periods respectively. Pair-trawl catch-rates, derived from official Spanish statistics for the 1982-86 period, indicated the same trend for overlapping years as the pair-trawl index estimated from the multiplicative analysis. The 1986 index, reported by Spain, was adjusted by the ratio of catch rates in both series for these overlapping years and appended to the 1977-85 pair-trawl catch-rate series. Catch and effort data for years since 1977 were considered to be better estimated and more reliable than those for earlier years.

In the time period under consideration, the two fisheries (Canadian otter trawl and Spanish pair trawl) have generally occurred in separate areas. The Canadian otter-trawl fleet has fished mainly inside the Canadian 200-mile fishery zone while the Spanish

pair-trawl fleet has fished outside the zone. Catch-rate indices for the two gears were combined after weighting each to an estimate of the geographical area inside (80%) and outside (20%) the zone. The combined index showed a general increase in catch rates from 1977 to 1984 with declines in both 1985 and 1986.

ii) Research surveys

Stratified-random research surveys were conducted by Canada during 1971-87, with the exception of 1983. To account for incomplete coverage in certain years, estimates of abundance for non-sampled strata were obtained by using a multiplicative model. These estimates showed considerable variation over the survey period with no consistent trend up to 1983. Biomass and abundance for 1984 to 1986 were high relative to the earlier period, with preliminary estimates indicating a substantial biomass increase in 1987. The Canadian survey in 1986 indicated that the 1980-82 year-classes were most abundant and that the 1983 year-class was poorly represented. Surveys by the USSR have been conducted on a stratified-random basis since 1983. Abundance estimates in this period showed an increase from 1983 to 1985 with a decline to the 1984 level in 1986. Biomass estimates showed a similar pattern, but with the decline from 1985 to 1986 being less pronounced. The pattern of relative abundance of the 1980-83 year-classes in the USSR surveys was similar to that observed by the Canadian surveys.

Analysis of Canadian survey data over the 1971-86 period for biomass and abundance distribution relative to the Canadian 200-mile fishery zone indicated that cod were much more abundant inside the zone than outside in 1986 than had been observed previously. It was concluded that the possibility exists that increased commercial catches, particularly of the magnitude observed from 1985 to 1986, may have produced the changes in cod abundance, as measured by the surveys. Other factors such as migration and areal distribution of cod may also influence the survey results.

iii) Catch-at-age data

Biological sampling data from the Canadian otter-trawl and Spanish pair-trawl fisheries were used to estimate the age composition and mean weight-at-age of the commercial catch in 1986. Average weights-at-age for the pair-trawl catch were larger at all ages than those from Canadian otter-trawl sampling. A sum of products check, using the combined average weights-at-age, indicated that the calculated catch was 91% of the reported catch. The 1980-82 year-classes were most abundant in the total catch-at-age.

c) Estimation of Parameters

i) Partial recruitment

Partial recruitment in 1986 was estimated by iteration as an average over the 1981-84 period. The values are as follows:

Age (years)	3	4	5	6	7	8	9	10	11	12
Partial recruitment	0.06	0.24	0.54	0.76	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 1959-86 period were used in cohort analyses. Natural mortality was assumed to be 0.20, fishing mortality for the oldest age-group (12) was set at the level for fully-recruited ages (7-10), and input partial-recruitment vector was as shown above.

iii) Fishing mortality in 1986

Average exploitable biomass values from cohort analyses over a range of fully-recruited fishing mortalities in 1986 were compared with the combined otter-trawl and pair-trawl catch-rate index by using a least-squares regression relationship, but the relationship was not significant. It was considered that the catch-rate index did not adequately reflect stock biomass and that this deficiency might be related in part to the method of determining directed fishing effort for the Canadian fishery. STACFIS recommends *that alternate methods of determining Canadian directed fishing effort be investigated before the next assessment of this stock.*

The relationships between Canadian survey abundance at ages 6+ and cohort numbers at ages 6+ for the 1977-86 period over a range of fully-recruited F-values were significant, and calibration in terms of placing the intercept near the origin indicated

a fully-recruited F in 1986 of 0.20. Survey data for 1984 were not included in the relationship. Age 6+ abundance, estimated from this survey, was higher than the others in the series and was not reflected by a correspondingly high cohort abundance. The age structure from the survey was also not consistent with those from surveys in 1982 and 1985.

Data from the USSR surveys prior to 1983 were not available in a format comparable to data for the recent period. STACFIS agreed that inclusion of USSR survey data would be very useful, and recommends *that comparable survey indices covering as much of the time series as possible be provided.*

Nominal catches and total fishing mortality for ages 7-10 for the 1959-86 period are shown in Fig 4.

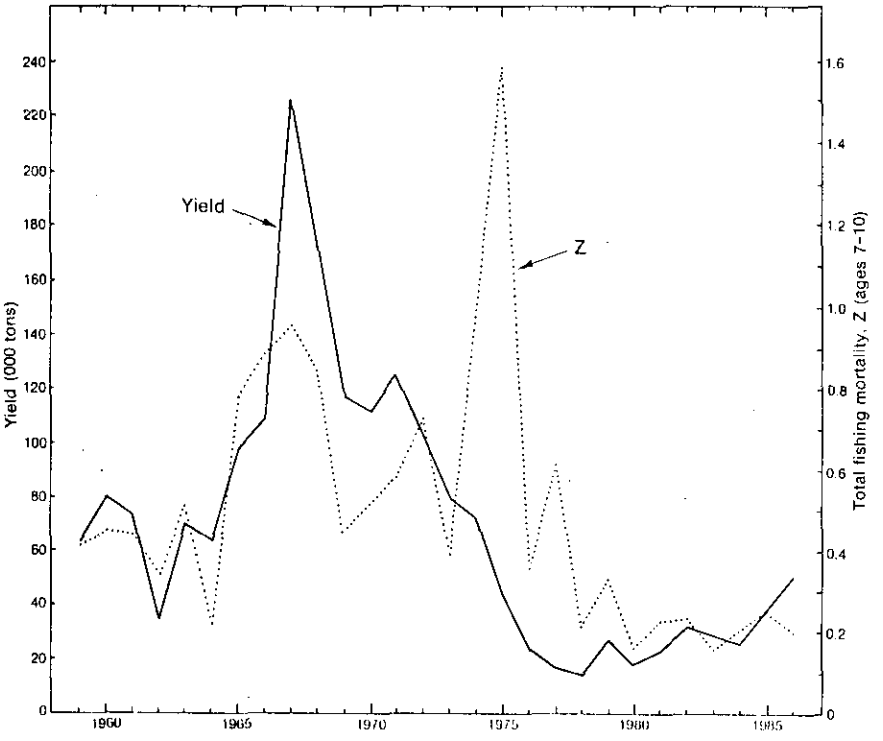

Fig. 4. Cod in Div. 3NO: trends in nominal catch and fishing mortality (ages 7-10), 1959-86.

iv) Recruitment

With an average partial-recruitment vector, cohort abundances of age 3 cod (F_{86} = 0.20) in 1984-86 (1981-83 year-classes) were estimated to be 106, 82 and 14 million respectively. From a significant relationship (r^2 = 0.84) between Canadian survey mean number-per-tow at age 3 and cohort abundance at age 3 (average over the year) for the 1977-82 period, cohort abundances at age 3 for these year-classes were predicted at 33, 29 and 20 million fish respectively. The partial-recruitment vector used for 1986 was adjusted to reconcile predicted year-class strengths. The best estimates for these year-classes were 62, 37 and 21 million respectively. The size of the 1981 year-class at 62 million, instead of 33 million from the recruitment relationship described above, is consistent with this year-class being fully exploited at age 5. A value lower than 62 million would have implied that the 1981 year-class was being exploited more intensively at age 5 in 1986 than the older and larger cod, given the terminal F estimated. Adjusted partial recruitment was used in the final cohort analysis as well as in the catch projections. Spawning stock biomass and age 3 recruits for the corresponding year-class abundance as estimated from cohort analysis are shown in Fig. 5.

v) Yield-per-recruit analysis

For previous assessments of this stock, the values of $F_{0.1}$ and F_{max} reference levels were estimated to be 0.18 and 0.22 respectively. Because the results of yield-per-recruit analysis depend to a large extent on mean weight-at-age data, and because

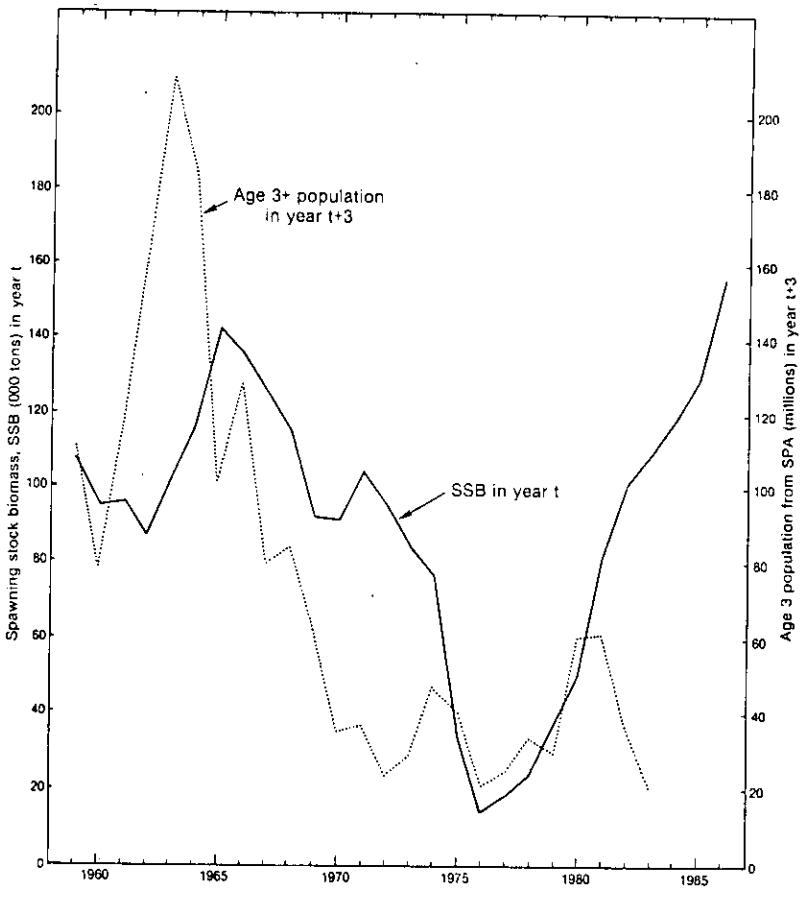

Fig. 5. Cod in Div. 3NO: trends in spawning stock biomass and abundance of age 3 recruits from cohort analysis for 1959-86.

estimates of these weights for older cod were not available for the current analysis, STACFIS concluded that reference fishing mortality levels ($F_{0.1}$ = 0.18, F_{max} = 0.22) which were used in previous assessments would be appropriate for this assessment.

d) Catch Projections

The parameters which were used to project stock sizes and catches are given in Table 8. The partial-recruitment vector was that for 1986 (as adjusted) from the cohort analysis. Mean weight-at-age values were averages of commercial weight-at-age data from 1984-86. The size of the 1984 and 1985 year-classes were set at the 1977-86 geometric mean of 35 million fish. The TAC for 1987 is 33,000 tons, but there is no reason to expect that the 1987 catch will be less than that of 1986, about 50,000 tons. Stock sizes were projected with both of these 1987 catch options and results are given in Table 9. At $F_{0.1}$ = 0.18, the catch for 1987 is

TABLE 8. Cod in Div. 3NO: parameters used in projections of stock biomass and catch.

Age (yr)	Stock size 1 Jan 1987 (000)	Mean weight (kg) Annual	Mean weight (kg) Start of year	Percent mature	Partial recruitment
3	35,000	0.55	0.41	0	0.04
4	17,430	1.00	0.74	4	0.55
5	21,992	1.51	1.23	22	1.00
6	25,924	2.16	1.81	64	1.00
7	17,718	3.26	2.65	94	1.00
8	6,120	4.71	3.92	99	1.00
9	3,904	6.78	5.65	100	1.00
10	2,310	8.43	7.56	100	1.00
11	1,594	9.33	8.87	100	1.00
12	1,541	11.21	10.23	100	1.00

Table 9. Cod in Div. 3NO: catch projections for two options of catch in 1987.

1987 catch (tons)	F_{87}	Projected 1988 catch (tons) $F_{0.1}$=0.18	F_{86}=0.20	F_{max}=0.22
33,000	0.15	40,370	44,450	48,450
50,000	0.23	37,390	41,170	44,880

projected to be 39,635 tons, representing an increase of about 20% over the current 1987 TAC. Projections of catch for 1988 and spawning stock biomass at the beginning of 1989 over a range of fishing mortalities, with catches in 1987 assumed to be 33,000 and 50,000 tons, are presented in Fig. 6A and 6B respectively.

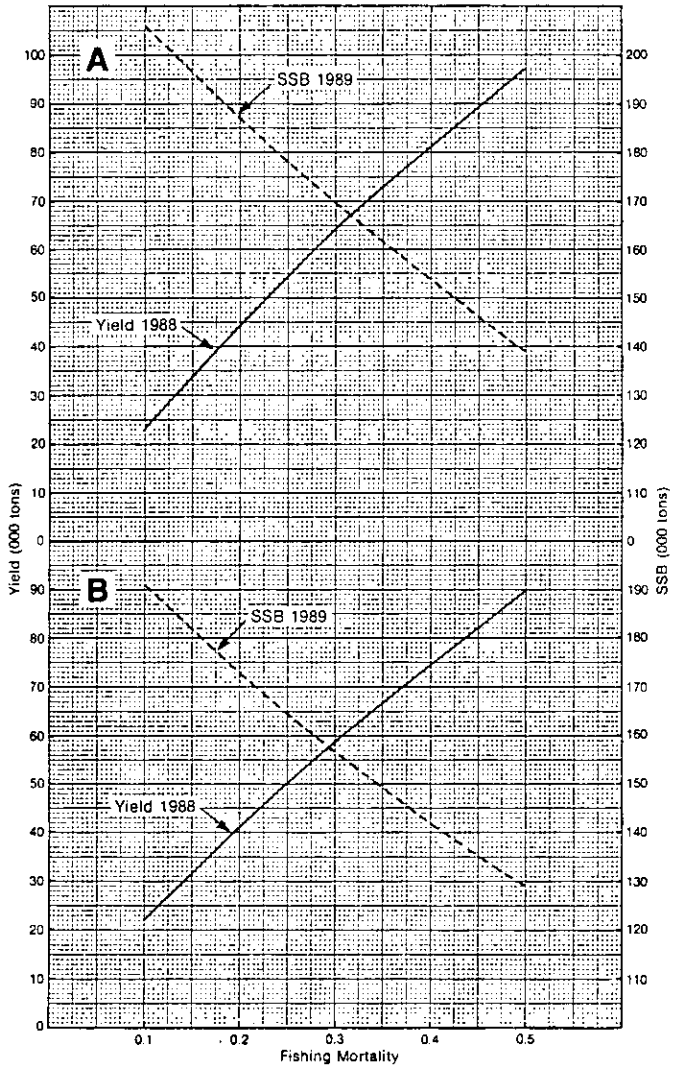

Fig. 6. Cod in Div. 3NO: projection of catch for 1988 and spawning stock biomass at the beginning of 1989 for a range of fishing mortality, with assumed catches in 1987 of (a) 33,000 tons and (b) 50,000 tons.

c) Research Recommendations

For cod in Div. 3NO, STACFIS recommends

(i) that alternate methods of determining directed fishing effort for the Canadian otter-trawl fishery be considered for the next assessment of this stock;

ii) that, in light of the different survey methodologies employed by the USSR in 1983-86 compared to two earlier periods, the results from the three time periods be calibrated, if possible, and a single series from at least 1977 to the present be made available at the September 1987 Meeting; and

iii) that estimates of mean weight-at-age for older ages (13-20) for a recent time period be derived from results of research vessel surveys and be included in a reanalysis of yield-per-recruit, with results to be presented at the September 1987 Meeting.

4. Redfish in Subarea 1 (SCR Doc. 87/38, 57, 59; SCS Doc. 87/14, 17)

a) Introduction

Landings of redfish were totally dominated by *Sebastes marinus*. The overall nominal catch in 1986 was at the same level as that for 1985, which was the lowest in the last 10 years. There were indications that landings in 1977 were overestimated in the official statistics. The decrease since 1984 was due to a reduction in the mixed redfish-cod fishery by trawlers from the Federal Republic of Germany. Since 1984, the redfish catch has been taken mainly by Japanese trawlers in a joint-venture charter arrangement with the Greenland Home Rule Trawler Company. The Japanese fishery is a directed redfish fishery. Recent catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Catch	31	8	9	8	6	8	7	6	3	3[1]	

[1] Provisional data.

Small *S. mentella* were quite abundant as by-catch in the shrimp fishery mainly in Div. 1A and 1B. By-catch estimates of small *S. mentella* were 970 and 936 tons in 1985 and 1986 respectively. The by-catches were discarded.

b) Input Data

i) Commercial fishery data

Directed effort data from the commercial redfish fishery are available only from 1984 onwards for Japanese trawlers. Effort data for the Federal Republic of Germany trawlers are difficult to evaluate, due to high and variable amounts of cod in the catches. Samples of age composition and length distributions from the Greenland commercial fishery in 1982, 1983, 1985 and 1986 are available. Catches were dominated by fish of ages 14 to 20.

ii) Research vessel surveys

A Canadian random-stratified bottom-trawl survey was carried out in August-September 1986 west of the West Greenland fishing banks at depths of 200-1,250 m. Golden redfish (*S. marinus*) were taken in small numbers in depths of 200-500 m with size range of 15-61 cm and a tendency for larger fish to be from deeper water. The trawlable biomass was calculated to be about 2,000 tons, but a major part of the stock is believed to reside in the bank areas which were not covered by the survey.

Beaked redfish (*S. mentella*) were widely distributed throughout the survey area with greater weight-per-tow from depths of 500 to 600 m. The trawlable biomass in the surveyed area was calculated to about 8,000 tons. The fish ranged from 6 to 45 cm in length, the majority being 8 to 11 cm. There was an increase in size with depth and a decrease in size with increasing latitude. This supports the hypothesis of the area between 66°N and 70°N being a nursery area.

A Greenland research shrimp-trawl survey has been carried out in the northern part of Subarea 1 since 1976. Length distributions of *S. mentella* from each year were utilized with age compositions for 1982-85, pooled together in a standard age-length key, to construct age distributions of the catch by year. The bulk of the fish was below 8 years, further supporting the hypothesis of the northern part of Subarea 1 being a nursery area for *S. mentella*.

c) Catch Projections

The *S. 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) at a level of about 10,000 tons with an equilibrium catch at 2/3 MSY effort of about 9,000 tons. Although some new information is available, the data are not sufficient for a new assessment. Therefore, STACFIS presently has no basis on which to advise if a catch of 9,000 tons in 1988 will correspond to 2/3 MSY effort.

d) Recommendations

i) Since the surveys by the Federal Republic of Germany and Canada in 1986 together covered the most important offshore areas of Subarea 1, STACFIS recommends *that the biomass estimates of redfish from the Canadian research survey off the banks and the Federal Republic of Germany research survey on the banks should be combined for the June 1988 Meeting, and further data from others also should be made available.*

ii) Noting the importance of commercial sampling data for redfish, STACFIS recommends *that analysis of sampling data for S. mentella from commercial catches by the Federal Republic of Germany in recent years should be made available in June 1988.*

5. Redfish in Division 3M (SCR Doc. 87/20, 37; SCS Doc. 87/13, 15, 18)

a) Introduction

Catches from this stock have ranged between 13,000 and 27,000 tons from 1975 to the present. The USSR has been the predominant force in this fishery in recent years. The 1986 catch was about 7,000 tons greater than those in 1984 and 1985 due to the increased catches by EEC countries. The present TAC of 20,000 tons has been achieved each year since 1983. Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	16	16	20	20	20	20	20	20	20	20	20
Catch	20	17	20	16	14	15	20	20	20[1]	27[1]	

[1] Provisional data.

b) Input Data

Catch and effort data extracted from ICNAF and NAFO Statistical Bulletins for the 1959-84 period were combined with provisional data for 1985 and utilized in a multiplicative model to derive a standardized catch-rate series (Fig. 7). There was a general decline from 1961 to 1967, followed by a sharp increase to the highest value on record in 1970. Since then, catch rates declined until 1979 and then increased moderately to 1982, from which point there has been a gradual decline to the present time.

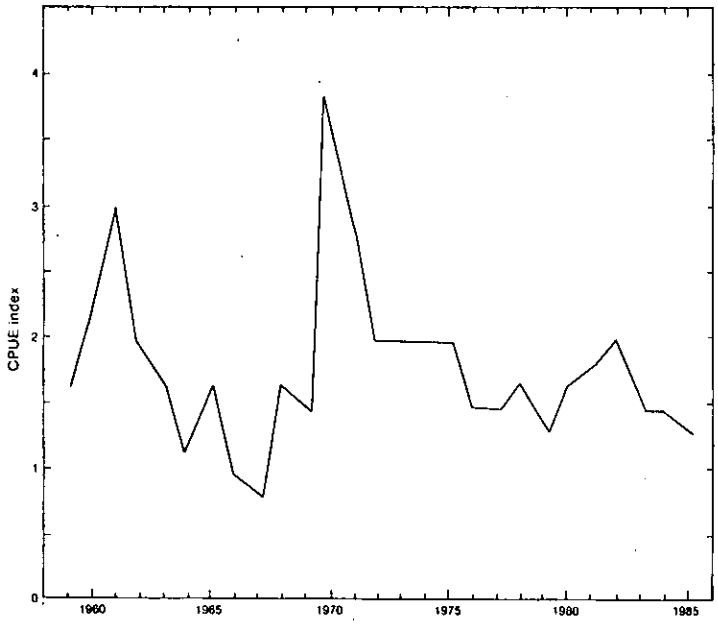

Fig. 7. Redfish in Div. 3M: commercial catch rates as derived by a multiplicative model for the 1959-85 period (1985 is preliminary).

Commercial length frequencies for 1986 were available for the Portuguese fishery (SCS Doc. 87/18) and for the USSR fishery through sampling by Canadian observers (SCR Doc. 87/37). Research length frequencies for 1980-86 (SCR Doc. 87/20), as well as percentage age composition, based on ageing by scales (SCS Doc. 87/15) in 1986, were available from USSR surveys. These indicate that the year-classes of the early 1980's are relatively strong, which is consistent with previous reports (NAFO Sci. Coun. Rep., 1986, page 58).

c) Estimation of Parameters

A virtual population analysis (VPA), utilizing natural mortality that varied with age, was presented (SCR Doc. 87/20). It was noted that calibration of the VPA was not documented in accordance with STACFIS guidelines and was difficult to follow. In addition, the points raised previously (NAFO Sci. Coun. Rep., 1986, page 85), concerning the use of variable M, have not been addressed. As a result, STACFIS was unable to evaluate the VPA results.

The standardized catch-rate series was regressed (least squares) on effort (unlagged and lagged 6, 8 and 10 years) (SCR Doc. 87/37). The unlagged relationship was not significant, but the relationships with lagged effort values were all significant. Equilibrium general production analyses, derived from relationships of CPUE on lagged effort, were quite similar and indicated an equilibrium yield at 2/3 effort MSY in the range of 15,000 tons and an MSY of 17,000 tons. It has been pointed out previously that regressions of CPUE on the lagged series of efforts were highly dependent on the 1970 and 1971 points (NAFO Sci. Coun. Rep., 1986, page 58). This same situation exists with the inclusion of the 1985 data and, therefore, the results are to be considered with caution. The catch and standardized effort from the multiplicative model were employed in a non-equilibrium version (Schaefer form) of a general production model (SCR Doc. 87/37). The results of this approach are as follows:

Parameter	f(MSY)	2/3 f(MSY)
Fishing effort (hr)	18,504	12,336
CPUE (tons/hr)	1.138	1.517
Yield (tons)	21,053	18,714

The exploitable biomass was estimated from the model to be about 300,000 tons at the beginning of 1987.

d) Catch Projections

Length frequencies from the commercial fishery indicate a wide range of lengths with the majority of redfish in the 20-30 cm range. A length composition from the USSR research survey in 1986 revealed that the catches were dominated by small (20-23 cm) and large fish (30-37 cm). These small redfish represent the year-classes of the early 1980's, which should recruit to the fishery in the next few years, and provide increased catch rates. The non-equilibrium model indicated yields for 1987 and 1988 at 2/3 f(MSY) and f(MSY) as follows:

Year	f(MSY)	2/3 f(MSY)
1987	27,766	18,786
1988	27,003	18,778

In view of the advised caution concerning results from the equilibrium general production analysis because of the 1970 and 1971 points, and because more confidence was put on the results of the non-equilibrium general production analysis, STACFIS therefore advises that the TAC for 1988 should remain at 20,000 tons.

e) Future Research

STACFIS expressed concern that potentially useful data are not being utilized because its guidelines concerning VPA presentations are not being followed, and recommends *that the STACFIS guidelines for presentation of VPA analyses be followed closely for future assesements so that the analyses can be fully utilized.*

6. Redfish in Divisions 3L and 3N (SCR Doc. 87/20, 58; SCS Doc. 87/13, 15, 18)

a) Introduction

Historical nominal catches from this stock have ranged from a low of 8,100 tons in 1964 to a high of 44,600 tons in 1959. The average catch over the 1959-86 period is just over 21,000 tons. The proportion taken from Div. 3N has been about 60% of the total. Provisional

statistics for 1986 indicate a catch of 42,000 tons, about 20,000 tons over the 1985 catch of 20,500 tons, due mainly to increased catches by EEC countries (primarily Portugal). Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	16	16	18	25	25	25	25	25	25	25	25
Catch	17	12	14	16	24	22	20	15	20[1]	42[1]	-

[1] Provisional data.

b) Input-Data

Catch and effort data obtained from ICNAF and NAFO Statistical Bulletins for the 1959-84 period were combined with preliminary NAFO data for 1985 and preliminary Canadian data for 1986 (no Canadian data for Div. 3N in 1986) and were utilized in a multiplicative model to derive a standardized catch-rate series (SCR Doc. 87/58). Catch and effort data were also analyzed separately for Div. 3L and Div. 3N due to questions raised previously concerning the variability of catch rates for the combined data (NAFO Sci. Coun. Rep., 1986, page 59). The catch rate series for Div. 3LN combined shows a great deal of fluctuation. The series derived from treating the data for each division separately also show a considerable amount of interannual variability. It was noted that the trends during some years were in opposite directions with respect to each division and that this constitutes a violation of the assumption of a constant relationship in the multiplicative model. In recent years, there was a general increasing trend in Div. 3L and a decreasing trend in Div. 3N.

Commercial length frequencies for 1986 were available from the Canadian and German Democratic Republic fisheries in Div. 3L (SCR Doc. 87/58) and the Portuguese fishery in Div. 3L and Div. 3N (SCS Doc. 87/18). A commercial length frequency for Div. 3NO combined was available from the Spanish fishery (SCS Doc. 87/13).

Population age compositions were available for Div. 3L and 3N separately from a USSR research survey in 1986 (SCS Doc. 87/15). In addition, a series of research length frequencies from USSR surveys in Div. 3N for 1980-86 were presented (SCR Doc. 87/20). These data indicate that year-classes of the early 1980's are relatively strong in Div. 3N.

c) Estimation of Parameters

A virtual population analysis (VPA) of catch-at-age data, utilizing age-variable natural mortality (M), was available (SCR Doc. 87/20). It was noted that calibration methods were not documented in accordance with STACFIS guidelines. It was also pointed out that previous discussion on the use of variable M resulted in a consensus by STACFIS that simulation techniques were required before utilizing this in VPA (NAFO Sci. Coun. Rep.,1986, page 85). Because this problem had not been addressed for this meeting, STACFIS was unable to evaluate the results from the VPA.

The relationships between CPUE and effort were examined for each division separately. The 1974 point was considered to be anomalous in both series and was therefore not included in the analyses. Least squares regressions of CPUE on effort (unlagged and lagged 6, 8 and 10 years) resulted in significant relationships with unlagged effort and effort lagged 6 and 8 years for Div. 3N but only with effort lagged 8 years for Div. 3L. Utilizing the results from the relationship with effort lagged 8 years in general production analyses for each division gave estimates of equilibrium yield at 2/3 effort MSY of 8,600 tons for Div. 3L and 15,700 tons for Div. 3N. It was noted that the ratio of the estimated equilibrium yields (35:65) is similar to the long-term ratio of catches in the two divisions (36:64).

d) Catch Projections

Length frequencies from the 1986 commercial fishery in Div. 3L indicate 30 cm and longer fish were dominant in the catch, whereas fish less than 30 cm were dominant in Div. 3N. This phenomenon had been noted previously (NAFO Sci. Coun. Rep., 1986, page 59). The USSR research length frequencies from Div. 3N showed that the year-classes of the early 1980's were relatively strong, but this was not shown by the survey data in Div. 3L. Catch rates seem to be stable or increasing slightly in Div. 3L. Recent catch rates in Div. 3N have declined somewhat, but this should be offset over the next few years by increased recruitment of the relatively strong year-classes of the early 1980's. Combined results of the general production analysis for Div. 3L and Div. 3N indicate an equilibrium yield at 2/3 effort MSY of 24,300 tons. Based on available information, STACFIS advises that the TAC should remain at 25,000 tons for 1988.

e) Future Research

STACFIS again noted the problem of evaluating assessments (as for redfish in Div. 3M) when guidelines were not followed, and recommends *that its guidelines be followed when presenting the results of VPA so that the analyses can be fully evaluated.* STACFIS also noted that some commercial data were available for Div. 3NO combined but could not be used, and recommends *that in the future commercial data be presented for Div. 3N and 3O separately.*

7. Silver Hake in Divisions 4V, 4W and 4X (SCR Doc. 87/11, 21, 42, 56; SCS Doc. 87/15)

a) Introduction

The silver hake fishery is conducted by large otter trawlers with small-meshed bottom trawls. Prior to 1977, the fishery was not restricted by season or area. Since 1977, the fishery has been restricted to the April-November period and to the area seaward of the small-mesh-gear-line (SMGL). Nominal catches of silver hake since 1970 ranged from a maximum of 300,000 tons in 1973 to a minimum of 36,000 tons in 1983. Since 1977, catches have generally increased from 37,000 tons in 1977 to 82,000 tons in 1986. Recent catches and TACs (000 tons) are as follows:

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	70	80	70	90	80	80	80	100	100	100	100
Catch	37	48	51	45	43	60	36	74	77[1]	82[1]	

[1] Provisional data.

Prior to 1982 almost all the catch was taken by the USSR. In 1986, as in recent years, the majority of the catch was taken by USSR (66,500 tons) with Cuba harvesting most of the remainder (16,000 tons). The fishery was, as usual, mostly in May, June and July. The catches fell short of the TAC in recent years because of Canadian allocations to countries which did not fish for silver hake. The USSR and Cuba have taken more than 99 and 90% of their respective allocations in each of the last 3 years.

b) Input Data

i) Commercial fishery data

Following the recommendation of STACFIS in 1986, the 1970-85 catch and effort data from the ICNAF and NAFO series were used, with the 1986 Canadian International Observer Program (IOP) data for 1986, in a multiplicative model. Because the catch rates in the Cuban fishery increased form 1978 to 1982, as a result of improved expertise and equipment, only the USSR data were used in the 1986 assessment (SCR Doc. 86/85). However, it is now believed that the effects of these improvements in the fishery, which may have affected Cuban catch rates prior to 1982, have not been evident since then. The Cuban catches prior to 1982 were minimal, but they now account for 20% of the total, and Cuban catch and effort data for 1982-86 were used in calculating the standardized catch rates for this assessment, as follows:

Year	CPUE	Year	CPUE	Year	CPUE	Year	CPUE
1970	2.855	1975	1.822	1980	1.492	1985	3.295
1971	2.049	1976	2.641	1981	1.797	1986	4.307
1972	2.271	1977	2.375	1982	4.774		
1973	2.990	1978	1.937	1983	2.396		
1974	2.026	1979	2.066	1984	3.786		

The catch rates have generally increased from 1980 to 1986, with the exception of 1982. The catch rate in 1982 was much higher than in adjacent years and is the highest in the series. The 1986 catch rate is only slightly less than that of 1982. It was considered unlikely that the drastic change in catch rate in 1982 was representative solely of a change in biomass.

The age composition of the catches in 1970-85 were taken from the previous assessment (SCR Doc. 86/62), with adjustments to reflect revisions in the reported nominal catches in 1984 and 1985. The changes were generally small and involved changes in the catch by month rather than total tonnage. The age composition in 1986 was calculated from the IOP sampling. Observers sampled 36,000 tons (43%) of the total catch of 83,000 tons. More than 250,000 length measurements and 1,900 otoliths were taken. Extensive sampling

and ageing was also conducted by USSR and Cuban samplers. The results of this effort have not been used in this assessment due to discrepencies in age and length composition. Accordingly, STACFIS urges that effort be made to incorporate all sources of data in future assessments. This is contingent upon resolving the discrepencies in ageing referred to in the Section "Ageing Techniques ...". The 1986 age composition in the catch was dominated by the 1983 year-class at age 3 (36% by number). The 1984 year-class at age 2 (14%) was below average strength, but the 1985 year-class at age 1 (26%) was the largest proportion of 1-year-olds in the catch since 1972.

ii) Research vessel indices

Results of the Canadian research vessel surveys in July were used to estimate numbers and biomass of silver hake from 1972 to 1986. The abundance in numbers for 1986 was second highest in the series, after 1984. The biomass increased slightly over 1985, while the numbers nearly doubled. The abundance at age from the survey indicated that the 1985 year-class is the largest at age 1 in the entire series. It is 73% of the estimate by numbers and 48% of the biomass estimate. The previously-strong 1983 year-class has fallen to only 20% of the biomass which is at or below the average since 1977. The research-vessel indices for 1982 to 1986 have been higher on average than in the period prior to 1982. The change in research vessel, which occurred in 1982, was adjusted for by the use of a conversion factor, but an effect due to research vessel may still be present. It should also be noted that the conversion factor which was applied was a general one which would not take into account age-specific differences in catchability and thus abundance estimates of age 1, for example, may not be directly comparable between the 1972-81 and 1982-86 periods. Correlations between the numbers and biomass indices from the July surveys and the standardized USSR CPUE were examined and significant correlations were found.

Joint USSR-Canada juvenile silver hake surveys have been conducted in a consistent manner since 1981. Two methods of calculating the survey index of abundance have been used by the USSR and Canadian scientists in the past. A standardized method of calculating the index was agreed upon last year (NAFO Sci. Coun. Rep., 1986, page 121) and was used to calculate the following series:

Year-class	1981	1982	1983	1984	1985	1986
Number per tow	579	9	232	43	285	231

Results from the juvenile surveys indicate that the 1986 year-class is similar in size to the 1983 and 1985 year-classes.

iii) Commercial fishery Observations

In 1986, as in the previous year, extremely dense and stable aggregations of silver hake were observed on the Scotian Shelf slope (SCR Doc. 87/21). The by-catches of pollock, hakes (*Urophycis* sp.) and mackerel were high relative to earlier years, similar to 1985, although still within the allowable rate.

A paper was presented which examined several factors influencing the recruitment of silver hake (SCR Doc. 87/11). The conclusions that the St. Lawrence River loading and the abundance of mackerel are the two major factors regulating silver hake recruitment and that cannibalism is not a factor could not be substantiated by the documentation available. The authors were not present to provide any further information on the work.

c) Estimation of Parameters

i) Partial recruitment

The partial-recruitment values of ages 1 and 2 were calculated from the ratio of F on ages 1 and 2 to average F on ages 3 and 4, and an iterative procedure with the SPA was used until there was no change in the resultant partial-recruitment vector (see Table 10).

The partial-recruitment values used to calculate exploitable biomass was based on annual vectors which were also calculated as the ratio of F on ages 1 and 2 to average F on the fully-recruited ages (3-9).

ii) Natural mortality

A paper was presented (SCR Doc. 87/42) which included a VPA using age-specific estimates of natural mortality, similar to those presented in the last 2 years (SCR Doc. 85/36 and

86/60). As in the last 2 years, there was insufficient documentation to evaluate the natural mortality estimates. Although the natural mortality may vary with age, a constant value of 0.4 was used, as in previous assessments.

iii) SPA calibration

Two different means of calibrating the SPA were examined. The exploitable biomass from SPA was regressed on the standardized CPUE and the research vessel survey numbers at age 4+ were regressed on the SPA numbers at age 4+. No significant regressions were obtained when calibrations using research vessel numbers at age 4+ with SPA numbers at age 4+ were examined.

The standardized catch-rate series was used to calibrate the SPA (cohort model). A view was expressed that the catch and effort data from the period prior to 1977 were unreliable. There were also doubts about whether the 1982 catch rate could reflect a change in biomass. These issues could not be resolved and calibrations based on three subsets of the time series were considered. Because the 1982 point and the 1970-76 points were mutually incompatible, a calibration using all years was not attempted. The three series that were considered were 1970-86 excluding 1982, 1977-86, and 1977-86 excluding 1982. Unweighted linear regressions were used to evaluate the relationships between the various indices being considered. The regressions of exploitable biomass on CPUE were non-significant for all levels of terminal F when 1982 was included in the dataset. The regressions were evaluated on the magnitude of the intercept as the criterion of selecting the highest r^2 (coefficient of determination) was unreliable, because the recent years were all at the high end of the CPUE range. The regressions, excluding only the 1982 point, had the smallest intercept at terminal F = 0.25. Excluding 1970-76 as well as 1982 indicated terminal F = 0.35. Because there was no documentation to allow evaluation of the basis for excluding the 1970-76 data, the terminal F indicated by all years except 1982 (i.e. F = 0.25) was selected as terminal F in 1986.

The conclusion that terminal F was 0.25 implies that there has been a decrease in fishing effort from the late 1970's to the present. This is consistent with standardized fishing effort, as estimated from the multiplicative model, but the magnitude of this change was not evaluated with respect to the expected proportionality between fishing mortality and fishing effort. It was concluded that a more thorough investigation of the relationship between F and fishing effort is required before firm conclusions can be reached.

iv) Yield-per-recruit

The Thompson and Bell yield-per-recruit was calculated by using the most recent partial-recruitment vector, natural mortality of 0.4, and mean weight-at-age data from the commercial fishery during 1977-86. The $F_{0.1}$ level of fishing mortality is 0.474, and the yield-per-recruit would be 0.063 kg at the level of F. These parameters are unchanged from the previous assessment (SCR Doc. 86/62).

d) Prognosis and Catch Projections

The input parameters for the catch projections are given in Table 10.

Table 10. Silver hake in Div. 4VWX: parameters used for catch projections.

Age (yr)	1987 stock size (000)	Mean W (kg)	Partial recruitment
1	2,526,686	0.067	0.08
2	1,593,140	0.154	0.58
3	354,663	0.199	1.00
4	489,281	0.239	1.00
5	195,717	0.275	1.00
6	83,710	0.331	1.00
7	29,830	0.425	1.00
8	6,111	0.562	1.00
9	2,471	0.678	1.00

The population vector at age for 1986 was generated from the SPA at F_t = 0.25 except for the recruitment at age 1. The 1986 number at age 1 in the SPA was almost double the largest recruitment seen previously (1971 year-class). Since the juvenile surveys have indicated that the 1983, 1985 and 1986 year-classes are similar in size as 0-group fish, it was assumed

for projection purposes that the 1985 and 1986 year-classes were in fact equal to the 1983 year-class at age 1. The high juvenile survey estimate for the 1981 year-class and the low estimate for the 1982 year-class were not consistent with year-class sizes calculated from the SPA. The July survey estimates of these and the 1983 and 1984 year-classes were more consistent with SPA numbers, however, and the juvenile estimates from the 1981 and 1982 year-classes were discounted. Recruitment in 1988 was assumed to be equal to the geometric mean of the recruitment from 1970 to 1984 (1.4 billion). The mean weights at age were averaged over 1984-86. The partial-recruitment vector was the same one used in the current assessment.

Projections to estimate the $F_{0.1}$ catch in 1988, using the above input parameters, were run under three different scenarios: the $F_{0.1}$ catch is taken in 1987, the TAC is taken in 1987, and the 1987 catch is equal to that of 1986 (Table 11). STACFIS advises that the $F_{0.1}$ catch in 1988 will be 167,000 tons.

Table 11. Silver hake in Div. 4VWX: predicted yields at $F_{0.1}$ in 1988 based on three catch scenarios for 1987.

Catch scenario for 1987	1987 parameters		1988 catch at $F_{0.1}$
	Catch	F	
Catch at $F_{0.1}$	143,928	0.474	147,540
Equal to TAC	100,000	0.310	161,560
Equal to 1986 catch	83,000	0.252	167,010

e) Future Research

The utility of the research vessel surveys conducted by Canada in July, March and October has not been fully investigated. The estimates of stock size from surveys are highly variable but there appears to be useful correlation between the survey estimates and the commercial catch-rate series. STACFIS recommends *that means of incorporating survey estimates into the current assessment methods be investigated.*

The radical changes in the conduct of the fishery at the time of extension of fisheries jurisdiction, which involved area and season of fishing, mesh size used, data collection and reporting methods, has made comparison of commercial fishery data series collected prior to, and after, this event difficult. This situation has contributed to the difficulties of STACFIS in assessing silver hake abundance for a number of years. The present assessment is heavily dependent on an assumed equivalence in catch reporting in the two periods.

While every effort should be made to investigate this issue, STACFIS recognized that new evidence concerning pre-1977 data is unlikely to be forthcoming at this late date. It is likely that only accumulation of new data which describe accurately present relationships between, say, CPUE and SPA biomass will allow resolution of the question whether or not these are different from those prior to 1977. STACFIS recommends *that consideration be given to criteria upon which such a decision might be based, noting that one aspect of this which bears investigation is whether relationships between F and effort can be satisfactorily derived between the two periods to validate effort standardization; it should also be investigated whether the F versus effort relationships can provide inferences concerning terminal F in SPA.*

The reliability of post-1976 catch rates as abundance indicators has consistently been questioned, and research on the influence of abiotic and biotic factors on silver hake behaviour and distribution has previously been identified as a high priority (NAFO Sci. Coun. Rep., 1985, page 64). STACFIS noted that a cooperative program between Canada and the USSR to address this question is planned and encouraged its implementation.

Other issues worthy of attention, given the importance of recruiting year-classes to this fishery and high variability in stock abundance, are the stock-recruitment relationship and factors influencing year-class size. STACFIS reiterates its recommendations made last year (NAFO Sci. Coun. Rep., 1986, pages 85-86) concerning research required to support assessments made using variable M at age.

8. American Plaice in Division 3M (SCS Doc. 87/13,15, 18)

a) Introduction

From 1974, when TAC regulation was introduced, to 1985, catches from this stock ranged from

600 to 1,900 tons. The 1986 nominal catch increased by about 120% over the 1985 level to approximately 3,800 tons. Until 1986, USSR vessels took most of the catch in recent years, but Spain and Portugal caught about 1,000 and 1,700 tons respectively in 1986, up from levels of 200-300 tons in 1985. The USSR catch was about 1,000 tons in both years. Recent TACs and nominal catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	2	4	2	2	2	2	2	2	2	2	2
Catch	2	1	1	1	1	1	2	1	2[1]	4[1]	

[1] Provisional data.

b) Input Data

Research vessel surveys by USSR indicated an increase in biomass in 1986 of about 2.5 times and abundance of about 1.5 times the relatively stable level of the 1983-85 period. There were no data available from commercial vessels to determine if a similar increase in CPUE occurred from 1985 to 1986.

c) Catch Projections

It was noted that an increase in biomass of 2.5 times in one year was unlikely to occur, given the apparent stability of this stock in the past, unless a significant increase in recruitment had occurred. While the USSR surveys did indicate increased abundance, it was thought that this increase did not correspond to an apparent increase of 2.5 times in the biomass. Given the variability associated with surveys, and that the 1986 value was the only one in a 4-year series which indicated a change in biomass, STACFIS concluded that there were insufficient data to advise a change in the TAC for this stock. STACFIS therefore advises that the 1988 TAC remain at the present level of 2,000 tons.

9. American Plaice in Divisions 3L, 3N and 3O (SCR Doc. 87/40, 43, 47; SCS Doc. 13, 15)

a) Introduction

This stock has been exploited consistently since the early 1950's, with the largest nominal catch (94,000 tons) in 1967. USSR vessels took significant catches during 1965-76, while Canada took over 90% of the catch during 1976-82. Starting in 1982, other nations, notably South Korea, Panama, Cayman Islands, USA, Spain and Portugal have increased their involvement in the fishery. This resulted in a catch by non-Canadian vessels of about 27,500 tons in 1986, the second highest value in the 27-year series, and an increase of about 90% over 1985. About 6,200 tons of the total in 1986 was estimated to have been taken by non-member countries, 4,500 tons of which has not yet been reported to NAFO and for which Canadian surveillance estimates of catch were used. Spain and Portugal reported increases in the catch in 1986 of about 6,400 and 9,240 tons respectively, while the Canadian catch in 1986 declined by about 6,800 tons from 1985. Overall, the 1985 and 1986 catches of 55,000 and 61,000 tons respectively were the highest since 1972 and exceeded the TAC by about 6,000 tons in each year. Most of the recent increase in catch has been in Div. 3N by vessels fishing outside the Canadian 200-mile fishery zone. Recent TACs and nominal catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	47	47	47	47	55	55	55	55	49	55	48
Catch	44	50	49	49	50	51[1]	39[1]	39[1]	55[2]	61[2]	

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

b) Input Data

i) Commercial fishery

Catch and effort data from the commercial fishery during 1956-86 were analyzed using a multiplicative model to obtain a catch-rate index. Data from Canadian (N) trawlers (tonnage classes 4 and 5), with directed effort for American plaice in Div. 3L and 3N, were used in the model, which standardized the catch rates with respect to gear/tonnage class, month, and division. The data for March 1985 in Div. 3L were excluded from the analyses, because the catch rate at that time (about 4.3 tons/hr) was far outside the

range of the rest of the data. The reasons for this very high value are not known, but they were probably related to factors other than stock abundance. In any case, the effect on the overall (yearly) index of this point was minimal, although there was an effect on the monthly component. A comparison of this catch-rate series with the one used previously for this stock revealed that the two indices were very similar from 1967 to 1986 and showed similar trends from 1960 to 1966. Catch rates declined from about 1.0 tons/hr in the mid-1960's to a low of 0.45 tons/hr in the 1974-78 period. Catch rates subsequently increased to a 17-year high of almost 0.7 tons/hr in 1985, but declined 30% to 0.48 tons/hr in 1986 (Fig. 8).

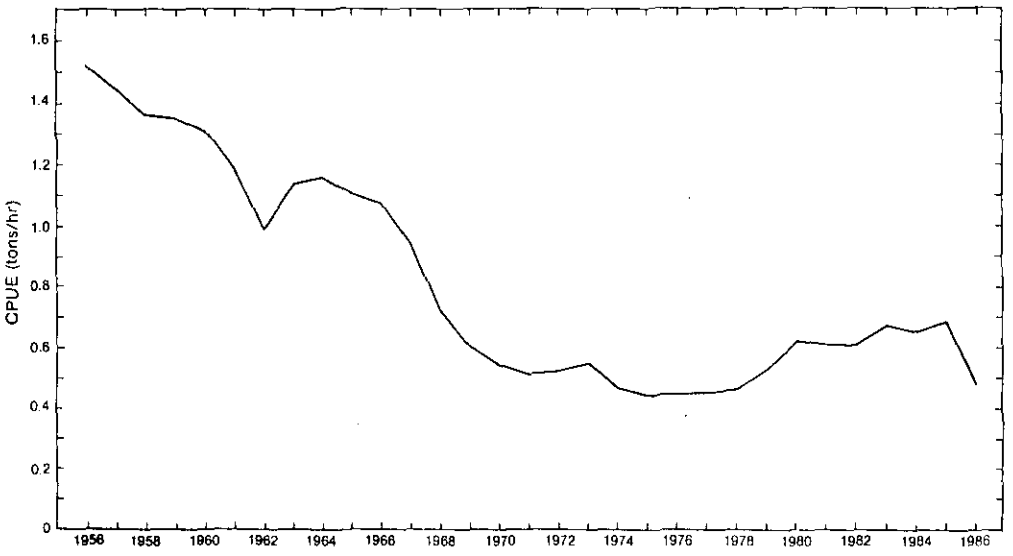

Fig. 8. American plaice in Div. 3LN: commercial catch rate index for 1956-86.

The age composition and weight-at-age data for the 1986 fishery were derived from two sources: length and age samples of the landings of Canadian trawlers fishing in Div. 3L and 3N (SCR Doc. 87/40); and length samples of the landings of Spanish freezer trawlers fishing in Div. 3N and 3O (SCS Doc. 87/13).

Because of apparent differences in the ageing of American plaice otoliths between Spanish and Canadian age-readers, it was decided to use age-length keys from the more experienced Canadian age-readers in calculating numbers caught at age in the Spanish fishery. Since the length frequencies from the Spanish catches indicated the presence of many more small fish than were found in the Canadian catch, it was decided to use an age-length key from the Canadian research vessel survey in Div. 3N in 1986 to beak down the Spanish length frequencies. The numbers-at-age from the Spanish fishery were adjusted to the total non-Canadian catch in Div. 3N (22,089 tons). It was noted that the catch composition by age-group in Div. 3L in 1986 was reasonable, without including sampling data from countries other than Canada. Spanish and Canadian length frequencies from Div. 3L were more similar than those from Div. 3N, and Canada took about 83% of the catch in Div. 3L, compared to only 27% in Div. 3N. Examination of length frequency data from Spanish catches in Div. 3N in 1985 indicated that a recalculation of the catch age composition for 1985 was not warranted for this assessment.

In light of the significant portion of the catch taken by non-Canadian vessels in recent years, STACFIS recommends *that any available data from these catches be incorporated into the catch numbers-at-age calculations, both in the historic data as well as on future occasions.* It was also noted that there was a Portuguese catch of over 9,000 tons from this stock in 1986 and that age and length frequency data from this segment of the fishery would be an asset in the assessment. STACFIS recommends *an exchange between the appropriate laboratories with the aim of resolving the differences in ageing of American plaice otoliths between Spanish and Canadian readers.*

At the request of STACFIS in 1986, a review of information on discarding for this stock was carried out. The discard rate during 1981-85 (reported in SCR Doc. 86/95) was constant around 5%, although preliminary estimates from the same database indicated that the rate may have doubled in 1986 over 1985. No estimates of discarding by length-groups or age-groups have been available since an increase from 1980 to 1982 in the discard rate of fish aged 6-10 was indicated (SCR Doc. 83/27). Data from the Canadian offshore trawler fishery were used in both cases. Although no data were available,

STACFIS was informed that the discard rate in the Spanish fishery was lower in 1986 than in 1985, possibly explaining the substantial increase in the catch of smaller fish in 1986. In any case, STACFIS could not evaluate the effects of discarding on the assessment of this stock and noted that the age compositions continue to reflect landings rather than total removals.

The catch-at-age vector for 1986 in Div. 3LN was considerably different from that for the 1985 fishery, mainly because the catch from the Spanish fishery in 1986 contained large numbers of small American plaice. Ages 5-9 accounted for about 47% of the catch numbers in 1986, compared to only 28% for the same age-groups in 1985. The catch projection by STACFIS in 1986 indicated that ages 6-9 would contribute about 32% of the numbers-at-age in the 1986 catch. The average weight-at-age values in 1986 were similar to those of previous years, with the exception of those at ages 6-8, which were considerably lower. In view of the decrease in the discard rate in the Spanish fishery, and the fact that most of the catch of American plaice at these ages was in the Spanish fishery, the differences in the mean weights at these younger ages (6-8) were acceptable.

ii) Research vessel surveys

Data from Canadian spring surveys in Div. 3L, 3N and 3O (SCR Doc. 87/40) indicate a decline in biomass from 1985 to 1986 from 312,000 tons to 266,000 tons for the 3 divisions combined. Preliminary estimates from the 1987 survey, just completed, place the biomass at 306,000 tons. A comparison of the 1985 and 1986 total population numbers from selected strata in Div. 3L and 3N indicate a decline of about 50% from the relatively stable population sizes in the 1977-82 period (Fig. 9). The strata chosen in this analysis were those common to the surveys in most years and have been used in recent assessments in the calculation of the research vessel survey abundance index for this stock. No comparable estimates are available for 1983-84. USSR surveys (SCS Doc. 87/15) indicate that the 1985 and 1986 biomass estimates in Div. 3LNO, 326,000 and 349,000 tons respectively, were down considerably from the 1984 (642,000 tons) and 1983 (534,000 tons) estimates, although it was noted that the 1984, 1985 and 1986 surveys were conducted by different vessels. Canadian surveys in the fall in Div. 3L, where most of the biomass of this stock is located, also indicate a decline from 1984 to 1986, with the 1986 biomass being less than half of the 1984 estimate and about two-thirds of the 1985 value.

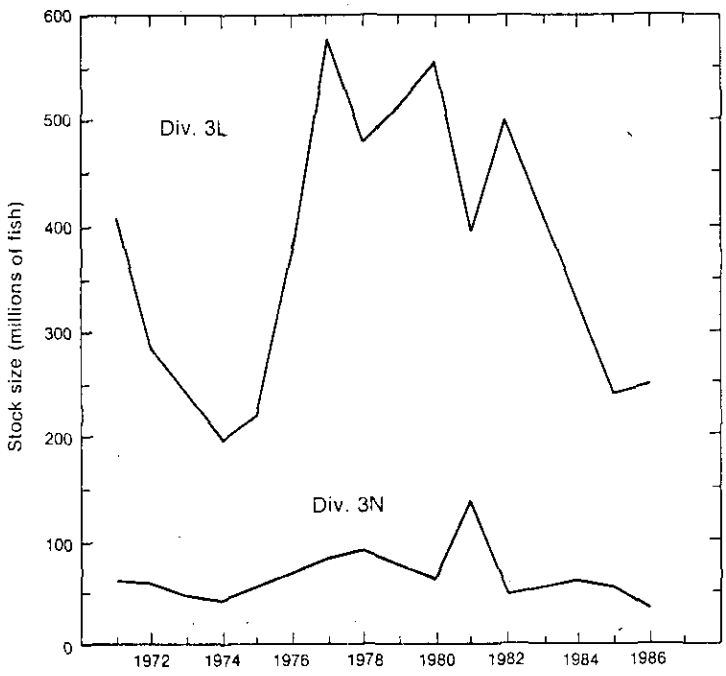

Fig. 9. American plaice in Div. 3LN: abundance index from surveys in Div. 3L (data missing for 1973, 1983 and 1984) and Div. Div. 3N (data missing for 1975, 1976 and 1983).

Noting an anomalously low biomass estimate in the 1986 winter survey in Div. 3L, STACFIS encouraged further analysis on the distribution of American plaice with respect to temperature and depth (NAFO Sci. Coun. Rep., 1986, page 65). Analysis of eight Canadian

surveys in Div. 3L which were conducted at various times in 1984-86 did not reveal any trends in the distribution of biomass by depth and season. In general, the surveys in 1984-86 showed that about 80% of the American plaice biomass in Div. 3L was located in depths less than 183 m. However, an exploratory survey in April 1987 located a large concentration of American plaice in depths slightly over 500 m on the northeastern slope in Div. 3L in depths outside those normally covered by the spring surveys. Catches of American plaice of the magnitude observed in this area were not common in any area of the Grand Bank, as determined from analysis of almost 12,000 fishing sets from Canadian surveys since 1948. Examination of the same database also showed that catches of the size taken in the April 1987 survey had not been observed previously in depths greater than 280 m on the Grand Bank. Biological sampling of the large catches indicated that the concentration was probably not of a spawning or feeding nature. Examination of water temperatures from 1970 to 1986 at hydrographic station 27 in Div. 3L (off St. John's) revealed a significant positive relationship between the mean temperatures in the bottom 25 m and the mean weight-per-tow of American plaice in selected strata of the Canadian surveys in Div. 3L. The relationship, an unweighted least squares linear regression, was better when the survey datum for year i+1 was plotted against the mean temperature in year i. STACFIS noted that 1984 and 1985 produced very low water temperatures in Div. 3L, similar to those of 1973-74, and that the survey results in 1985-86 and 1974-75 in Div. 3L represented four of the five lowest points in the 13-year series. It was pointed out that a detailed analysis of the effects of temperature on the distribution of American plaice is underway and the results should be presented to STACFIS in the near future.

Catches from the line transects, bisected by the Canadian 200-mile fishery zone, from a survey conducted in April 1986 on the Tail of the Bank, indicated American plaice to be significantly more abundant within the zone (SCR Doc. 87/43). These results were in agreement with the stratified-random survey conducted in the area shortly afterwards. However, in contrast, the mean number-per-tow, in all four of the 3-year periods examined from 1971-82, was greater for sets in the stratified-random surveys outside the 200-mile zone, compared to the sets inside, with the differences being statistically significant in the 1974-76 and 1977-79 periods. In 1984-86, however, the mean number-per-tow from sets inside the 200-mile zone was greater than from sets outside the zone although the difference was not statistically significant. For the mean weight-per-tow, catches were greater inside the zone in the 1971-73 and 1974-76 periods, although not significantly so, and catches were greater outside the zone in the 1977-79 and 1980-82 periods, with the former period showing a significant difference. In 1984-86, the mean weight-per-tow was significantly higher in the sets inside the zone. As well, a trend was noted in the surveys from 1982, 1984, 1985 and 1986, as indicated in the following table:

	Catch rates inside and outside of 200-mile zone[1]							
	1982		1984		1985		1986	
Parameter	In	Out	In	Out	In	Out	In	Out
Mean number per tow	50.6	94.1	46.4	65.5	74.6	67.5	37.5	22.0
Mean weight (kg) per tow	31.0	30.2	58.5	35.3	53.3	30.8	32.8	9.8

[1] No comparable survey in 1983.

STACFIS noted that catches from the area outside the 200-mile fishery zone decreased over the 1982-86 period, particularly from 1985 to 1986. However, it was noted that unusual distributions of American plaice had been observed in some surveys in 1986-87 and that the above results may have been influenced by changes in the distribution of American plaice in the Tail of the Bank area.

Canadian surveys for juvenile flatfish using a stratified-random design in depths shallower than 100 m on the Grand Bank, were conducted in 1985 and 1986. Both surveys indicated large numbers of juvenile American plaice (ages 1-4) in stratum 360 in Div. 3N, the area of which is about 93% outside the Canadian 200-mile fishery zone. As a result of several large catches in this stratum in 1986, it was estimated that about 75% of the population at ages 1-4 in the survey area was contained in this stratum. These concentrations of juvenile American plaice, which were mixed with the adult population to some degree, may indicate a nursery area for the southern Grand Bank American plaice population. Concern was expressed that should this be the case, the mixing of the adults and juveniles in this area would make the younger American plaice more vulnerable to exploitation by the fishery on the Tail of the Bank.

nation of Parameters (for Div. 3LN only)

Partial recruitment

In the 1986 assessment of this stock, a long-term (1960-78) average partial recruitment was used as input for cohort analysis and for catch projections. However, a comparison of the actual catch composition by age-group (numbers) in 1986 with that projected in the 1986 assessment revealed a substantial difference, with more young fish in the catch than was predicted. Therefore, a different partial-recruitment vector was calculated for the 1986 catch, based on averaging the fishing mortalities for 1973-77 in a cohort analysis. These years were chosen because the average catches in Div. 3L and 3N were about equal in this period, and the pattern of percent catch composition by age-group was similar to that observed in 1986. the partial-recruitment values are given in Table 12 and are somewhat higher at ages 6-12 than the long-term average values. It was noted that changes in partial recruitment are not uncommon for this stock, and that recent changes may have resulted from changes in the country composition and location of the fishery.

Natural mortality

The value of $M = 0.2$ in the present assessment was the same as that used in recent assessments of this stock.

Fishing mortality

The value of terminal fishing mortality (F_t) in 1986 was determined on the basis of two unweighted least squares regressions: (a) average annual exploitable biomass from cohort analysis against the CPUE series in Div. 3L and 3N as obtained from the multiplicative analysis, and (b) age 9+ population numbers from cohort analysis against age 9+ population numbers from selected strata from Canadian research vessel surveys in Div. 3L and 3N.

In the first case, the average annual exploitable biomass was calculated by multiplying the average annual biomass estimates at age in the cohort analysis by the partial-recruitment vector noted previously (1973-77 average). In comparing the results of cohort analysis at levels of F_t equal to 0.45, 0.50, 0.55 and 0.60, it was noted that the sum of the 1986 and 1985 residuals, as well as the sum of the squares of these residuals, were lowest at $F_t = 0.50$. The correlation coefficient decreased as F_t increased, indicating a lower value of F_t, but the differences were not significant over the range of F_t used. However, the intercept of the relationship moved closer to the origin over the range of F_t, indicating a slightly higher value of F_t. STACFIS again noted that trends in the pattern of residuals existed in this relationship. A plot of the catchability coefficient calculated from the values in this relationship indicated several trends over time, but STACFIS did not evaluate the potential effect of these trends on the calibration, and used the relationship between average annual exploitable biomass and CPUE as it stood. However, STACFIS did note that the 1965-67 points may have been influential in determining the relationship. In view of the deficiencies in catch reporting of flatfish as in years prior to 1977, particularly prior to 1973 when catches were reported as unspecified flounders, STACFIS agreed that the effect of the points prior to 1977 in determining the relationship of average exploitable biomass and CPUE should be investigated.

In the second case, the regressions were not significant at $F_t = 0.45$ and 0.50, but were significant at $F_t = 0.55$ and 0.60. The correlation coefficient increased over the range of F_t used, and the sum of squares of the 1986 and 1985 residuals decreased over the range of F_t. However, the 1986 residual was close to zero at $F_t = 0.55$.

Based on these analyses, STACFIS decided that terminal F in 1986 for this stock was in the range of 0.5 to 0.6 and chose 0.55 as the midpoint.

Yield-per-recruit

Based on long-term average weights and partial-recruitment values, an analysis that was conducted several years ago indicated $F_{0.1} = 0.26$ and $F_{max} > 3.0$ for this stock. This very high value for F_{max} is caused by the flat-topped shape of the yield-per-recruit curve and is not considered to be a realistic management strategy for this stock (Fig. 10). Recent changes in the fishery have caused the partial-recruitment values to change, indicating changes in the yield-per-recruit curve. STACFIS was unsure if these trends would continue, but recommends *that these changes be investigated and that their potential effect on the calculation of reference levels of fishing mortality be fully documented.*

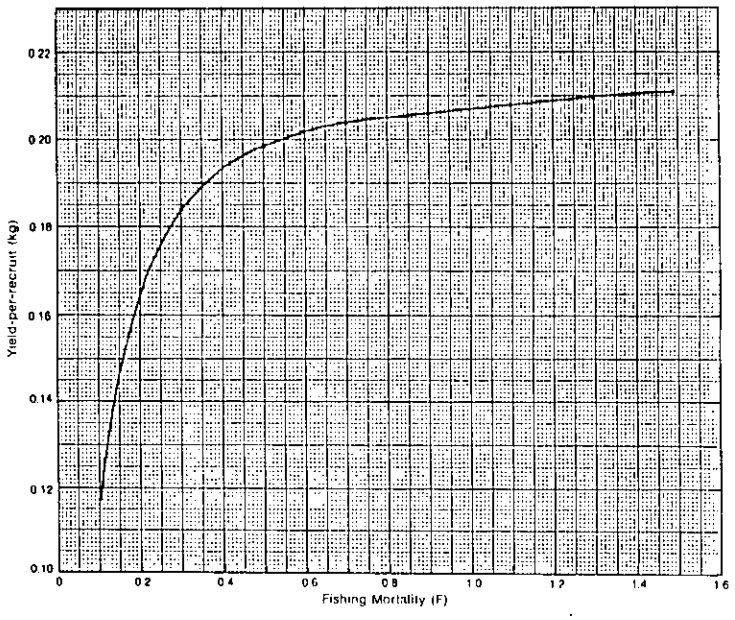

Fig. 10. American plaice in Div. 3LNO: yield-per-recruit curve.

d) Assessment Results

The cohort analysis for Div. 3LN with F_t = 0.55 showed a relatively stable population size at ages 8+ in the 1978-82 period, declining to a 1986 level about 70% of the average in that period. The population biomass at these same ages was similar to those observed in 1974-76, when the catch rates were about the same as those in 1986. From the data available, it was believed that the recruitment at age 6 in 1986 in the cohort analysis was unreasonably high, and, in view of the sensitivity of this value to slight changes in partial recruitment, it was decided to replace this with the geometric mean for the 1974-82 period from the cohort analysis at F_t = 0.55. Historic trends in some population parameters are illustrated in Fig. 11 and 12.

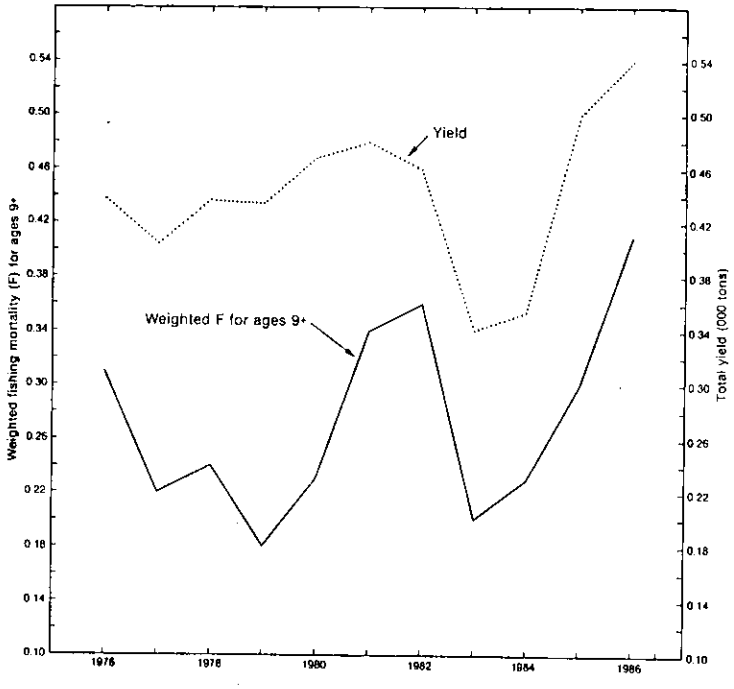

Fig. 11. American plaice in Div. 3LN: trends in total yield, and fishing mortality (ages 9+) weighted by population.

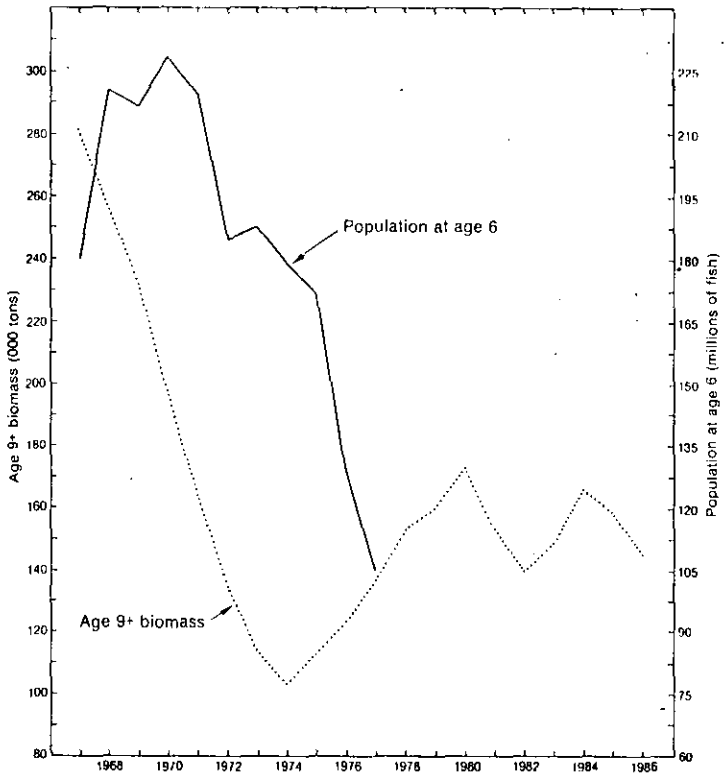

Fig. 12. American plaice in Div. 3LN: trends in age 9+ biomass (at beginning of year) in year t and recruits at age 6 in year t+6.

e) Catch Projections and Prognosis

The parameters used in catch projections are listed in Table 12. The 1986 population was that generated from the cohort analysis at F_t = 0.55, except that the recruitment estimate at age 6 was replaced by the geometric mean of the 1974-82 values at age 6 from the same analysis. This value was also used to represent the recruitment estimate at age 6 in 1987 and 1988. The mean weights-at-age were the 1984-86 averages, and were lower at ages 6-10 and higher at ages 11+ than those used in the 1986 projection. The partial-recruitment values were those used in the cohort analysis and their derivation was described previously.

Table 12. American plaice in Div. 3LNO: parameters used in projections of biomass and yield.

Age (yr)	1987 stock size (000)	Mean W (kg)	Partial recruitment
6	190,000[1]	0.298	0.050
7	147,716	0.356	0.127
8	121,478	0.440	0.284
9	48,811	0.541	0.465
10	32,966	0.623	0.665
11	25,784	0.747	0.833
12	21,953	0.984	1.0
13	12,698	1.303	1.0
14	7,018	1.676	1.0
15	2,918	2.161	1.0
16	1,498	2.715	1.0
17	544	3.146	1.0
18	142	4.009	1.0
19	15	4.094	1.0

[1] Geometric mean recruitment (1974-84).

In the projection, a catch of 44,000 tons of American plaice in Div. 3LN was assumed for 1987 (i.e. 1987 TAC minus an assumed catch of approximately 4,000 tons in Div. 3O). This catch level is associated with a fishing mortality of 0.44 in 1987 which is about 70% higher than

$F_{0.1}$. The projected catch in Div. 3L and 3N for 1988 at $F_{0.1}$ = 0.26 is 28,000 tons. Catches in Div. 30 have averaged about 4,600 tons in the last 5 years. Therefore, STACFIS advises that a catch of 33,000 tons in 1988 would correspond to fishing at $F_{0.1}$ for the stock in Div. 3LNO. A catch in Div. 3LN in the 1988 associated with the 1986 level of fishing mortality (0.55) would be 53,900 tons which would correspond to a TAC of 58,500 tons for Div. 3LNO as a whole. Yield in 1988 and spawning stock size (age 9+ population biomass) at January 1, 1989 at different levels of fishing mortality in 1988 are shown in Fig. 13.

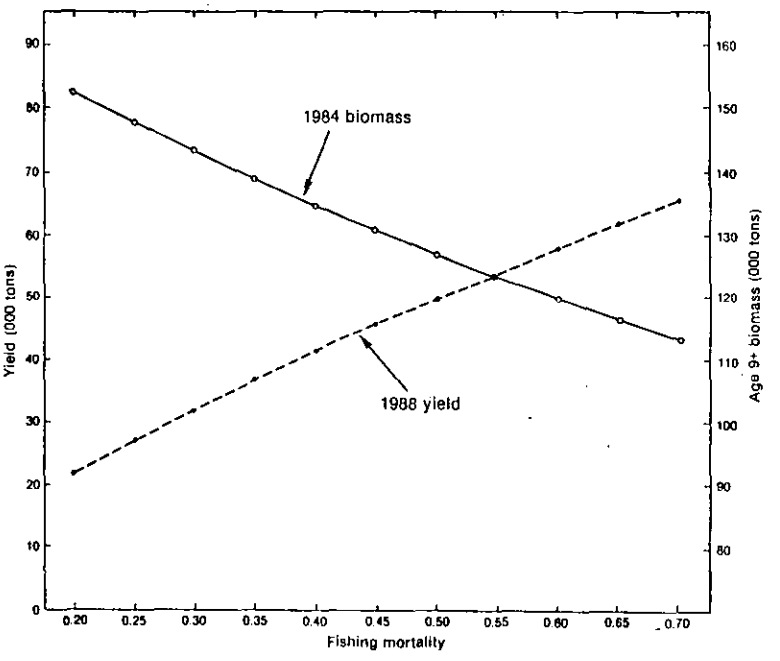

Fig. 13. American plaice in Div. 3LN: projected yield in 1988 and biomass (age 9+) at beginning of 1989 for a range of fishing mortality (fully-recruited age-groups).

It was noted that the catch projected at $F_{0.1}$ for 1988, including an estimate for Div. 30, was much lower than all previous estimates of the annual advised catches at $F_{0.1}$ for this stock. Commercial catch rates, which were very important in determining the population sizes in recent assessments, declined 30% from a 17-year high in 1985 to an 8-year low in 1986. This indicated a change in fully-recruited fishing mortality from 0.35 in 1985 (1986 assessment) to 0.55 in 1986 (1987 assessment). The 1987 assessment indicates F in 1985 to be in the range of 0.4-0.5.

Canadian research vessel surveys in Div. 3LNO indicated relatively stable population sizes in 1985-87, down by about 50% from the 1977-82 average. Research vessel survey data were not used for calibration of cohort analysis in 1985 and 1986, because no survey was conducted during 1983 and a survey of only limited coverage was conducted in 1984. However, use of the research vessel series in this assessment indicated a level of fishing mortality in 1986 similar to that indicated by the commercial catch rates.

In view of the long-term stability of the catches from this stock, as well as some of the apparent anomalies noted in the abundance indices in recent years, STACFIS was concerned that the magnitude of the decline in population size from 1985 to 1986 indicated by this assessment may reflect changes in availability rather than abundance. STACFIS is therefore not confident that the 1988 assessment will confirm the present conclusion, but might in fact support the previous view of the stock. It is evident from Table 13 that a catch in 1988 from fishing between the $F_{0.1}$ level and the F_{86} level would not produce a large change in the spawning stock biomass (age 9+) at the beginning of 1989 (see also Fig. 13). A delay of 1 year in implementing fully the implications of this new assessment may therefore be appropriate.

Table 13. American plaice in Div. 3LN: projected catch in 1988 and biomass at start of 1989, for constant catch in 1987 and various F-values in 1988.

Catch in 1987 (tons)	Fishing mortality in 1988	Catch in 1988 (tons)	Age 9+ biomass on 1 Jan 1989 (000 tons)
44,000	$0.26(F_{0.1})$	27,900	146.7
44,000	0.30	31,800	143.2
44,000	0.35	36,500	138.9
44,000	0.40	41,100	134.8
44,000	$0.55(F_{86})$	53,900	123.3

f) Future Research

With a view toward improving the assessment of the American plaice stock in Div. 3LNO, STACFIS recommends

i) that available length frequency information from non-Canadian catches be incorporated into the calculation of numbers and mean weights-at-age in the commercial fishery, and that countries involved in the fishery for this stock be encouraged to provide appropriate data to the NAFO Secretariat;

ii) that information on the ageing of otoliths from this stock be exchanged between Spanish and Canadian age readers;

iii) that data from more strata be included in the analysis of Canadian surveys, with the use of a multiplicative model being investigated to achieve this goal;

iv) that the effect of recent changes in the age composition of the catch and corresponding changes in mean weight-at-age and partial-recruitment vectors on the calculation of yield-per-recruit be examined; and

v) that the effect on the calibration of cohort analysis of data prior to 1977, when some catch estimates may have been less reliable, be examined.

10. Witch Flounder in Division 3NO (SCR Doc. 87/24; SCS Doc. 87/13)

a) Introduction

Catches of witch flounder in Div. 3NO prior to 1985 ranged from 8,000 tons in 1974 to about 2,400 tons in 1981 and 1982. Provisional data for 1985 and 1986 indicate catches of 8,700 tons and 9,100 tons respectively. The major prosecutors of this fishery have traditionally been Canada and USSR, but a significant portion of the catch was taken by Spain and USA in 1985 and 1986. While Portugal had no catch prior to 1986, it accounted for a large proportion of the catch in 1986. Most of the additional catch in 1985 and 1986 came from Div. 3N. Recent catches and TACs (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	10	10	7	7	5	5	5	5	5	5	5
Catch	6	3	3	2	2	4	4	3	9[1]	9[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort statistics were available from Canadian trawlers which fished the southwestern slope of the Grand Bank (Div. 3O) during winter and spring from 1972 to 1986. although, for many of these years, there has been very little directed fishing effort for witch flounder. The highest catch rate of 0.72 tons/hr was recorded in 1972. Catch rates declined to a low of about 0.20 tons/hr in 1979 but have generally increased since that time to about 0.54 tons/hr in 1985 and remained stable in 1986. No information is available for Div. 3N. Catch-at-age data from the Canadian fishery in Div. 3O indicate a relatively stable age composition since about 1983.

ii) Research vessel surveys

Research vessel surveys have been carried out in Div. 3NO since the early 1970's, but they were only conducted in depths less than 200 fath. Therefore, important depth zones for witch flounder were not surveyed. As a result, STACFIS could not evaluate the usefulness of data from these surveys as indices of abundance for witch flounder in this area.

c) Catch Projections

Considering the commercial fishery data, STACFIS concluded that the witch flounder stock component in Div. 3O may have been relatively stable in recent years at some level higher than in the previous 10 years. However, due to the lack of data, STACFIS could not advise on the status of the witch flounder stock component in Div. 3N. With the information available, STACFIS was not able to advise a change in the TAC for 1988 from the 5,000 ton level presently in effect.

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

d) Future Research

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

11. Yellowtail Flounder in Divisions 3L, 3N and 3O (SCR Doc. 87/43, 44, 46, 48; SCS Doc. 87/13, 15, 18).

a) Introduction

Nominal catches increased from a few hundred tons in the early 1960's to a peak of 39,000 tons in 1972, averaged about 13,000 tons from 1976 to 1984, and increased to about 29,000 tons in 1985 and 1986. Canada was virtually the only nation involved in the fishery during 1976-81, but several other countries have entered the fishery since 1981, notably South Korea, Spain, Portugal, Panama, USA and Cayman Islands. An estimated catch of over 15,500 tons was taken by non-Canadian vessels in 1985, about 62% of which was taken by non-member countries. Catches by all countries were lower in 1986 than 1985, with the exception of Canada, with an 800 ton increase, and Portugal, which reported 5,500 tons in 1986 and 0 tons in 1985. Virtually all of the increase in catch in 1985 and 1986 came from Div. 3N, outside the Canadian 200-mile fishery zone. Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	12	15	18	18	21	23	19	17	15	15	15
Catch	12	15	18	12	15	13[1]	10[1]	15[1]	29[2]	30[2]	

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

b) Input Data

i) Commercial fishery

Catch rates of yellowtail flounder by Canada (N) offshore otter trawlers (tonnage class 4 and 5) declined from about 0.6 tons/hr during 1969-73 to a low of 0.33 tons/hr in 1976 (SCR 87/44) (Fig. 14). The catch rate increased to just over 0.6 tons/hr in 1980-81, was constant at a level around 0.55 tons/hr during 1982-85, and declined about 19% to 0.46 tons/hr in 1986. The USA catch of yellowtail declined from 1985 to 1986, although the number of fishing trips remained relatively constant.

The age composition and average weight-at-age data for 1986 were obtained from samples of landings of Canadian trawlers from Div. 3LNO. Examination of length frequency data from non-Canadian catches (SCS 87/13, 18) did not indicate that recalculation of age composition and average weight parameters was necessary at this time. It was recommended that such data be incorporated into the calculations, if possible, for future assessments.

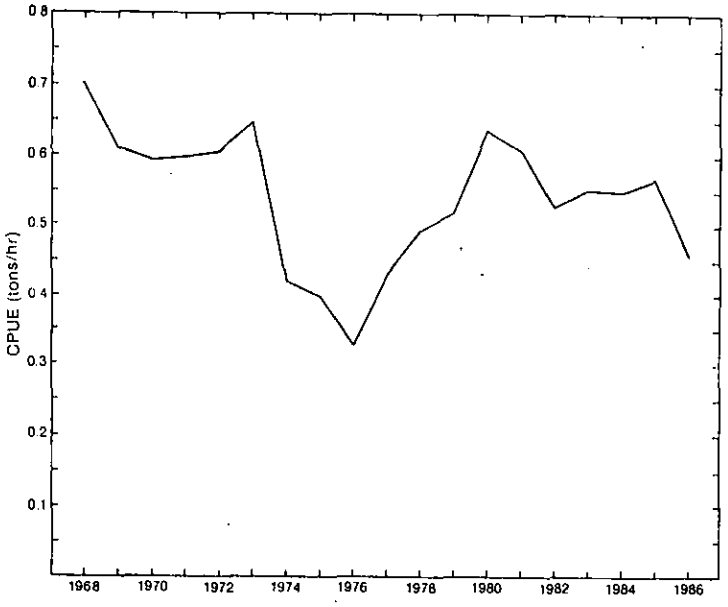

Fig. 14. Yellowtail flounder in Div. 3LNO: commercial catch-per-unit effort, 1968-86.

As in 1985, the 1978 and 1979 year-classes dominated the commercial catch in 1986, comprising about 75% of the catch both by number and weight. The 1978 and 1979 year-classes were among the strongest in the 19-year time series at age 7. The catches of ages 4 and 5 fish were at low levels in 1982-86, contributing less than 3% to the catch (by number) in 1986, the lowest value in the series. Although the catch at age does not indicate the presence of any strong year-classes after those of 1978 and 1979, STACFIS noted that these two year-classes did not appear to be particularly strong in the commercial catch at ages 4 and 5. The weights at age were lower in 1986 than 1985 but were similar to the values for other years in the series. The sum of the products of number at age in the catch and weight-at-age was 2.6% higher than the nominal catch, a difference considered to be acceptable.

ii) Research vessel surveys

Stratified-random groundfish surveys. The Canadian spring surveys (SCR 87/44) indicated a relatively stable population of yellowtail flounder during 1978-82 (Fig. 15). There was no survey in 1983 when the population size showed a sharp increase between 1982 and 1984. The 1985 and 1986 estimates (as well as the preliminary estimate for 1987) of population size are slightly below the 1978-82 mean value. A preliminary estimate of the biomass in Div. 3LNO from 1987 Canadian spring survey showed a 13% decrease from the 1986 biomass estimate. However, USSR research surveys (SCS 87/15) indicated a decline in abundance during 1984-86 with a decline in biomass during 1983-86. The decline in both USSR indices was approximately 50% from 1985 to 1986. It was also noted from recent Canadian surveys that the 1978 and 1979 year-classes were relatively strong, which was in agreement with data from commercial catches in 1985 and 1986. However, these surveys do not show the 1980 and 1981 year-classes as being strong.

STACFIS noted that Canadian survey coverage was not complete in some years and recommends *that additional strata be included in the group of selected strata for Div. 3LNO, allowing an index to be calculated which would probably be more indicative of yellowtail abundance*. STACFIS also noted that no attempt was made to relate survey results to environmental factors, particularly in the last 3 or 4 years, and that such work may be important for this stock, in view of its location at the northern limit of the species range. STACFIS was informed that analysis of these data was in progress and the results would be presented in the near future.

Line transect survey (Divisions 3NO, April 1986). Catches from line transects bisected by the Canadian 200-mile fishery zone boundary on the southern Grand Bank indicated yellowtail flounder to be significantly more abundant within the zone than outside the zone in April 1986 (SCR 87/43). These results were in agreement with the results from the stratified-random survey which was conducted in the area shortly afterwards in 1986 but were clearly different from the results of the stratified-random survey in 1985. Although the 1985 survey indicated yellowtail flounder to be more abundant in the area just outside the boundary than in the area just inside the boundary, STACFIS noted that the 1985 survey was virtually the only one in the series in which this situation

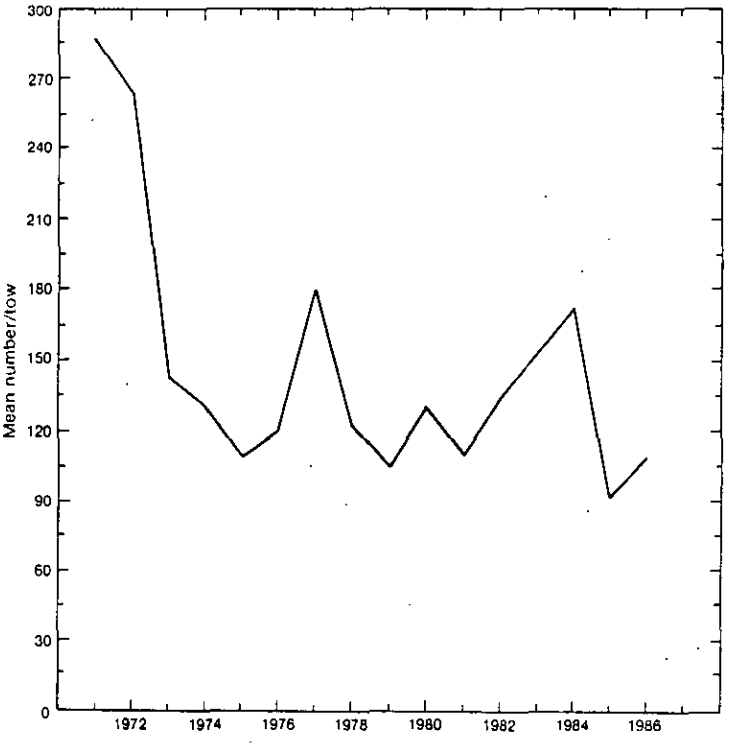

Fig. 15. Yellowtail flounder in Div. 3LNO: abundance index from research vessel surveys, 1971-86 (no estimate for 1983).

occurred. However, it was noted that the ratio of average catch weight inside the boundary to average catch weight outside the boundary was 4.2 in the 1986 transect survey and 10.4 in the 1986 stratified-random survey, compared to 0.86, 1.07 and 1.88 in the 1985, 1984 and 1982 stratified-random surveys respectively, and an average value of 2.05 in the 1971-79 surveys. It was noted that a large increase in the catch from the area outside the 200-mile fishery zone in Div. 3N occurred in 1985, but the data were insufficient to determine if the differences in the mean catches on either side of the boundary (from the 1985 and 1986 surveys) could be attributed to this increase in catch or were caused by changes in the yellowtail distribution in these years.

Juvenile surveys. Canadian surveys for juvenile flatfish, using a stratified-random design in depths inside the 100 m isobath, were conducted in 1985 and 1986. The survey design is such that independent estimates can be derived from fishing sets conducted during the day and during the night. Both abundance and biomass estimates were found to be statistically higher during night sets (SCR 87/48). In addition, the 24-hr diel study in 1986 showed higher numbers and weights of both juveniles and adults during night catches. At the recommendation of STACFIS in 1986, a re-examination of the distribution of yellowtail flounder (ages 1-4) showed that juveniles are mainly limited to the strata in and around (to the west of) the Southeast Shoal. Estimates of average number-per-tow by age-group in 1985 and 1986 were recalculated for these strata and may be appropriate as indicators of year-class strength. STACFIS noted that the 2-year time series of juvenile surveys was insufficient to evaluate the relative strengths of recruiting year-classes, but was encouraged that reanalysis of the data resulted in new information on juvenile distribution and diel variability. Further investigation into these aspects of yellowtail flounder distribution was recommended.

Tagging results from the 1972 tagging program (SCR 87/46). Out of the 998 tagged yellowtail flounder in Div. 3N, 5% tag returns were reported, mostly from the second and third quarters of 1973 and 1974. Movements of 13 tagged fish showed that 8 out of 13 ranged 4-12 miles from the tagging site while the remaining 5 were recaptured over a range of 31-86 miles. All tag recoveries were made inside the 100 m depth contour on the Grand Bank.

c) Assessment Results

STACFIS noted that the previously documented occurrence of very high levels of mortality at the older ages has not been resolved for this stock. Primarily for this reason, cohort analysis was not used to form the basis of catch projections.

d) Catch Projections

STACFIS again expressed concern that the nominal catch in 1986 was almost double the TAC, similar to the situation in 1985. It was noted that high catches, between 23,000 and 37,000 tons in 1970-75, were followed by sharp declines in stock abundance and yield. Commercial CPUE decreased by 35% from 1973 to 1974, and declined a further 21% from 1974 to 1976. STACFIS noted that the decline in CPUE from 1973 to 1976 was reversed shortly afterward, when catches were reduced from above 22,000 tons to 8,000-15,000 tons in 1976-78. The abundance indices for this stock were relatively stable from 1978 to 1984, when catches averaged about 14,200 tons.

STACFIS noted that catches from this stock were negligible prior to 1965, indicating that the stock was probably below a commercially exploitable level until the mid-1960's. The establishment of yellowtail flounder on the Grand Bank may have been related to the severe depletion of the haddock stock in the same area, following very large catches in the late 1950's and early 1960's as postulated by Pitt (J. Fish. Res. Board, Can., Vol. 22(1970): 2261-2271). In view of this, as well as the observed decline in abundance of yellowtail flounder in the mid-1970's after several years of catches over 22,000 tons, STACFIS expressed concern that it may be possible to reduce this stock to very low levels, perhaps even to the level of the early 1960's, when there was no commercial fishery.

STACFIS noted that the strong 1978 and 1979 year-classes cannot be expected to contribute significantly to catches after 1987 and that recent research vessel surveys do not indicate anything other than average recruitment. STACFIS, therefore, reiterated that the stock cannot sustain catches around 30,000 tons. With the 1985 and 1986 catches close to this level, and the indices of abundance all showing declines either from 1985 to 1986 or 1986 to 1987, STACFIS advises that the catch from this stock in 1988 should not exceed the current TAC level of 15,000 tons.

e) Future Research

With respect to the yellowtail flounder stock in Div. 3LNO, STACFIS recommends

i) that available sampling from the non-Canadian catch in 1985 and 1986 be incorporated into the calculation of age composition of the catch and average weight-at-age;

ii) that the Canadian research-vessel survey data be reanalyzed to include information from more strata, the feasibility of using a multiplicative model in this analysis be investigated; and

iii) that further analysis on the distribution and abundance of juvenile yellowtail flounder be conducted, involving determining the effects of diel variability on indices of abundance from research vessel surveys on both juvenile and adult yellowtail flounder.

12. Greenland Halibut in Subareas 0 and 1 (SCR Doc. 87/22, 33, 34, 35; SCS Doc. 87/14, 15)

a) Introduction

Nominal catches peaked at 25,000 tons in 1975 and have been less than 10,000 tons since 1980. The provisional catch in 1986 was 8,700 tons, which is a decrease of 5% from that in 1985. The whole catch was taken by Greenland, mainly in Div. 1A (75%). The fishery is primarily carried out as an inshore gillnet fishery, although a minor inshore longline fishery also takes place. In one of the main areas for the fishery for Greenland halibut, Jakobshavn-Ilulissat region in Div. 1A, the proportion of the catch taken by gillnets was estimated to be 80% of total for this species. Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	20	20	25	25	25	25	25	25	25	25	25
Catch	13	12	19	8	10	9	9	7	9[1]	9[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Some information on the commercial fishery in the Jakobshavn-Ilulissat region (Div. 1A) is available for 1985 and 1986 and for the spring of 1987 (SCR Doc. 87/33). A gillnet fishery off Jakobshavn Icefiord shows length distribution of catches with a narrow range and a peak in the 60-64 cm length groups. A longline fishery mainly in Jakobshavn

Icefiord show length distribution of catches with a broad length range of 30-124 cm and no pronounced peak. The proportions of the catches of the two fisheries are very dependent on variation in ice-cover conditions. For instance, the winter of 1985/86 and the spring of 1986 were unusually warm, and the length composition of the total catch from the Jakobshavn-Ilulissat region in 1986 was dominated by the gillnet catches.

ii) Research data

Trawl surveys. USSR trawl surveys were conducted in Div. 0B during the autumn annually since 1979. The results indicate that abundance and biomass have declined substantially since 1982. This might be due to changes in hydrological conditions which occurred in the period for which the trawl surveys were made. Abundance index for 1986 increased from 3.1 kg/hr at 200-300 m to 534 kg/hr at 800-900 m and decreased to 241 kg/hr at 1,000-1,100 m.

A Canadian stratified-random trawl survey was conducted in August-September 1986, covering Subarea 0 and 1 in depths of 200-1,250 m from 61°N to 70°N. Abundance of Greenland halibut was greatest at depths between 600 and 1,000 m, which is consistent with the data from the USSR survey. Size of fish generally increased with depth. The estimated biomass for the investigated area was 282,000 tons, but the estimate was considered conservative because much of the area of distribution of Greenland halibut was not surveyed. Stratified mean number-per-tow by age-group indicated strong 1979 and 1985 year-classes. The catch curve from this survey indicated a total mortality (Z) of 0.64. However, this value is probably overestimated due to the absence of old mature fish which had been shown in earlier USSR surveys to exist in depths beyond that of this survey.

Tagging. Results from tagging experiments in Godthab Fiord (Div. 1D) in 1969 and 1970 show no recaptures outside the fiord (SCR Doc. 87/34). STACFIS noted that there is no evidence of spawning within the fiord. So far, the assumed emigration from West Greenland fiords to the Davis Strait for spawning has never been confirmed by tagging experiments. This could be due to the lack of commercial fishing in the deeper parts of the Davis Strait. From the longline tagging experiment, the average total mortality (Z) was estimated to be 0.76. Reliable fishing mortality estimates cannot be made because no information on tagging mortality and non-reporting of recaptures are available.

Other research results. By-catches of Greenland halibut in the Greenland shrimp fishery and in Federal Republic of Germany groundfish surveys indicate that the main areas of distribution of young fish are the offshore area north of 68°N latitude and in Disko Bay (SCR Doc. 87/35). High abundance of young fish are also found in some coastal areas in southern West Greenland. In light of the hydrography and the currents in the area, a drift of larvae to the West Greenland area is consistent with spawning in the Davis Strait. However, the high abundance of young fish in some coastal areas could not be explained by a passive transport of larvae from the Davis Strait, and it was suggested (SCR Doc. 87/35) that young Greenland halibut in the coastal area in the southern part of West Greenland may originate from the Iceland-East Greenland area, from where they are transported by the East Greenland current to West Greenland.

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.

13. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 87/45; SCS Doc. 87/15)

a) Introduction

Catches of Greenland halibut during 1970-76 ranged from about 24,000 tons to 30,000 tons annually. The highest annual catch of 39,000 tons was taken in 1978. In recent years most of the catch has been taken by Canada, particularly by inshore gillnet fishermen along the coasts of northeastern Newfoundland and southern Labrador, although Poland, USSR, German Democratic Republic and Japan still take part in the fishery. Catches have been declining since 1983, and the 1986 catch of about 12,000 ton was the lowest annual catch since 1965 with the 1985 catch of 17,000 tons being the second lowest since 1965. Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC[1]	30	30	30	35	55	55	55	55	75	100	100
Catch	32	39	34	33	31	26	28	25	17[2]	12[2]	

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

b) Input Data

i) Commerical fishery data

Due to the nature of this fishery and the migratory behavior of Greenland halibut, it is particularly difficult to obtain CPUE data which may be an accurate reflection of total stock abundance. The only new catch rate (0.56 tons/hr) was from Canada (N) otter-trawl fishery during July-August 1986 based upon only 1,100 tons of directed catch. Nevertheless, it was consistent with a trend of declining catch rates during 1984-86 in Div. 2J for the same time of year. Such a decline was unexpected, due to presence in the fishery of the relatively strong 1979 year-class.

The age composition of the Canadian commercial fishery is primarily comprised of 6-, 7- and 8-year-old fish, and these age-groups accounted for 80% of the 1985 and 1986 catch in numbers. This was due to the fact that the fishery is mainly by highly-selective gillnets in the more southerly range of the stock where younger fish are more abundant. Should the present fishing pattern continue, the concentration of the fishery on these age-groups is likely to continue.

ii) Research vessel surveys

Estimates of biomass from research-vessel surveys in Canada in Div. 2J and 3K declined from 1984 to 1985, but the 1986 biomass estimate was similar to the 1983 and 1984 estimates. A similar trend was shown for USSR surveys in Div. 3K for the same period. No trend was apparent from Canadian surveys in Div. 3L. The estimated minimum trawlable biomass in Div. 2J+3KL for 1986 was 196,000 tons, despite the lack of complete survey coverage. This compares to an average estimate of 197,000 tons for 1983-84. These estimates are considered minimal because the deepwaters of the continental slope where larger Greenland halibut are located are not surveyed, and the catchability for this species could be as low as 15-20% according to experimental evidence. A large portion of the stock area (i.e. Div. 2GH) has not been surveyed since 1981 when minimum trawlable biomass levels were estimated to be in the order of 200,000 tons during 1978-81.

Catch-at-age data from the Canadian surveys in Div. 2J and 3K indicated the 1979 year-class to be stronger than any other in the series at age 5, and the 1974-77 year-classes were considered to be average at age 5. The 1980 year-class was about average at age 5 in the 1985 survey, but it was previously indicated to be stronger than average according to the results of modal analysis of length frequency data from the northern shrimp surveys in Div. 2H and 2J. The 1981 year-class was in the size range of the 1974-77 year-classes.

Age compositions from the shrimp survey of Div. 2H and 2J in 1984-86 showed conflicting evidence as to the relative strengths of the 1979 and younger year-classes. For example, the 1979 year-class dominated the catch from Div. 2H in 1984. The 1984 year-class clearly dominated in the 1985 survey, and the mean catch-per-tow of the 1985 year-class in the 1986 survey was higher than any in the series. In Div. 2J, the 1982 and 1983 year-classes dominated the catch in both 1984 and 1985. In the 1986 survey, the 1985 year-class occurred in greater abundance than any in the series, similar to that shown for Div. 2H. In view of the short time series, it is still too early to relate the abundance estimates of recruiting year-classes from the shrimp surveys to those of the groundfish surveys or from SPA to establish precise recruitment indices of abundance.

c) Estimation of Parameters and Assessment Results

Due to lack of suitable calibration procedures for SPA, estimation of fully-recruited fishing mortality could not be determined. With present catch levels and survey biomass estimates, however, STACFIS considers the overall fishing mortality on this stock to be quite low.

d) Catch Projections

From the available data, STACFIS cannot advise a TAC based on fishing at $F_{0.1}$. However, considering the low exploitation levels and the high level of estimated biomass, STACFIS advises that a TAC of 100,000 tons throughout Subarea 2 and Div. 3KL in 1988 is unlikely to exceed the fishing mortality level of $F_{0.1}$.

STACFIS noted that, at the present fishing pattern mainly in shallower depths (< 500 m) and in the more southerly divisions (particularly Div. 2J, 3K and 3L), a catch of 100,000 tons is not likely to be achieved. However, older fish (age 10+) are more abundant in depths greater than 700 m on the continental slope and in the more northerly areas (Div. 2G and 2H), part of the advised TAC may be fished there.

e) Future Research

STACFIS recommends *(i) that biomass estimates and catch-at-age data from the complete USSR series of Greenland halibut surveys be provided in a single document for the June 1988 Meeting; (ii) that the shrimp survey data on Greenland halibut be examined further in an attempt to standardize the catch-at-age between Div. 2H and 2J to better evaluate year-class strength; and (iii) that the lack of correspondence between survey and SPA population size and age structure be investigated as a basis for exacting improved hypotheses about SPA input parameters.*

14. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 87/39; SCS Doc. 87/15)

a) Introduction

A total catch of 31 tons was reported for 1986, a decrease from 51 tons in 1985. Catches since 1978 have been restricted to by-catches in the Greenland halibut fishery. Recent catches and TACs (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	8	8	8	8	8	8	8	8	8	8	8
Catch	3	3	6	7	2	+	+	+	+	+	+

b) Input Data

i) Commercial fishery data

There has been no directed fishery for roundnose grenadier in SA 0+1 since 1978. Therefore, no update of the catch-effort analysis which had been presented previously (NAFO Sci. Coun. Rep., 1985, page 72) was possible.

ii) Research data

Results from a 1986 Canadian research survey in SA 0 and 1 (SCR Doc. 87/39) indicated that the species was not found north of about 66°30'N. The fish ranged in size from 3.5-20.5 cm (anal fin length), with the size generally increasing with depth. They were caught at depths from about 600 m to the maximum depth fished (1,250 m) but were most abundant between about 800 and 1,100 m. The total estimated trawlable biomass was determined to be about 110,000 tons, with about 90% of this being estimated in SA 1.

USSR research data for SA 0 (SCS Doc. 87/15) indicated that fish aged 7-9 predominated in the area in 1986. The mean length (total) of grenadiers declined from about 63 cm in 1981 to about 56 cm in 1986. This probably indicates an increase in smaller fish, because there has been only a low annual catch during this period.

c) Catch Projections

STACFIS noted the continuing lack of commercial data for this stock due to continued low catches. The present TAC of 8,000 tons represents a relatively low proportion (about 7%) of the estimated minimum trawlable biomass from the 1986 survey. Because of the lack of recent commercial data, and since the 1986 survey result is a point estimate, STACFIS advises that the 1988 TAC remain at the 1987 level of 8,000 tons.

d) Future Research

STACFIS noted that in the absence of a directed commercial fishery, any updates concerning the status of this stock must come from research data. The question of appropriate research in this area will be addressed by STACFIS in September 1987 in response to a specific request from Canada.

15. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 87/39; SCS Doc. 87/15)

a) Introduction

The 1986 catch of about 7,500 tons was up about 25% from the reported catch in 1985 but was only about 68% of the TAC. This increase was due to increased catches by both the German Democratic Republic and the USSR. Nominal catches, however, remain low relative to those prior to 1979. Catches and TACs (000 tons) for the recent period are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	35	35	35	30	27	27	11	11	11	11	11
Catch	15	21	8	2	7	4	4	4	5[1]	7[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch and effort data were available from the ICNAF/NAFO database for the 1967-85 period. In addition, data were available for the 1978-86 period from the Canadian Observer Program. The two data sets were analysed separately using a multiplicative model to derive standardized catch rates and effort (SCR Doc. 87/39). Catch rates have declined from the early 1970's to the present. Both series indicate relative stability in catch rates in the 1980's.

ii) Research data

The results of a 1986 research survey in Subarea 2 and Div. 3K by the USSR were presented (SCS Doc. 87/15). Catches consisted of ages 3-20 fish. Smaller fish were found in Div. 3K than in Subarea 2 and the size of the fish caught in both areas increased with depth. It was noted that the percentage of females also increased with depth.

c) Estimation of Parameters

Data were insufficient to carry out an analytical assessment of this stock. Examination of the relationships between standardized CPUE and standardized effort (unlagged and lagged 4 and 6 years) indicated that the relationships were either not significant or were significant with positive slopes. Thus general production analysis was not possible.

d) Catch Projections

As has been reported previously, the low catches relative to the TACs in recent years may, in part, be due to the limitations on Greenland halibut by-catch. Catches have increased from 1984 to 1986, possibly because of a reduction of this by-catch problem due to warming water in 1986 (NAFO Sci. Coun. Rep., 1986, page 73) and movement from the area of the relatively strong 1972 and 1973 year-classes. It was noted, however, that the catch rates have not increased during this period but instead have remained relatively stable. Therefore, STACFIS has no basis to advise a change in the TAC for 1988 from the present level of 11,000 tons.

STACFIS noted that, in the past, virtual population analyses were carried out on this stock. In recent years, however, catch-at-age data have not been made available by the countries which prosecute this fishery. STACFIS therefore recommends *that those countries involved in the Greenland halibut fishery examine their databases for data on age composition of commercial catches and if possible, prepare updated VPAs for this stock, following the designated guidelines for presentation of the results.*

16. Wolffish in Subarea 1 (SCR Doc. 87/61; SCS Doc. 87/14)

a) Introduction

The nominal catch in West Greenland waters includes two species: Atlantic wolffish (*Anarhichas lupus*) and spotted wolffish (*A. minor*). Since 1957 the total combined catch has been in the range of 2,000-6,000 tons. There is some indication that the 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	1986
Catch	6	6	6	17	5	4	4	3	2	2	2[1]

[1] Provisional data.

b) Input Data

Groundfish survey estimates by the Federal Republic of Germany indicated a decline in biomass of Atlantic wolffish from 28,000 tons in 1982 to only 7,000 tons in 1984. In 1985 and 1986, biomass estimates remained at this low level. Abundance, however, decreased to a lesser

degree, because a reduction in numbers of older and larger fish was partly compensated by increasing numbers of younger and smaller fish. Average individual weights declined from 1.2 to 0.5 kg over the survey period.

A similar trend in biomass and abundance was observed for spotted wolffish over the same period. This species is, however, far less abundant in the survey area than Atlantic wolffish. Biomass estimates declined from 9,000 tons in 1982 to 2,000 tons in 1985 but increased again to 4,000 tons in 1986. The respective average individual weights were 5.1 kg. 2.9 kg and 3.6 kg.

It seems unlikely that the offshore commercial trawl fishery, exerting a relatively low and even decreasing level of fishing effort during the same period, could have contributed significantly to the observed changes. It was noted that the surveys cover only a part of the area of distribution of both species and that spotted wolffish is generally more abundant in inshore areas.

c) Catch Projections

Until more biological data and separate catch statistics for the two species become available, it will not be possible to carry out a detailed assessment. Trawl catches off West Greenland are not expected to increase significantly in the near future. The available statistics and biological information indicates no change in the previous advice, i.e. a total catch in the range of 5,000-6,000 tons corresponding to the long-term average catch.

d) Future Research

Acknowledging the presentation of recent studies, STACFIS encouraged the continuation of further biological investigations on the wolffish stocks off West Greenland.

17. Capelin in Divisions 3L, 3N and 3O (SCR Doc. 87/18, 49, 50, 60, 69)

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 1979-86. Provisional statistics for 1986 indicate a total catch of 48,000 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:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Advised TAC[1]	200	200	16	16	30	-[2]	60	38	60	130	293
TAC[1]	200	200	10	16	30	30	30	26	26	55	54
Catch	74	30	12	14	24	27	25	33	25[3]	48[3]	

[1] For Div. 3L only in 1979-86.
[2] Management measures adopted by Fisheries Commission without STACFIS advice (NAFO Sci. Coun. Rep., 1981, page 83)
[3] Provisional data.

b) Input Data

i) Commercial fishery (SCR Doc. 87/50)

A logbook survey of the inshore capelin fishery in Div. 3L, designed to provide estimates of catch-per-unit-effort, was initiated in 1981. The catch rates of trapnets and purse seines in the following table (where catches are derived from the addition of the quantities actually landed and the quantities of discards from logbooks) show similar patterns over the 6-year period, increasing from 1981 to 1983, declining in 1984 and increasing from 1984 to 1986. The 1985 catch-rate estimates are probably biased upward because fishing patterns were different in 1985 (NAFO Sci. Coun. Rep., 1986, page 74). The 1986 catch rates are the highest in the series.

	1981	1982	1983	1984	1985	1986
Trapnets (tons/day)	2.9	3.1	3.4	2.9	4.6	4.6
Purse seines (tons/day)	9.4	16.4	18.8	14.3	16.4	19.0

Discarding (which includes dumping of dead capelin as well as releasing fish alive) of capelin in 1986 was lower than in 1985 due to favourable market conditions. During 1986, 'redfeed' and low percentages of females in the catch were the principal reasons for discarding. The reported by-catch of cod in trapnets in 1986 (less than 0.5% of reported logbook landings) was lower than in 1985 (1.0%).

The 1983, 1982 and 1981 year-classes accounted for 62%, 34% and 3% of the commercial catch (by numbers) in the 1986 inshore fishery.

ii) Research data (SCR Doc. 87/18, 49, 60, 69)

Aerial surveys of capelin in Trinity Bay and Conception Bay have been conducted in June and July since 1982 (SCR Doc. 87/49). Total surface area of schools, estimated from aerial photographs, provided an index of abundance. The trends in the school surface area index from 1982-85 were comparable to the catch-rate indices and projected biomass estimates, however, the 1986 school surface area index was biased downwards because of incomplete coverage. Bad weather in 1986 restricted flying time to less than half of the time flown in 1984 and 1985.

An acoustic survey by Canada in Div. 3NO during 26 June-05 July 1986 provided a biomass estimate of 495,000 tons, of which 485,000 tons were mature (SCR Doc. 87/69). The 1986 estimate is the highest in the 1981-86 Canadian survey series (range of 85,000-495,000 tons). The strong 1983 year-class dominated in the 1986 survey, accounting for 67% of the catch by numbers and 65% of the biomass.

An acoustic survey was also conducted by Canada in Div. 3L during 15 May-01 June 1987 (SCR Doc. 87/69). The total biomass was estimated to be 2,576,000 tons, compared to an estimate of 3,697,000 tons from a similar survey in 1986. In the 1987 survey, the 1985 year-class accounted for 57% of the estimate by number and 25% by weight. While accounting for 25% of the estimate by number, the 1983 year-class accounted for 52% of the estimate by weight. Results from Canadian acoustic surveys in 1985-87 indicated that the 1985 year-class was approximately one quarter the strength of the 1983 year-class and 1.4 times the strength of the 1984 year-class at age 2.

Results of an acoustic survey by the USSR (SCR Doc. 87/18) in Div. 3LNO during 16-27 June 1986 provided a total biomass estimate of 1,492,000 tons (933,000 tons in Div. 3L, and 559,000 tons in Div. 3NO), compared to an estimate of 2,200,000 tons from a comparable survey in 1985. The 1983 year-class dominated in both Div. 3L (71% by number) and Div. 3NO (75% by number).

The USSR also conducted a survey (SCR Doc. 87/18) for 0-group capelin in Div. 3LNO during 30 November-12 December 1986. The abundance of the 1986 year-class was lower than the 1984 and 1983 year-classes by factors of about 3.8 and 6 times respectively. No 0-group estimates of the relative size of the 1985 year-class were available.

An analysis of relative year-class strengths from Canadian offshore acoustic surveys and inshore catch rates (SCR Doc. 87/60) indicated that, during the 1980's, the 1983 year-class was strong and the 1981 year-class was weak. The inshore catch rates by age-group indicated that the 1980 and 1982 year-classes were also strong, while the relative indices by age-group from the offshore surveys showed that these year-classes were weak. The low indices for these year-classes may have resulted from insufficient survey coverage or lack of coverage of high densities of capelin due to ice cover.

c) Estimation of Parameters

Estimates of the strength of the 1984 year-class indicate that it is about 17-26% of the 1983 year-class, and the 1985 year-class is about 24-36% of the 1983 year-class. The major contributors to the mature population in Div. 3L during 1988 will be the 1984 and 1985 year-classes, and, because these year-classes are weaker than the 1983 year-class, the spawning biomass in 1988 is expected to decline.

Spawning mortality and mean weight-at-age vectors and proportions mature were the same as used in previous assessments (Table 14). No estimates of spawning mortality at age 2 are available, and, for catch projections, the estimate of spawning mortality is 1.39. Estimates of year-class strength for immature and mature capelin were derived from the 1987 Canadian survey.

d) Catch Projections

The results of the projections, using the estimates of year-class strength and parameters as outlined above, together with M = 0.30 and a spawning date of 1 June, are given in Table 15.

Table 14. Capelin in Div. 3LNO: parameters used in projections of stock size.

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

[1] Used to calculate mature biomass in 1988.

Table 15. Capelin in Div. 3LNO: Projections of stock size for 1988.

Age	Number of fish (millions)		
	June 1987		
	Mature	Immature	June 1988
2	4,700	83,100	
3	13,800	4,700	62,500
4	37,600	900	6,000
5	9,400	-	3,700
6			700
Biomass (tons) of mature fish			900,000

STACFIS continues to consider an exploitation rate of 10% of the mature biomass to be appropriate for capelin, and accordingly advises a TAC of 90,000 tons for Div. 3L in 1988.

The estimates of abundance of the 1984 and 1985 year-classes were derived from acoustic surveys and therefore exhibit large variances. The large variance in the acoustic estimates resulted, in part, from the variance around target strength values, and, as previously noted (NAFO Sci. Coun. Rep., 1986, page 75), the Canadian target strength values resulted in higher estimates of year-class abundance than the target strength values used by USSR scientists.

No stock projections were made for capelin in Div. 3NO because estimates of the 1984 and 1985 year-classes for this stock were not available. During its deliberations in 1986, STACFIS noted that this fishery had been closed for several years due to low stock levels but that the stock had recovered enough to allow a small commercial fishery. Consequently, STACFIS advised that a catch of 10,000 tons would not be detrimental to the stock and such a precautionary TAC would represent approximately 5% of the average biomass observed since 1981. With the additional survey results from 1986, a catch of 10,000 tons would represent less than 5% of the 1981-86 average biomass.

The acoustic surveys in Div. 3NO during 1986 resulted in biomass estimates of approximately 500,000 tons. If the spawning stock biomass in Div. 3NO declines in the same proportion as that projected for the spawning stock in Div. 3L (projections of 1,300,000 tons and 900,000 tons) between 1986 and 1988, then the spawning stock biomass in 1988 would be in excess of 300,000 tons. A catch of 10,000 tons in 1988, as advised for 1987, would represent less than 5% of this projected biomass. Based on these considerations, STACFIS advises that a catch of 10,000 tons from Div. 3NO in 1987 would probably not be detrimental to the stock.

18. Squid in Subareas 3 and 4

a) Introduction

Nominal catches of short-finned squid (*Illex illecebrosus*) in Subareas 3 and 4 peaked at 162,000 tons in 1979, declined rapidly to about 400 tons in 1983. The reported catch in 1986 was only 37 tons, the lowest in the past years. Recent TACs and catches (000 tons) are as follows:

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
TAC	25[1]	100	120	150	150	150	150	150	150	150	150
Catch	83	94	162	70	33	13	+	1	1[2]	+[2]	

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

b) Catch Projections

STACFIS was unable to provide catch projections on squid in Subareas 3 and 4 for 1988. However, there was no reason to change advice that was formulated in 1980 (NAFO Sci. Coun. Rep., 1979-80, pages 39-40 and 57-59), and STACFIS advises that the TAC for 1988 should remain at 150,000 tons.

c) Future Research

The lack of information on squid at this meeting reflects a reduction or elimination of squid research programs in the NAFO area. STACFIS points out that periods of high squid abundance can be expected in the future, like those that have occurred in the past. Improved knowledge of squid population dynamics will be essential, if the fishery is to be effectively managed during such periods and optimum utilization achieved. The present period of low abundance provides an opportunity to make progress in understanding the biology and dynamics of squid before an increase in abundance actually occurs. Under the present circumstances, STACFIS sees no point in making specific research recommendations, as previously, although the need for such work remains. Contracting Parties are encouraged to reconsider the wisdom of not providing support for squid at this time.

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

The shrimp stock in Davis Strait and Denmark Strait were assessed and advice for the fishery in 1987 was provided by the Scientific Council at its meeting in January 1987 (SCS Doc. 87/1). At that time, the Scientific Council questioned the need for future special meetings on shrimp.

The Committee noted that requests by Denmark (Greenland) and Canada for advice regarding the 1988 fisheries had been received and agreed that consideration of these requests should await the decision of the Scientific Council concerning the time when future assessments of the shrimp stocks should be conducted. (See relevant section of the preceding report of the Scientific Council.)

III. RESPONSE TO THE FISHERIES COMMISSION REQUEST

1. Cod in Divisions 2J, 3K and 3L (SCR Doc. 87/54)

a) *Is there further information available on stock separation in Div. 2J+3KL?*

A review of studies on discrimination of the various stock components of cod in Div. 2J+3KL was presented at the 1986 Annual Meeting (NAFO Sci. Coun. Rep., 1986, pages 121-124). Information on genetic variation, migrations, meristics, infestation by parasites, growth rates, ages and lengths at maturity and spawning time were discussed. No new information on this topic is available, and the conclusions from previous discussions remain unchanged.

b) *Is there further information on the proportion of the biomass of the cod stock in Div. 3L in the Regulatory Area?*

Results from Canadian research-vessel surveys in Div. 3L in spring and in Div. 2J, 3K and 3L in autumn during 1986 were added to previously analysed data sets. The proportion that the cod biomass in the Regulatory Area in Div. 3L is of the biomass in the surveyed area in that division is now estimated to be 3.4% from eight spring surveys (1977-82, 85-86) and six autumn surveys (1981-86), compared to previous estimates of 3.5% and 3.1% respectively. Results from two winter surveys (1985 and 1986) indicate that 25.3% of the Div. 3L cod biomass occurs in the Regulatory Area during this time of year.

Results of autumn surveys in Div. 2J, 3K and 3L during 1986 indicate that the proportion of the entire stock biomass occurring the the Regulatory Area in Div. 3L for this time of year is 0.9%. This is the same percentage that was derived from results of previous autumn surveys (1981-85). From these same survey results, the average divisional breakdown of

biomass differs only marginally with the inclusion of the 1986 survey data. These average divisional proportions are now estimated to be :42% in Div. 2J, 31% in Div. 3K and 27% in Div. 3L. With the assumption that the relative distributions 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 previously-reported conclusion remains unchanged, i.e. 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 (NAFO Sci. Coun. Rep., 1986, pages 79-80).

The relative distribution of cod biomass among divisions during 1986 was quite similar to the estimates for the 1981-83 period. During 1984 and 1985, the percentages of divisional biomass are higher than those of 1981-83 and 1986 in Div. 3L. STACFIS noted that 1984 and 1985 were years when bottom water temperatures on the shelf were lower than normal, and this may have affected cod distribution and/or availability.

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The sixth meeting of the Subcommittee on Environmental Research was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, on 9 June 1987, 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 1986

A total of 16 documents referred to environmental conditions in Subareas 0-6 during 1986. Studies on satellite-tracked iceflows indicate that fish larvae, reaching Cape Farewell via the East Greenland Current, do not necessarily flow into the West Greenland area. Autumn temperatures in the upper 200 m over Fylla Bank were observed to be warmer for the second consecutive year. A review of investigations over the southern Labrador and northern Newfoundland shelves indicated that 1984-86 was a period of extremely cold conditions. A progress report was presented on an investigation into year-to-year changes in the windfield over the Gulf of Maine and Scotian Shelf. A significant difference in the meridianal winds in the Northwest Atlantic between the 1950-62 and 1970-79 periods was found.

3. Overview of Environmental Conditions in 1986 (SCR Doc. 87/62)

As a continuation of a project which began in 1983, the 1987 presentation provided an overview of (i) sea-surface temperature data from the Gulf of Maine to Labrador and southwestern Greenland, (ii) subsurface temperatures and salinities off Newfoundland and in the Bay of Fundy, (iii) wave heights and ice conditions in the Labrador Sea region, and (iv) meteorological observations of air temperature and sea-surface pressure. Offshore surface temperature data showed negative annual anomalies for the Canadian region while positive anomalies were observed south of Greenland and in the Gulf of Maine southward. Anomalous low-pressure systems dominated the NAFO region in the winter, causing north to northwesterly winds. This pressure pattern changed throughout the seasons, and conditions in summer were near normal.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Ageing Studies of Silver Hake (SCR Doc. 87/52)

Results of the 1986 and 1987 silver hake otolith exchanges between Canada and USSR indicate 82% and 70% agreement respectively. In the 1986 exchange, 61% of the differences (11 of 18) resulted from USSR ages being greater than Canadian ages. The 1987 exchange indicated a reverse trend with 80% of disagreements (24 of 30) due to USSR ages being less than Canadian ages.

A summary of 1984-87 exchange results indicates 68-85% agreement between age readers. Bias was evident in all exchanges but the direction of the bias was variable. Relative to the Canadian ages, USSR ages were higher in 1984, lower in one 1985 exchange and higher in another 1985 exchange, higher in the 1986 exchange and lower in the 1987 exchange. This may be due to the influence of strong year-classes moving through the population and the mean age of fish in exchange samples.

The variability in both the level of agreement and the direction of bias in differences has potential impact on independent estimates of catch-at-age values derived from age determinations by different age readers. It was also noted that otolith exchanges are only useful for monitoring inter-reader agreement and do not provide a means for identifying or resolving causes of different otolith interpretation. STACFIS therefore recommends *that future exchanges of silver hake otoliths be designed to allow for identification of specific reasons for differing interpretations as, well as the level of inter-reader agreement, with photographs of otoliths being the means of*

achieving this objective, and that the following protocol be used as the basis for an exchange in 1987:

i) Sample collection (100 otoliths) by Canada from Div. 4W in June-July.

ii) Otolith storage in glass vials with 60:40 glycerin solution, black and white photographs for each otolith pair, and age interpretation to be marked directly on the photographs.

iii) Age determination to be done without knowledge of individual fish length and sex.

iv) Standard notation will be used to record age reading, i.e. underline strong annulus, overline weak, C_2 to indicate check, SPL_3 to indicate split zone, NO to indicate narrow opaque edge (typical recording would be: P2, 1, 2, SPL3, 4 NO). (See guidelines for age determination of silver hake by J. J. Hunt (1980 in J. Northw. Atl. Fish Sci., vol. 1, p. 65-80).)

v) Canada, USSR and Cuban age readers to estimate ages for sample.

vi) Otoliths with a set of photographs to be forwarded to USSR by Canada, and photographs marked with ages and the otoliths be returned to Canada from USSR; otoliths with a second set of photographs to be forwarded to Cuba, and the marked photographs and otoliths to be returned to Canada.

vii) Results to be analyzed and reported to interested parties by 31 December 1987.

2. Analysis of Inconsistency in Silver Hake Catch at age (SCR Doc. 87/51)

A review of percent catch-at-age in numbers for the 1980-86 silver hake fishery indicates substantial differences in estimates derived from Canadian and USSR sampling data. On the average, Canadian results show higher proportions at ages 1 and 2 and lower proportions for older fish, relative to the USSR derived estimates. The mean ratio for ages 1-5 (Canadian to USSR) was 2.29, 1.22, 1.01, 0.66 and 0.87 respectively in 1980-86 data. To assess the possible influence of age determination, the USSR catch length frequency for 1985 was partitioned into catch-at-age by using the reported USSR and Canadian age-length keys. The two independent estimates of percent age composition were in good agreement for ages 1 and 2 but appeared to have reciprocal differences for ages 3 and 4, with the USSR key generating more age 3 fish. It was noted that the Canadian key gave different results when used to partition length frequencies that were derived from USSR sampling and Canadian observer sampling.

Comparison of length frequency distributions, derived independently from Cuban, USSR and Canadian observer samples, indicated differences between data sources. Canadian observer samples showed consistently smaller lengths, relative to Cuban and USSR samples. Spatial and temporal sampling distribution were assessed to be potential sources of this difference.

STACFIS concluded that both age determination and sampling were contributing factors in different estimates of catch-at-age and recommends *that studies on silver hake be continued in order to identify and resolve the extent and source of these differences.*

3. Age Determination of Atlantic Wolffish (SCR Doc. 87/36)

Two methods of ageing Atlantic wolffish were compared: age determination from otoliths and vertebrae. Age determination by otoliths seems to be more precise than age determination by vertebrae, although the precision of both methods can be expected to increase with acquisition of greater experience. STACFIS discussed different ways of making the annual rings more visible and the special problems with age determination of wolffish. Ages determined from vertebrae were generally lower than ages determined from otoliths. However, the difference is not great when calculating mean length at age from the two different methods of age determination. The parameters of the von Bertalanffy growth equation were calculated and compared with earlier results of combined material from the Barents Sea and Greenland waters and with the results from the Icelandic area. Length-at-age values were generally found to be greater than given for the Barents Sea and Greenland and smaller than given for the Icelandic area. STACFIS recommends *that ageing studies on Atlantic wolffish including validation be encouraged.*

VI. GEAR AND SELECTIVITY STUDIES

1. Trawl Escapement and Selectivty Problems

In accordance with the Council's recommendation of September 1986 (NAFO Sci. Coun. Rep., 1986, page 110), Dr. J. Messtorff (EEC) reported briefly on his contact with Dr. H. J. Bohl. (gear research expert) who indicated that some information existed from earlier selectivity experiments. STACFIS proposed that Dr. Bohl be requested to compile the available information for its meeting in September 1987.

VII. REVIEW OF SCIENTIFIC PAPERS

STACFIS noted that there were several research documents which were either not presented or were not adequately considered during earlier deliberations at the present meeting. Brief summaries of these are given below.

1. Fishery Ecology of Silver Hake in Div. 4VWX (SCR Doc. 87/11)

A study of factors regulating recruitment of the silver hake stock in Div. 4VWX was presented. According to this paper, cannibalism does not appear as a significant factor, at least for the range of population sizes examined (1958-76). Otherwise, abundance of mackerel spawning stock and runoff of the St. Lawrence River seem to have a positive effect on the recruitment. The authors think that mackerel eggs and larvae would be food for silver hake and that runoff of St. Lawrence River may increase nutrients in the silver hake habitat.

2. Understanding Marine Fish Communities (SCR Doc. 87/12)

This paper reviewed the literature from the point of view of historical perspectives as well as describing the results of some recent research on the subject. Some directions on future research and prospects for future investigations were provided.

3. Natural Mortality of Greenland Halibut (SCR Doc. 87/10)

This paper described the results of three methods of estimating natural mortality (M) for Greenland halibut in NAFO Subareas 0 and 2 and Div. 3KL. Natural mortality rates were in all cases higher for males (0.23-0.35) than females (0.026-0.070). For both sexes combined, the estimates of M ranged from 0.062 to 0.075.

4. Ichthyoplankton Survey on Flemish Cap in April-May 1986 (SCR Doc. 87/19)

The results of the ichthyoplankton survey which was carried out on Flemish Cap in April-May 1986 are given. Eggs and larvae from the samples are presented quantitatively and qualitatively, and the distribution patterns for redfish larvae and cod and American plaice eggs are defined.

5. Vertical Distribution of Parasitic Fauna in Deepwater Fishes (SCR Doc. 87/41)

Eight groups of parasites (epicontinental, epipelagic, mesopelagic, mesobenthic, bathybenthic, bathypelagic, bathyalpelagic, polyzonal) are defined in accord with the vertical zones of the ocean. Most of the typical deepwater parasites are not closely related to certain depths. As for the mesopelagic, bathypelagic and bethyalpelagic fishes, the ranges of their specific deepwater parasites coincide to some extent with those of their hosts. The ranges of specific deepwater parasites in fishes, which are ecologically related to the bottom are smaller than the ranges of their hosts. The parasitic fauna of some fishes is reported to become poorer with depth at the expense of secondary deepwater forms and polyzonal species. The number of deepwater parasite species does not decline with depth and only the reduction of the incidence and degree of infestation is observed.

6. Haddock Spawning Area Closures, 1970-87 (SCR Doc. 87/13)

The seasonal closures of haddock spawning areas in Div. 4X and Subarea 5 were instituted by the International Commission for Northwest Atlantic Fisheries (ICNAF) for 1970 and subsequent years, and have been retained by both Canada and USA after extensions of jurisdiction. The ostensible reason for initiating these closures was because they encompassed the spawning area and season, spawning area closures being one of a limited set of regulatory measures available under the ICNAF constitution in 1969. The objectives were to reduce catches during this period and supplement total catch limitations by spreading catches throughout the year. This was a reasonable expectation because the closures corresponded to areas and times of peak commercial catch rates. There is no basis upon which to judge whether or not spawning closures have intrinsic biological value (e.g. through improving recruitment). Nonetheless, this appears to be the basis for fishermen's support of these measures. Despite numerous changes made to the closures, those in effect now are not greatly different than those first instituted. Areas off Cape Cod and Browns Bank are slightly smaller but closed seasons are one or two months longer than in 1970. Attempts to institute a spawning closure for Div. 4W haddock failed.

VIII. OTHER MATTERS

1. Progress Report on Contributions for the Special Session in September 1987

There was a good response to the call for papers for the special session on "Biology of Dermersal Resources of the North Atlantic Continental Slope, with Emphasis on Greenland Halibut and Grenadiers", with 28 potential contributions. There are 13 papers on Greenland halibut, 4 of which are major overviews from the North Atlantic, West Greenland, Iceland and the Barents Sea-

Norwegian Sea areas. Seven papers deal with grenadier species. Other papers deal with other deepwater species such as lanternfishes, blue hakes and Atlantic halibut. There are 3 papers to be presented in succession concerning oceanography of the continental slopes of the Northwest Atlantic. The special session is scheduled for 3 days, which will allow ample time for presentation and discussion.

2. Progress Report on the Special Session in September 1988

Dr. J. C. Rice (Canada) was nominated and he accepted the task of organizing the September 1988 Special Session on "The Impact of Changes in Environmental Conditions in the North Atlantic on the Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Regions in the Early 1980's". It was agreed that the convener would provide STACFIS with a proposed outline of topics for review at the September 1987 Meeting, because time was not sufficient at this meeting to expect an outline to be prepared and reviewed.

3. Proposed Theme for Special Session in September 1989

STACFIS considered as a possible general topic the "Changes in Biomass and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes". It was agreed that such a theme was of interest, but that it would be necessary to define the scope in order to avoid duplication with the more restricted 1988 theme. In general, the session would attempt to compare the different environmental regimes in the NAFO area (e.g. Subarea 1, Subareas 2+3, Subarea 4, Subareas 5+6) with respect to carrying capacity (production of various trophic levels) and ecosystem structure (number and type of species and species groups important in food web involving fishes), and including estimates of sustainable fish yield. It was recognized that the porposal would encompass both environmental and anthropogenic impacts on the various levels of the ecosystems in the Northwest Atlantic. STACFIS decided to give further consideration to the title and scope at the time of the Annual Meeting in September 1987, and requested the Chairman to solicit a detailed proposal in the meantime.

4. Arrangements for Conducting Stock Assessments

At the beginning of the STACFIS Meeting, it was decided that, due to a somewhat reduced workload in contrast to previous years, the Committee meet as one group to address its business. STACFIS is pleased to report that evening sessions were not required this year and that its work was finished earlier than anticipated.

5. Acknowledgements

Before adjourning the meeting, the Chairman of STACFIS thanked the participants for their support and help in making the meeting a successful one. A particular note of thanks was extended to the Chairman of the Environmental Subcommittee. Appreciation was expressed to the NAFO Secretariat for their continued excellent support.

ANNEX 1. REPORT OF THE 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 June 1987, to consider environment-related topics and report on various matters referred to it by STACFIS. Scientists attended from Canada, Cuba, Denmark (Greenland), EEC, Japan, USSR and USA.

The Subcommittee reviewed the following documents: SCR Doc. 87/06, 14, 15, 16, 17, 26, 27, 29, 31, 62, 63, 64, 65, 66, 67 and 68.

1. Marine Environmental Data Service (MEDS) Report for 1986/87 (SCR Doc. 87/63)

a) Data collected in 1986

Approximately 9,500 oceanographic stations were occupied within the NAFO area during 1986, of which data for 4,535 were sent directly to MEDS and data for 4,856 were received through IGOSS (Integrated Global Ocean Services System). Of the latter, approximately 1,250 were duplicates of data sent directly to MEDS. The total number of stations is about 25% lower than in 1985, but the percentage of station data received by MEDS has risen from near 50% in 1985 to over 80% in 1986. The number of stations received through IGOSS is almost twice that received last year. The majority of the data consisted of BT (bathythermograph) records.

b) Historical data holdings

A total of approximately 13,000 historical data stations were received and/or processed during 1986, a seven-fold increase from the previous year. Approximately 10,000 of these were CTD stations. MEDS has also acquired the complete holdings of the US NODC (National Oceanographic Data Center) for the Canadian region which includes the NAFO area. The processing of these data will occur during the coming year.

c) Drifting-buoy data

A total of 29 drifting-buoy tracks were received by MEDS during 1986 from the GTS (Global Telecommunications System) and from the Bedford Institute of Oceanography. These represented approximately 76 months of buoy data. A diagram to show the general distribution of the drifter tracks was presented in the report. During the discussion, it was recommended that plots of the tracks of individual buoys be presented.

d) Current-meter data

A list of current meter moorings deployed in the NAFO region by the Bedford Institute of Oceanography in 1986 and archived there was given in the MEDS report.

e) Review of environmental conditions (SCR Doc. 87/63, 65)

A review of environmental conditions was presented, based on three sources: (i) sea-surface temperature maps produced by the National Weather Service in the United States, (ii) a monthly state-of-the-ocean report issued by the Bedford Institute of Oceanography (based primarily on the US temperature maps), and (iii) an analysis of surface and subsurface data based on the data reported to MEDS and using the Levitus 1982 Atlas for the climatic means. It was noted by the author that there are some disagreements between each of the methods, due to different data sources and different base periods being used to define the normal conditions. He suggested that caution must be exercised, not only in his overview but in all such papers, and that, before an anomaly is considered significant, all potential sources of data must be examined to ensure that there is general agreement.

The Subcommittee was informed that MEDS is presently publishing a Monthly Monitor Report which lists BT, bottle and CTD station locations taken each month as well as the tracks of satellite-monitored buoys during the month for the Atlantic region (20-65°N, 20-80°W). Separate publications are also available for the Arctic and Pacific regions. Interested parties can obtain these publications on an regular basis by contacting MEDS.

2. Review of Environmental Studies in 1986

a) Subareas 0 and 1 (SCR Doc. 87/06, 27, 29, 31)

Results from recent studies on the variability of water masses and currents in Denmark Strait were presented. High variability in the physical properties, as well as the horizontal and vertical extent of the three primary water masses (the Irminger Sea water, Labrador Sea water and North Atlantic water), were documented for the Dohrn Bank region. It was noted that this

paper (SCR Doc. 897/06) had been presented at the January STACFIS meeting on shrimp stocks in the Denmark Strait at which time it was recommended that, in order to determine if the dynamical regime of the Irminger Current system is responsible for maintaining the shrimp stock in the area, a combined biological and oceanographic sampling program would be required with station separations of less than 10 km in order to resolve the baroclinic aspects of the current. This same paper presented a drift track of a satellite-monitored buoy placed on the ice in the fall of 1984, which indicated a strong southwestward flow along eastern Greenland but, contrary to popular belief, shortly after passing Cape Farewell the buoy headed into the Labrador Sea rather than continuing northward along western Greenland.

A paper, based primarily on the distribution and abundance of young cod and haddock, indicated that the larvae of these two species may drift from Iceland to Greenland. It was further suggested that the recent near-collapse of the cod stock off West Greenland may be due to cessation of inflow of larvae from the Icelandic area. The drift track mentioned above indicates that larvae reaching Cape Farewell do not always flow along the West Greenland coast.

Autumn temperatures in the upper 200 m over Fyllas Bank were observed to be higher than the 1963-85 mean and above normal for the second consecutive year following the extremely low temperatures between 1981 and 1984. The warm conditions are believed to be a result of increased influence of the Irminger Current. A paper on the heat transport in West Greenland waters concluded that the early 1980's cold period arose through an air-sea heat exchange due to a very cold airmass over the region. This contrasts with the late 1960's cold period which is believed to have resulted from oceanic advective processes, i.e. through an increase of East Greenland water into West Greenland.

Results from a transect in March over St. Pierre Bank indicate that the lower-than-normal temperatures which were observed during the last 2 years have persisted into 1986. Temperatures during 1986 in the upper 200 m were the lowest on record over the 9 years that data have been collected.

A pilot project to collect temperature data along the Flemish Cap section (47°N) with airborne expendable bathythermographs (AXBT) was initiated in 1987. Although extremely successfully, it was noted that the high cost of the probes is, at present, a deterrent to the establishment of routine monitoring with AXBT.

The mean annual cycle and monthly anomalies of temperature and salinity for 10 standard depths at Station 27 off St. John's, Newfoundland, were calculated from historical data (1946-86) and presented. The 1986 temperatures and salinities in the depth range from 75 to 125 m show below-normal values.

A review of investigations into the temperature distributions over the southern Labrador and northern Newfoundland shelves concentrated on the subsurface layer of cold water known as the Cold Intermediate Layer (CIL). Data from several sources, including hydrographic data along standard sections, long-term current-meter moorings over Hamilton Bank, Station 27 temperature and salinity data, and sea-ice data, were examined and all indicated the 1984-86 period as a period of extremely cold conditions. The CIL appears to have had its greatest extent in 1984. The extent of the CIL decreased in 1986 from the previous 2 years, and the magnitude of the negative temperature anomalies also decreased.

c) Subareas 4, 5 and 6 (SCR Doc. 87/14, 15, 16, 17)

An analysis of warm-core Gulf Stream rings in the area west of 60°W showed that 10 rings were formed during 1986, two more than in 1985 and also two more than the 1974-85 mean. No rings that formed in 1985 survived in 1986, but four rings that were formed in 1986 continued into 1987. The age of the rings varied from 30 to 302 days, comparable to the long-term mean.

Water temperatures were obtained across the continental shelf and upper slope in the New York Bight region southeast of Sandy Hook, New Jersey (Div. 6A), on 14 separate occasions during 1986 using XBTs (expendable bathythermographs). Temperatures on the bottom at mid-shelf during summer were higher than normal by about 2°C and higher than 1985. At mid-shelf to outer-shelf depths, bottom temperatures during the autumn were 1° to 1°C higher than normal. For the second consecutive year, bottom temperatures along the supper slope remained above 12°C during the entire year. The position of the shelf-slope front in 1986 generally followed the long-term mean seasonal pattern of being further shoreward in autumn-winter and more seaward in spring-summer. The mean position was approximately 15 km shoreward of the long-term average location, although the standard deviations of its position was 25% less than the 10-year mean values.

A progress report was presented on an investigation into year-to-year changes in the windfield over the Gulf of Maine and Scotian Shelf during the spring. It was stimulated by

work in the northeastern Atlantic Ocean which suggested that low-frequency changes in the wind had profound effects on phytoplankton and zooplankton around the British Isles. A significant difference in the meridonal winds in the northwest Atlantic between the 1950-62 and 1970-79 periods was found. Biological data is presently being sought to compare to the wind data.

3. Overview of Environmental Conditions in 1986 (SCR Doc. 87/62)

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 sea-surface temperature data at Halifax, Nova Scotia, and Boothbay Harbor, Maine, showed near-normal and slightly below-normal annual anomalies relative to the 1951-80 mean respectively.

b) Offshore surface temperature data from ships of opportunity showed negative annual anomalies over the Scotian Shelf and most of the Grand Bank and in the slope water region, while positive anomalies were observed in the Gulf of Maine and southward. This continues the pattern which began last year and is a reversal of the warm in the north and cold in the south prevalent in the late 1970's and early 1980's.

c) Subsurface temperatures at Station 27 off St. John's, Newfoundland (Div. 3L), were below the long-term mean for the fifth consecutive year, but the magnitude of the anomalies was smaller than in past years and were positive during the last 2 months of the year. This implies a possible end to the extremely cold conditions in the subsurface waters of the region.

d) At Prince 5 off St. Andrews, New Brunswick (Div. 4X), salinities and temperatures were generally above the 1951-80 normal but the magnitude of the anomalies was small.

e) Significant height and frequency of large waves in the Labrador Sea were above normal in 1986. On the Grand Bank and Scotian Shelf, significant wave height was above normal but the frequency of large waves was near normal.

f) Sea ice appeared early and was of longer duration than normal in both the Gulf of St. Lawrence and off north and northeastern Newfoundland. The ice also was present later than normal in the Gulf but the last ice occurred slightly earlier than normal off Newfoundland.

g) The number of icebergs crossing 48°N latitude was 204, a 5-fold reduction from last year and the lowest number of icebergs recorded since installing the SLAR (side-looking airborne radar).

h) Annual air temperatures were below normal throughout all of eastern Canada during 1986, primarily due to negative anomalies during the last 4 months of the year. The maximum anomalies were in Labrador and Baffin Island with values of over -1°C.

i) An anomalous low-pressure system dominated the NAFO region in the winter, causing north to northwesterly winds. In spring, a high-pressure anomaly occupied the area which implies anomalous southerly winds to the southern NAFO region (Subareas 3-6). While summer conditions were near normal, autumn pressure patterns indicated north to northwesterly winds, caused by a high over northern Quebec and a strong low northeast of Iceland.

4. Marine Environment and Ecosystems Subcommittee (MEES) (SCR Doc. 87/67)

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 a summary of a meeting that was held in November 1986, involving 5 sessions: (i) use of bioeconomics in setting quotas; (ii) studies of juveniles of Canadian Atlantic fish stocks; (iii) a proposal for a Scotian Shelf modelling project; (iv) a meeting of the MEES core membership to discuss areas of future activity by the Subcommittee; and (v) reports by certain working groups. The last included work on a reanalysis of environment-fish correlations of Sutcliffe and coworkers. Catch data for 9-14 years were considered for the stock that were analyzed in the earlier work. The predictive power of the earlier relationships was generally found to be weak. Overall, the mean deviations of the predicted catch based on environmental regressions were similar to predictions based on the long-term means, but they were higher than deviations in predictions from lagged catch data. Environmentally-based predictions of landings for invertebrate stocks were generally more accurate than those for fish stocks. Many difficulties with the analysis was attributed to the use of catch data which were not corrected for effort. Plans are underway for the next MEES meeting, where holistic ecosystem modelling, capelin management strategies, and relationships between oceanographic and catch data will be discussed.

5. Remote-sensing Activities

A brief report on remote-sensing activities of the Marine Climatology Investigation Group of the National Marine Fisheries Service at the Northeast Fisheries Center in Narragansett, Rhode Island, was presented by M. Ingham. He informed the Subcommittee that sea-surface temperature charts with isotherm contours are being published weekly for the shelf area from the southern Scotian Shelf to Chesapeake Bay. He also reported on an application of remote sensing whereby the same group monitors the water masses (shelf water, slope water, Gulf Stream, Gulf Stream rings) that are present at a deep waste-disposal site off the continental shelf south of Hudson Canyon.

6. Environmentally-related Aspects of the Special Session in September 1987

The Chairman of the Subcommittee noted that four environmentally-related papers would be presented at the special session in September 1987.

7. Revision of List of NAFO Standard Oceanographic Sections and Stations

In recent years, it has been noted that the depths of stations on the standard NAFO sections, as given in the published List of Standard Oceanographic Sections and Stations (ICNAF Selected Papers, No. 3, pages 109-117, 1979), do not correspond with on-site measured values. In some cases near continental slopes the depths can vary greatly, and it is unclear whether one should seek the designated depth or the position. The Subcommittee decided that the positions should be maintained and that a study of the actual depths at the standard stations be undertaken. It was generally agreed that the approximate depths at the station sites should be published but they should be used only as a guide. The Chairman (M. Stein) agreed to update the depths of the stations with the intention to present a revised list of stations for consideration at the June 1988 Meeting.

8. National Representatives

The Subcommittee was not aware of changes in the names of national representatives who are responsible for submitting oceanographic data to MEDS. The present representatives are: R. Keeley (Canada, R. J. Dominguez (Cuba), E. Buch (Denmark) H. Hecht (Federal Republic of Germany), Mr. Francois (France), W. Thiele (German Democratic Republic), S. Kawahara (Japan), R. Leinbo (Norway), A. J. Paciorkowski (Poland), K. Hughes (USA), G. I. Luka (USSR) and P. Edwards (United Kingdom).

9. Other Matters

a) Status of the *ad hoc* Working Group on the Flemish Cap Project

In light of the Special Session on recruitment in September 1986 which examined recent advances in understanding recruitment mechanisms from results of the Flemish Cap and Georges BAnk Projects and with no plans for sampling in the near future, the Convener of the Working Group on the Flemish Cap (J. Anderson) proposed that the Group be disbanded. The Subcommittee agreed with the proposal and recommends *that the Working Group be discontinued, with the proviso that the Flemish Cap Project be maintained on the Council's agenda for 1988 in order to keep the Subcommittee informed of the analyses which are still outstanding and also to promote the reporting of the results of such work to STACFIS.*

b) Mean temperature and salinity conditions on the Grand Bank and Scotian Shelf

The Subcommittee was informed of two recent technical reports containing monthly mean temperatures and salinities at 16 standard depths between 0 and 1,000 m for 38 and 35 subareas in the Grand Bank and Scotian Shelf regions respectively. The data consist of all of the MEDS bottle holdings between 1910 and 1982. Copies are available from the authors (K. Drinkwater and R. Trites).

c) Retirement of J. Colton

It was announced that Dr. J. B. Colton will be retiring this month. Dr. Colton, a prominent American oceanographer, has worked for many years on the relationship between the physical-chemical environment and biological processes. A note wishing him well in his retirement was sent on behalf of the Scientific Council.

d) Sea-surface temperature maps

At the June 1986 Meeting, the Subcommittee was informed that the oceanographic analysis charts of sea-surface temperature (SST), which are published triweekly by the National Weather Service (NWS) of NOAA, had decreased the areal coverage of the NAFO region such to eliminate the Flemish Cap, northern Grand Bank and northern Newfoundland Shelf. The Scientific Council agreed at that time that the Chairman should write to NWS indicating the

usefulness of the charts to NAFO scientists and request that the areal coverage revert back to the original boundaries. The letter was drafted, but through some misunderstanding was not sent. The letter will be updated and sent before the end of the present Scientific Council Meeting.

10. Acknowledgements

The Chairman, noting no further business, thanked the participants for their contributions and cooperation. The Chairman of the Scientific Council (J. Messtorff) thanked the Chairman for conducting the meeting of the Subcommittee very efficiently.

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 12 June 1987 to consider and report on various matters referred to it by the Scientific Council (see Appendix IV for agenda) dealing mainly with fishery statistics, biological sampling and biological surveys. Scientists attended from Canada, Cuba, Denmark (Greenland), EEC, Japan and USSR, and an observer attended from USA.

I. STATISTICS AND SAMPLING

1. Fishery Statistics

a) CWP activities relevant to NAFO (SCS Doc. 87/06, 10)

The Committee noted the report of the 13th Session of the CWP, which was held in Rome on 11-18 February 1987. Mr. D. Cross, in his capacity as Deputy Secretary of the CWP, reviewed this report and drew the Committee's attention to matters of particular interest to NAFO, namely, THE CWP's acceptance of the statistical boundary changes in NAFO Subareas 4 and 5, the minor modification to the definition of nationality, the discussion on discard statistics, the detection of discrepancies between the databases of the different international agencies, and the compilation of a handbook of fishery statistics.

The Committee noted the CWP recommendation that more frequent meetings of small groups of agencies be held to deal with the problem of discrepancies between databases and the request that budgetary provision be made for this. In NAFO's case, these budgetary implications would be minimal because the discussions related to discrepancies in statistics for the Northwest Atlantic would almost certainly be held at the NAFO Headquarters, the site of the most complete statistics for the area.

b) Progress report on Secretariat activities in 1986/87 (SCS Doc. 87/06)

The Committee noted with pleasure that there had been continued improvement by national statistical offices in respecting the deadline for the submission of STATLANT 21A reports and that, as a result, the Secretariat was able to prepare a provisional inventory of nominal catches (SCS Doc. 87/20) for only the second time in recent years. However, the Committee regretted that a similar improvement has yet to be recorded for STATLANT 21B data. The work of the Scientific Council and the publication of the Statistical Bulletin continued to be adversely affected by late and/or incomplete submission of these STATLANT 21B reports by some Contracting Parties. The Committee therefore welcomed the Secretariat's preparation of SCS Doc. 87/19, which outlines the obligations of Contracting Parties in the submission of catch and fishing effort statistics. STACREC therefore recommends *that SCS Doc. 87/19 on the Scientific Council's requirements for fishery statistics be brought to the attention of the Contracting Parties.*.

The Committee regretted that a recommendation from the June 1986 Meeting had not resulted in an improvement in the submission of data from several non-member countries which fish in the Regulatory Area. STACREC accordingly advises the Scientific Council to recommend *that the Fisheries Commission and the General Council take note that fishing by non-member countries in the Regulatory Area has become a significant factor in the exploitation of the resources of the area, but the statistics on many of these activities are not available to the Scientific Council. This has a serious adverse effect on the ability of the Scientific Council to provide advice, and the General Council and Fisheries Commission are requested to make further efforts to resolve this problem.*

c) Review of STATLANT 21A and 21B Forms

The Committee noted that last year's recommendations concerning effort prorating and the statistical boundaries within Subdiv. 5Ze (the latter having been approved by the General Council at its 8th Annual Meeting in September 1986) were being taken into account by FAO in the printing of STATLANT 21A and 21B forms for 1986. The notes for completion of these forms were being revised and improved (particularly with regard to the instructions on effort prorating). There were no further proposals for changes at this time.

d) Proposed new boundary changes in Subarea 4

It has been found that the description of the boundary of Div. 4S as found in the Convention on Future Multilateral Cooperation in the Northwest Atlantic is unsatisfactory because Pte.

des Monts, from which a line should be drawn "due east to a point at 49°25'N latitude, 64°40'W longitude", is in fact south of latitude 49°25'N. Since the current Canadian statistical system uses the Pte. des Monts as the reference, there would be no disruption of statistical series if the description of the boundary were modified to take account of the coordinates of Pte. des Monts. Accordingly, STACREC advises the Scientific Council to recommend *that if the General Council wishes to resolve the issue of the boundary between Div. 4S and 4T, the coordinates of Pte. des Monts should be established and the boundary should be allowed to "run in an easterly direction along a rhumb line to a point at 49°25'N, 64°40'W...".*

2. Biological Sampling (SCS Doc. 87/11)

a) Progress report on activities in 1986/87

An inventory of sampling data presented for 1985 was considered to be incomplete. It was noted that the Secretariat plans to compile a volume (for 1979-84) of an inventory of sampling, similar to that published under the ICNAF regime for 1967-78, as the first of such volumes under the NAFO regime, and to this end, STACREC recommends *that the Secretariat contact those responsible for the submission of sampling data to ensure that previous lists for 1979-84 are verified prior to publication and to submit any outstanding data for 1985.*

b) Forms and deadlines for submission of data

The Committee noted the existence of a document (SCS Doc. 86/23) regarding the procedure for reporting of sampling data which also contained examples of forms presently utilized for submission of age-length tables and length frequencies. No changes in reporting procedures were proposed.

II. BIOLOGICAL SURVEYS

1 Review of Survey Activity in 1986

An inventory of surveys conducted in 1986 as reported by Canada, Denmark (Greenland), Federal Republic of Germany, France, USSR and USA was compiled by the NAFO Secretariat and listed in Table 1.

2. Survey Plans for 1987 and Early 1988

An inventory of surveys planned for 1987 and early 1988 provided by Canada, Denmark (Greenland), Federal Republic of Germany, France, USSR and USA was compiled by the NAFO Secretariat (Table 2).

3. Review of Stratification Schemes (SCS Doc. 87/23, 25)

Papers were presented on proposed stratification schemes for NAFO Div. 2G and 2H (SCS Doc. 87/23) and NAFO Subareas 0 and 1 (SCS Doc. 87/25). There was discussion about the practical problems incurred in utilizing a stratification scheme for both single and multispecies surveys. It was noted that the stratification schemes presented were designed with priority on surveying for deepwater species and may not be appropriate for other species such as cod. Further analyses should be conducted to reevaluate these schemes with respect to distribution of species occurring in these areas. Results of these analyses should be made available at the June 1988 Meeting. STACREC welcomed the progress which had been made in developing these stratification schemes and looked forward to resolution of outstanding issues so that the schemes could be adopted as part of the standard NAFO system (see NAFO Sci. Coun. Studies, No. 2).

4. Coordination of Surveys in 1987 and 1988

There were no proposals for review on coordination on surveys. Such coordination is most often done on a bilateral basis.

5. Survey Design Procedures

STACREC noted that the *ad hoc* Working Group, which was set up to evaluate material that had been submitted to the June 1986 Meeting relevant to conducting bottom-trawl groundfish surveys in order to derive more precise indices for assessment purposes than those presently available, met for the first time on 12 June 1987, with J. Messtorff (EEC), V. A. Rikhter (USSR), J. Bertrand (EEC), D. Power (Canada) and W. Brodie (Canada) (as Convener) in attendance.

Documents which outlined survey procedures, as requested by STACREC at an earlier date (NAFO Sci. Coun. Rep., 1985, pages 95, 104), were examined. These documents were SCR Doc. 86/66 by USSR and three working papers which were submitted by scientists from France, Canada and the Federal Republic of Germany at the June 1986 Meeting. It was noted that the series of French surveys in

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1986.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
			STRATIFIED-RANDOM SURVEYS		
E. Greenl.		DEU	9-10	Groundfish (OTB)	160
0+1	AB	CAN-N	8-9	Groundfish	235
	ABC	GRL	7-8	Shrimp	58
1	B-F	DEU	10-11	Groundfish (OTB)	155
2	H	CAN-N	9	Groundfish	26
	HJ	CAN-N	8	Shrimp	136
2+3	JK	CAN-N	1-2,11-12	Groundfish	338
3	KLMNO	USSR	4-8	Groundfish	530
	L	CAN-N	1-2,5,11	Groundfish	575
	LNO	CAN-N	4	Groundfish	80
		"	8-9	Juvenile flatfish	131
	NO	"	4-5	Groundfish	207
	Ps	"	3	Groundfish	162
		"	3-4	Scallop	326
		FRA	2-3	Groundfish	94
0-3	BGHJKLNO	USSR	9-12	G. halibut and capelin	175
4	R	FRA	1	Cod	36
	RST	CAN-G	8	Redfish	183
	T	"	9	Groundfish comparative	183
		"	12	Groundfish migration	45
	Vn	CAN-SF	10	Shrimp	30
	VnW	"	5	Shrimp	30
	VWX	"	9-10	Redfish	82
	WX	"	7	Groundfish	176
		USSR	10-11	Juvenile silver hake	100
	X	CAN-SF	10-11	Groundfish	98
		USA	4,10-11	Bottom trawl	65
4+5	VWXZe	CAN-SF	6	Scallop	116
	XZe	"	3	Groundfish	159
5	YZ	USA	3-4,10-11	Bottom trawl	334
	Z	"	8	Scallop	222
		"	6-7	Clam	93
6	ABC	USA	3-4,9-10	Bottom trawl	329
		"	7-8	Scallop	283
		"	6-7	Clam	241
			OTHER SURVEYS		
1	A	GRL	8-9	Whale marking	-
		"	8	Narwhal aereal	-
	ABCD	"	6	Hydrography, plankton	117
	BCD	"	6	Iceland scallop	50
		"	5-6	Harp seal	-
	BDF	"	7-8	Young cod	200
	CD	"	10-11	Cod inshore	60
	D	"	5	Iceland scallop	35
		"	7	Cod	20
		"	12	Capelin	-
		"	12	Hydrography	6
		"	4	Hydrography	23
		"	7	Cod	80
2	J	CAN-N	7-8	Cod	-
2+3	JK	CAN-N	1	Groundfish	3
		"	10	Capelin (acoustic)	-
	JKLM	"	10-11	Salmon tagging	-
	JKLMNOP	"	8	Oceanography	-
3	?	USSR	2-6	Ichthyoplankton	88
	KL	Can-N	6	Cod (acoustic)	-
	L	"	2,6,8,10,11	Crab	92
		"	5-6	Capelin (acoustic)	-
		"	4-11	Oceanography	-
		"	6-7	Cod tagging (acoustic)	-
		"	6-8	Herring and capelin larvae	-
		"	9	Scallop	27
		"	10-12	Pelagic (acoustic)	-
	LMN	USSR	8-12	Hydroacoustic (capelin)	114
	LNO	"	5-6	Hydroacoustic (capelin)	8
	LPs	CAN-N	3-5	Pelagic (acoustic)	-
		"	9-10	Cod tagging	-
	NO	"	6-7	Capelin (acoustic)	-
	NOP	"	6	Squid	144
	Ps	"	1	Scallop	31
		"	3	Cod tagging	100
		"	7	Redfish (acoustic)	-
		FRA	3	Scallop	96
4	R	CAN-N	5	Crab	17
	RS	CAN-SF	6	Cod/capelin acoustics	-
	T	CAN-G	5	Diver herring spawning beds	-
	TVn	"	11	Herring acoustics and trawl	-
	VW	CAN-N	2-3	Squid	130
	VWX	CAN-SF	1-2	Squid	129
		"	10	Scalworm	-
	W	"	1-2	Herring acoustics	11
		"	11	Gear trials	15
	WX	CAN-SF	4-5	Lobster habitat	44
	X	"	1	Pollock ichthyoplankton	47
		"	1	Gear trials	-
		"	2	Deep sea	34
		"	2	IOP training	-
		"	3	Groundfish acoustics	4
		"	4	Gear trials	-
		"	5	Gear trials/pollock	-
		"	6	Larval/Juvenile cod	49
		"	7	Live fish	34
		"	10	CTD trials	-
4+5	XZe	CAN-SF	2	Pollock	-
		"	6-7	Lobster larvae	406
		"	9	Lobster	102
		"	9-10	Scallop larvae	118
		"	10-11	Larval herring	163
4+5+6	XYZABC	USA	1-2,5-6	Eggs, larvae, chlorophyll,	
			11-12	temperature, salinity	493
		"	3-4,9-10	Eggs, larvae, temperature	281
5	Y	USA	8-9	Eggs, larvae, temperature	36
	Ze	CAN-SF	6	Juvenile gadoids	40
		"	8	Deep trawling	61
		"	8	Scallops	150
	Z	USA	5	Juvenile fish (IKMT)	88
		"	6	Juvenile fish (MOCNESS)	115
				(MOCNESS vs. IYGPT)	25
				(Bottom trawl)	20
		"	7	J. fish (bottom trawl)	145
5+6	YABC	USA	6-8	Eggs, larvae, temperature	221
6	ABC	USA	8-9	Eggs, larvae, chlorophyll, temperature, salinity	174

Subdiv. 3Ps, as well as the Federal Republic of Germany surveys in Div. 2J, were comparable over virtually all years. Differences in the Canadian and USSR surveys over time were briefly discussed.

It was noted that further work could not be carried out by this group at this meeting due to time constraints. The Convener agreed to prepare summaries of the available data for examination by the working group in September 1987. In addition to these summaries, the working group should also consider at that time what further survey data or analyses, if any, should be made available for consideration in June 1988.

III. OTHER MATTERS

1. Review of Scientific Observer Program

It was noted that coverage in the Regulatory Area under the NAFO Scientific Observer Program

Table 2. Biological surveys planned for the NAFO Area in 1987 and early 1988.

Country	Area	Type of survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1987	
CAN-N	2GH	Groundfish	Aug 14-Sep 07
	2HJ	Shrimp	Jul 08-22
	2J+3K	Groundfish	Oct 21-Dec 01
	3L	Groundfish	Oct 15-Nov 03
	3LNO	Groundfish	Apr 21-Jun 02
		Juvenile flatfish	Sep 03-22
	3Ps	Scallop	Apr 30-May 12
CAN-G	4T	Groundfish	Sep 02-26
		Groundfish migration	May 18-23
		Juvenile cod (IYGPT)	May 27-Jun 10
		Groundfish migration	Jun 13-19
CAN-SP	4V	Shrimp	May 04-15
		Shrimp	Oct 05-16
	4VSW	Cod	Oct 05-16
	4VWX	Groundfish	Mar 09-Apr 04
		Scallop	May 18-29
		Groundfish	Jun 29-Jul 24
		Redfish	Oct 19-30
	5Ze	Scallop	Aug 03-28
DEU	E. Greenl.	Groundfish (OTB)	Aug 25-Oct 05
	1BCDEF	Groundfish (OTB)	Oct 08-Nov 20
FRA	3Ps	Groundfish	Feb 03-Mar 08
GRL	0+1ABCD	Shrimp trawl	Jul-Aug
USA	4X	Bottom trawl	Apr 06-May 01
		Bottom trawl	Oct 12-30
	5YZ	Bottom trawl	Mar 23-Apr 17
		Bottom trawl	Sep 28-Nov 06
	5+6	Scallops	Jul 06-Aug 13
	6	Bottom trawl	Mar 02-Apr 03
		Bottom trawl	Sep 10-Oct 09
USSR	0B+2GHJ	G. halibut and grenadier	Sep-Dec
	3KLMNO	Groundfish	Mar-Jul
	4VX	Juvenile silver hake	Oct 15-Nov 30
		OTHER SURVEYS - 1987	
CAN-N	2J	Cod	Jul 20-Aug 15
	2+3	Salmon tagging	Sep 24-Oct 13
		Gear trials	Nov 05-24
	2J+3K	Capelin (acoustic)	Sep 30-Oct 19
	2J+3KLMNOP	Oceanography	Jul 25-Aug 15
	3	Gear trials	Mar 30-Apr 19
	3K	Cod (acoustic)	Jun 04-23
	3KLP	Herring (acoustic)	Oct 05-Dec 04
	3L	Capelin (acoustic)	May 14-Jun 02
		Crab	May 25-Jun 12
		Capelin	May 25-Jun 22
		Cod tagging	Jun 15-Jul 10
		Pelagic larvae	Jun 24-Jul 03
		Pelagic larvae	Jul 13-31
		Crab	Aug 03-19
		Pelagic larvae	Aug 18-Sep 04
		Oceanography	Aug 24-Sep 05
		Squid	Sep 07-11
		Pelagic larvae	Sep 14-Oct 02
		Crab	Oct 12-30
		Larval capelin	Nov 26-Dec 11
	3NO	Capelin (acoustic)	Jun 24-Jul 06
	3OP	Squid	Jun 04-18
	3P	Redfish (acoustic)	Jul 24-Aug 12
		Cod tagging	Sep 08-Oct 07
Can-G	4T	Diver herring spawning bed	Sep
		Herring acoustics and trawl	Nov 10-Dec 05
CAN-SP	3LMNO+4RST	Capelin, Ichthyoplankton	Nov 16-Dec 04
	4V	Herring acoustics	Jan 05-30
	4VW	Haddock tagging	Apr 06-17
		Clam tag recovery	Sep 03-18
	4VWX	Groundfish acoustics	Mar 23-Apr 03
		Parasite collection	Apr 06-10
		Sealworm	Apr 13-24
		Gear studies	Apr 27-May 15
		Sealworm	May 22-29
		Halibut survival	Jun 25-Jul 10
		Lobster larvae	Jul 13-31
		Gear studies	Sep 14-Oct 02
		Deep trawling	Sep 21-Oct 02
	4X	Crab tagging	Jun 01-12
		ECOLOG, test	Jun 15-26
		Plankton	Jul 27-31
	4VWX+5Z	Pollock acoustics	Jun 01-12
	4X+5Ze	Cod larvae	Apr 14-24
		Larval scallop	Sep 28-Oct 20
		Herring larvae	Oct 19-Nov 13
	4X+5Z	Lobster	Aug 31-Sep 11
		Offshore herring	Oct 22-Nov 13
	5Ze	Larval cod	Mar 23-Apr 03
		5Ze fishery	Jul 13-24
		Juvenile gadids	Jul 27-Aug 07
	4+5+6	Squid	Jan 05-31
		Observer training	Feb 02
GRL	E. Greenl.	Whales aerial	Jul-Aug
	1A	Shrimp	Jun
		G. halibut	Aug
		Heavy metal	Sep
		Environmental research	Sep
	1ABC	G. halibut	Sep-Oct
	1ABCDEF	Hydrography, plankton	Jun-Jul
		Hydrography	Nov-Dec
		Whales aerial	Jul-Aug
	1BCDEF	Capelin scouting	Apr-May
	1D	Hydrography	Jan
		G. halibut	Jan
		Hydrography	Feb
		Iceland scallop	Mar-Apr
		Heavy metal	Jun
		Hydrography	Jun
		Hydrography	Sep-Oct
		Hydrography	Dec
	1DEF	Hydrography	Mar
		Cod	Nov
	1E	Environmental research	Jun
	1EF	Small cod	Jun-Jul
		Young fish	Oct
USA	4X+5YZ+6ABC	Eggs, larvae, chlorophyll, temp. salinity, phytoplankton	Jan-Feb
		" " " "	May
		" " " "	Aug-Sep
		Eggs, larvae, temperature	Mar-Apr
		" " "	Sep-Oct
		Eggs, larvae (mackerel), temp.	Nov-Dec
	5Z	Juvenile fish (Gadoids)	
		IKMT trawl	May 17-25
		MOCNESS	Jun 01-12
		Bottom trawls, IYGPT	Jun 15-27
		Bottom trawl	Jul 08-17
		Bottom trawl	Jul 21-30
		Submersible	Jul 25-30
	5YZ+6A	Eggs, larvae (mackerel), temp.	Jun-Jul
	6A	" " " "	Apr
USSR	2J+3KLNO	Hydroacoustic capelin	Nov
	3K	Hydroacoustic Myctophidae	Sep-Dec
	3KLMNO	Hydroacoustic capelin	Mar-Jul
	3LMNO	Ichthyoplankton and hydrography	Mar-May
		SURVEYS PLANNED FOR EARLY 1988	
CAN-N	2J+3K	Groundfish	Feb 01-22
	3LNO	Redfish	Jan 18-31
	3Ps	Groundfish	Feb 02-21
	4VW	Squid	Feb 23-Mar 14
CAN-SP	4V	Herring acoustics	Jan 04-29
	4VWX	Deep trawling	Jan 15-26
	4X	Haddock acoustics	Mar 14-25
	5Z	Groundfish	Feb 29-Mar 18

continued to decline during 1986. The only reported coverage for the 1983-86 period is that by Canada which is as follows: 145 observed number of days fished in 1983, 134 days in 1984, 76 days in 1985, and 34 days in 1986.

2. List of Fishing Vessels for 1986

The Committee noted the updated lists have been received by the Secretariat from the following countries: Canada, Denmark (Greenland), Denmark (M), France (SP), Norway, United Kingdom and United States of America. Noting that certain countries were remissive in submitting their lists, STACREC accordingly recommends *that the Secretariat contact those responsible for the submission of this information urging them to comply with the request.*

3. Tagging Activities Reported for 1986 (SCS Doc. 87/8 + addendum)

Information was again compiled by the Secretariat (SCS Doc. 87/8 + addendum). STACREC noted the usefulness of this document and requested that the Secretariat continue this practice.

4. Review of Relevant Documents (SCS Doc. 87/3, 16)

The Committee took note of the Secretariat's documentation of historical catches of selected species by stock area and country (SCS Doc. 87/3) for the 1975-85 period and requested that the series be continued.

The Committee also noted a paper entitled "Guidelines for the Establishment of Logbook and Related Systems" by J. A Pope (FAO Fish. Rep. 793). That paper was considered to be useful as a compendium or manual on the subject.

5. Conversion Factors

Information came to the attention of STACREC that the Fisheries Commission had requested the Scientific Council's advice on a conversion factor study tabled during its 8th Annual Meeting in September 1986. Mr. R. Wells (Canada) indicated that he was aware of the origin of this study and agreed to make arrangements for its presentation to the Scientific Council as its September 1987 Meeting. There was general discussion on this subject, including the benefits that could be gained if a Scientific Council representative was present during meetings of working groups such as the one set up to study conversion factors. STACREC accordingly recommends *that the Scientific Council bring to the attention of the Fisheries Commission that having the presence of a Scientific Council observer at such working group meetings would be beneficial in assisting the Scientific Council to provide timely advice in response to Commission requests.*

6. Program of Research

A proposal to discontinue the reporting of programs of research in future years was accepted.

7. Acknowledgements

There being no further business, the Chairman extended his thanks to the participants, the rapporteurs for their assistance and the staff of the NAFO Secretariat for their excellent work.

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

Chairman: J. S. Beckett Rapporteur: R. G. Halliday

The Committee met at NAFO Headquarters in the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 8 and 15 June 1987. In attendance were J. S. Beckett (Chairman), R. G. Halliday (Canada), Sv. Aa. Horsted (Denmark-Greenland), S. Kawahara (Japan), M. G. Larrañeta (EEC), and V. A. Rikhter (USSR). The Chairman of the Scientific Council (J. Messtorff) and the Assistant Executive Secretary (V. M. Hodder) also attended. The Administrative Assistant (W. H. Champion) and M. D. Grosslein, in his capacity as Associate Editor, attended the meeting of 8 June.

1. Review of STACPUB Membership

The Chairman welcomed V. A. Rikhter back to the Committee, replacing A. T. Pinhorn who had resigned.

2. Review of Scientific Publications Since June 1986

a) Journal of Northwest Atlantic Fishery Science

The shortage of submitted manuscripts in 1985 and early 1986, with consequent shortage of editor-approved papers, resulted in production of only Vol. 7 (No. 1), containing 9 papers (88 pages), with publication date of December 1986.

Six papers have been approved and galley-processed for Vol. 7 (No. 2), but 3 or 4 more are needed to facilitate publication in late summer or autumn 1987.

b) NAFO Scientific Studies

Number 10, (112 pages) containing 9 papers, was published in August 1986, about 3-4 months after the usual time in the spring due to illness of the Editor.

Number 11, (128 pages) containing 11 papers was published on schedule in March 1987.

c) NAFO Statistical Bulletin

Volume 34 for 1984 (304 pages) was published in December 1986 after an 8-month delay due to late receipt of some data.

d) NAFO Scientific Council Reports

The volume containing reports of 1986 meetings of the Scientific Council in January, June and September (156 pages), was completed in December 1986 and distributed in early 1987.

e) Indexes and Lists of Titles

i) The provisional index and list of titles of 124 research (SCR) documents and 28 summary (SCS) documents, which were presented at the Scientific Council Meetings during 1986, were compiled and presented in SCS Doc. 87/2 (32 pages).

ii) The provisional index and list of titles of papers, which were published during 1980-86 in *NAFO Scientific Council Studies* (No. 1 to 10) and in *Journal of Northwest Atlantic Fishery Science* (Vol. 1 to 7(1), were compiled and presented in SCS Doc. 87/7 (74 pages). STACPUB expressed its appreciation that Mr. Hodder had brought this index up to date, and agreed to follow his suggestion that publication be delayed until 10 years of publications were available for indexing.

3. Editorial Matters Regarding Scientific Publications

a) Editorial Board activities

Journal submissions increased to 18 in 1986 and 10 papers have been received to date in 1987. However, it appears that submissions may be stabilizing at about 20 or less per year, which is less than the number required (30 submissions) to support two issues per year. It was decided that one issue would be published in 1987 as Vol. 7 (No. 2) completing this volume. STACPUB members preferred that each volume be issued within a calendar year, even though this will likely require a return to one-issue volumes in some, if not most, years. As subscribers are charged by the issue and not by the volume, this was not seen as a problem. Production of Vol. 8 for 1988 as one issue or two will be decided at the June 1988 Meeting based on the volume of papers available.

b) Editorial Board appointments

In November 1986, the Secretariat was informed of the sudden death of Dr. G. A. Robinson (Associate Editor for Biological Oceanography) about 2 months earlier in September 1986, only 2-3 months after he had retired from the Institute of Environmental Research, Plymouth, England. The need to fill the vacancy was considered to be urgent, and Dr. J. M. Colebrook of the same Institute was appointed in February 1987.

c) Position of editor and review of interim arrangements

The Chairman reported that enquiries concerning candidates for editor had resulted in one response from a European laboratory, and from one group which may be interested in providing services on a contractual basis. STACPUB members expressed reservations about both of these proposals based on communication difficulties and expense respectively.

The three Associate Editors who could be contacted immediately prior to, or during, the meeting indicated that the interim arrangements, whereby they took on full responsibility for editing Journal papers, were working satisfactorily. The Committee noted the great contribution that Mr. Hodder had made to Council publications and recognized that the Secretariat's ability to contribute to the editorial work of the Council depended heavily on the qualifications of Mr. Hodder's replacement. This will affect not only technical editing of the Journal but the editing of the Studies series, presently undertaken entirely by Mr. Hodder. In view of this, STACPUB decided to maintain the present interim arrangements until a new Assistant Executive Secretary is appointed, and recommends *that the Scientific Council convey to the Executive Secretary of NAFO that the Council wishes that the replacement for the present Assistant Executive Secretary, on his retirement, should be qualified to assume the editorial responsibilities for Studies and the Journal currently discharged by Mr. Hodder and that these duties should be part of his job responsibilities.*

4. Promotion and Distribution of Scientific Publications

a) Brochure for the Journal

A suitable brochure has been produced by the Secretariat and this has been mailed to about 1,000 institutes and libraries worldwide, based on mailing lists obtained from Canadian sources.

b) Advertising for the Journal

Advertisement of the Journal through the Allen Subscription Catalogue has been initiated for the 1988 catalogue.

c) Invitational papers

The concept of inviting review papers for the Journal received wide support within the Committee. A list of possible topics was reviewed and it was agreed that the Chairman would explore with potential authors the possibility of producing some of these papers, and the possibility of finding suitable authors for others. The list was recognized as only a first set of suggestions and that additional suggestions would be welcomed.

It was recognized that the present definition of the scope of the Journal is ambiguous about publication of review papers. As guidance to editors and potential authors, clarification is probably necessary. The suggestions for review papers included not only reviews of scientific topics but reviews of management practices and of fishery developments of a more historical nature. It was agreed that the Chairman, in consultation with STACPUB members and editors to the extent practical, would develop a proposal for revision of the Journal scope for consideration at the meeting of September 1987.

d) Other promotional initiatives

A review of Journal subscriptions indicated that no progress has been made to date in significantly improving distribution of the Journal. No new promotional initiatives were raised, however.

e) Publication costs and revenues for Scientific Council publications

Publication costs and revenues for the various publications related to the activities of the Scientific Council were reviewed. No noteworthy changes have occurred from the previous years.

5. Papers for Possible Publication

a) Review of proposals from 1986 meetings

A most useful comprehensive review of the results of the annual paper selection process since 1980 was provided by Mr. Hodder. During 1980-85, a total of 213 research documents were nominated, of which 65% were submitted for consideration and 57% published. Response in 1985 was notably poorer than earlier years (47% received and 31% accepted). In 1986, 31 papers were nominated for possible publication of which 48% have been received and 35% accepted to date. However, more papers from the 1986 selections were expected.

b) Proposal for publication from 1987 documents

Documents produced for the January and June 1987 meetings were reviewed and the Committee requested the Assistant Executive Secretary to invite the authors of the following documents to submit suitably revised manuscripts for possible publication in one of the Scientific Council series: SCR Doc. 87/5, 6, 12, 13, 28, 31, 35, 41, 48, 62 and 68. It was noted that SCR Doc. 87/68 was considered by the authors as a report on ongoing work and the present recommendation is based on the authors being in a position to provide a final report, at least on this part of their work, fairly soon. If extensive additional work is proposed, however, the Committee would be pleased to consider a revised document at some later meeting.

The Assistant Executive Secretary brought the Committee's attention to a proposal received concerning publication of an atlas of fishing distributions from fisheries observer data. While the Committee thought the material would likely be of substantial interest, particularly to fishermen, it concluded that the Council publications do not provide a suitable outlet. The author is encouraged to look elsewhere for a suitable vehicle for this material. If this proves unsuccessful, the Committee would be prepared to consider whether making special arrangements for publication of this material can be justified.

6. Other Matters

a) Microfiche of ICNAF documents

The Secretariat reported that a microfiche reader had been purchased, as recommended, for use by the Scientific Council. STACPUB was disappointed that only seven sets of microfiche had been purchased to date, despite notification of 17 previously-interested parties and wide distribution of an advertising brochure. More purchases are expected, however.

b) Microfiche of NAFO documents

The Secretariat provided a cost estimate of approximately $5,500 (Can.) to produce 30 copies of all NAFO SCR and SCS Documents distributed in 1979-85. STACPUB decided that the Council would be unwise to proceed with this project until demand was clearly established through sales of the ICNAF series already produced. The matter was deferred until such a time.

c) Acknowledgements

The Committee, on behalf of all members of the Council, expressed its deep gratitude for the contributions made to the Organization's publications by the Assistant Executive Secretary, Mr. Hodder. His retirement later in 1987 will bring to an end an era in which he has been a dominant force in the documentation of the Council's work, as well as of its predecessor STACRES of ICNAF. Mr. Hodder's high and inviolable standards, which he directed towards all aspects of his responsibilities, have resulted in a record of the Council's work of which both the Council and Mr. Hodder can be proud. He can retire knowing that he has made his mark on the Organization and that his labours will be missed. He is wished a long and happy retirement.

APPENDIX IV. AGENDA FOR SCIENTIFIC COUNCIL MEETING - JUNE 1987

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 1986
2. Review of relevant recommendations from 1986 meetings (see Appendix III)
3. Stock assessments

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

- Cod (Div. 3M; Div. 3NO)
- Redfish (Div. 3LN; Div. 3M)
- American plaice (Div. 3LNO; Div. 3M)
- Witch flounder (Div. 3NO)
- Yellowtail flounder (Div. 3LNO)
- Capelin (Div. 3NO)
- Squid (Subareas 3 and 4)
- [Note also Item 3 of Annex 1 concerning cod in Div. 3L.)

b) Stocks within the 200-mile fishery zone in Subareas 2, 3 and 4, as requested by Canada (Annex 2)

- Greenland halibut (Subarea 2 and Div. 3KL)
- Roundnose grenadier (Subareas 2 and 3)
- Silver hake (Div. 4VWX)
- Capelin (Div. 3L)

c) Stocks within the 200-mile fishery zone in Subarea 1 and at East Greenland, as requested by Denmark on behalf of Greenland (Annex 3):

- Atlantic cod (Subarea 1)
- Redfish (Subarea 1) (if possible, by species)
- Wolffish (Subarea 1) (if possible for spotted and striped)
- Northern shrimp (Subarea 1, north of 71°N)
- Northern shrimp (East Greenland)

d) Stocks overlapping the fishery zones in Subareas 0 and 1, as requested by Canada and by Denmark on behalf of Greenland (Annexes 2 and 3):

- Greenland halibut (Subareas 0 and 1)*
- Roundnose grenadier (Subareas 0 and 1)*
- Northern shrimp (Subareas 0 and south of 71°N in Subarea 1)

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

a) Marine Environmental Data Service report for 1986
b) Review of environmental studies in 1986
c) Overview of environmental conditions in 1986
d) Update of remote-sensing activities
e) Marine Environmental Ecosystems Subcommittee of CAFSAC (report)
f) Environmentally-related aspects of Special Session in September 1987
g) Revision of List of NAFO Standard Oceanographic Sections and Stations
h) Other matters

5. Ageing techniques and validation studies (if any)

6. Gear and selectivity studies

a) Trawl escapement and selectivity problems (NAFO Sci. Coun. Rep., 1986, p. 110)
b) Other relevant studies

* Note Canadian request for analysis of necessary research activity (Annex 2)

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

8. Other matters

   a) Further consideration of need for mid-term shrimp meetings in January (NAFO SCS Doc. 87/1, page 6)
   b) Proposal for further work on ageing shrimp (NAFO SCS Doc. 87/1, page 5)
   c) Progress report on contributions for the Special Session in September 1987 (W. R. Bowering, Convener)
   d) Preparation for Special Session in September 1988 on "The Impact of Changes in Environmental Conditions in the North Atlantic on Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Regions During the Early 1980's" (outline and conveners)
   e) Proposed theme for Special Session in September 1989
   f) Review of current arrangements for conducting stock assessments
   g) Other business

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

1. Fishery statistics

   a) CWP activities relevant to NAFO

      i) Report of 13th Session in February 1987
      ii) Consideration of recommendations and proposals

   b) Progress report on Secretariat activities in 1986/87

      i) Acquisition of STATLANT 21A and 21B reports for recent years
      ii) Publication of statistical information
      iii) Updating of fishery statistics database

   c) Review of reporting requirements

      i) Forms and deadlines for submission of STATLANT 21A and 21B statistics
      ii) Implementation of recommendations on boundary changes and effort prorating

2. Biological sampling

   a) Progress report on activities in 1986/87
   b) Forms and deadlines for submission of data

3. Biological surveys

   a) Review of survey activity in 1986
   b) Survey plans for 1987 and early 1988
   c) Review of stratification schemes
   d) Coordination of surveys in 1987 and 1988 (if requested)
   e) Survey design procedures (ad hoc Working Group Convener - W. Brodie)

4. Other matters

   a) Review of scientific observer program
   b) List of fishing vessels for 1986 (progress report)
   c) Tagging activities reported for 1986
   d) Review of relevant SCR and SCS documents (not considered in Items 1 to 3 above)
   e) Conversion factors
   f) Program of research

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

1. Review of STACPUB membership

2. Review of scientific publications since June 1986

3. Editorial matters regarding scientific publications

   a) Editorial board activities
   b) Editorial board appointments
   c) Position of editor and review of interim editorial arrangements

4. Promotion and distribution of scientific publications

   a) Brochure for the Journal
   b) Advertising for the Journal
   c) Invitational papers
   d) Other promotional initiatives
   e) Production costs and revenues for Scientific Council publications

5. Papers for possible publication

   a) Review of proposals from 1986 meetings
   b) Review of contributions to 1987 meetings

6. Other matters

   a) Question of microfiching NAFO research documents

V. Rules of Procedure

1. Report by Executive Secretary on implementation of amended rules

2. Formulation of Rules common to the three main bodies of NAFO (GC Doc. 86/4, items 9, 23, 27, App. X)

VI. Collaboration with other Organizations

1. Combined assessment of cod stocks at West and East Greenland

2. Reconsideration of establishment of joint ICES/NAFO Working Group on seals

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

VII. Adoption of Reports

1. Provisional report of January 1987 Meeting (SCS Doc. 87/01)

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

VIII. Arrangements for Special Sessions

[See under Fishery Science, Section 8(c), 8(d) and 8(e)]

IX. Future Scientific Council meetings, 1987 and 1988

X. Nomination and Election of Officers for 1987-89

1. Scientific Council
2. Standing Committee

XI. Other Matters

XII. Adjournment

ANNEX 1. FISHERIES COMMISSION REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1988 OF CERTAIN STOCKS IN SUBAREAS 3 AND 4

1. The Fisheries Commission with the concurrence of the Coastal State requests that the Scientific Council, at a meeting in advance of the 1987 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 1988:

Cod (Div. 3NO; Div. 3M)

Redfish (Div. 3LN; Div. 3M)

American plaice (Div. 3LNO; Div. 3M)

Witch flounder (Div. 3NO)

Yellowtail flounder (Div. 3LNO)

Capelin (Div. 3NO)

Squid (Subareas 3 and 4)

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

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As general reference points the implications of fishing at $F_{0.1}$, F_{1986}, and F_{max} in 1988 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 1988 and the long term. Values of F corresponding to the reference points should be given and their accuracy assessed.

b) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference points should be the level of fishing effort or fishing mortality (F) which is calculated to be required to take the MSY catch in the long term and two-thirds of that effort level.

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

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

e) Presentation of the result should include the following:

i) for stocks for which analytical dynamic-pool type assessments are possible:

- a graph of yield and fishing mortality for it least the past 10 years.
- a graph of spawning stock biomass and recruitment levels for at least the past 10 years.
- a graph of catch options for the year 1988 over a range of fishing mortality rates (F) at least from $F_{0.1}$ to F_{max}.
- a graph showing spawning stock biomasses at 1.1.1989 corresponding to each catch option.
- graphs showing the yield-per-recruit and spawning stock per-recruit values for a range of fishing mortality.

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

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

3. The Fisheries Commission with the concurrence of the coastal state requests that the Scientific Council continue to provide information, if available, on the stock separation in Div. 2J+3KL and the proportion of the biomass of the cod stock in Div. 3L in the Regulatory Area.

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1988

OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1987 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1988:

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 1987 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1988 of the following stocks:

Shrimp (Subareas 0 and 1)
Greenland halibut (Subareas 0 and 1)
Roundnose grenadier (Subareas 0 and 1)
Capelin (Div. 3L)

With respect to Greenland halibut and roundnose grenadier in Subareas 0 and 1, Canada requests that the Scientific Council also prepare an analysis of research activities necessary to allow estimation of the total biomass and the distribution of that biomass between the two subareas. This analysis should include quantitative description of the activities deemed necessary (e.g. ship time, number of stations, etc.) and commentary on the periods over which such activities shall be carried out.

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 of $F_{0.1}$ in 1988 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those to be expected at the $F_{0.1}$ level in both the short and long term. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1988 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 stocks.

L. S. Parsons
Assistant Deputy Minister (Science)
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 3. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON

MANAGEMENT OF CERTAIN STOCKS IN 1988

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1987 Meeting to provide advice on the status of the stocks and on the scientific basis for management in 1988 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)
      iv) Northern shrimp (Pandalus borealis), north of 71°N

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

      i) Greenland halibut
      ii) Roundnose grenadier
      iii) Northern shrimp (Pandalus borealis), south of 71°N

   c) 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.

   d) Any other stock of invertrebrates and finfish in Subarea 1 for which data allow a status report.

2. More specific guidelines as basis for the analyses and advice will follow before the meeting starts.

Einar Lemche
Greenland Home Rule Authorities
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APPENDIX VI. LIST OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS (SCR)

JANUARY 1987

SCR No.	Ser. No.	
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87/02 N1282 NAFO SECRETARIAT. Provisional index and list of titles of research and summary documents for 1986. (31 pages)

87/03 N1283 NAFO SECRETARIAT. Historical catches of selected species by stock area and country for the period 1975-85. (38 pages)

87/04 N1284 PARSONS, L. S. Canadian request for scientific advice on management in 1988 of certain stocks in Subareas 0 to 4. (1 page)

87/05 N1285 LEMCHE, E. Denmark (Greenland) request for scientific advice on management of certain stocks in 1988. (1 page)

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87/21 N1363 NAFO. Provisional Report of Scientific Council, Dartmouth, Canada, 3-17 June 1987.

Northwest Atlantic Fisheries Organization

Serial No. N1363

NAFO SCS Doc. 87/21
Corrigendum

SCIENTIFIC COUNCIL MEETING - JUNE 1987

Provisional Report of Scientific Council, June 1987 Meeting

The following corrigenda and additions were brought to the attention of the NAFO Secretariat following distribution of the provisional report (NAFO SCS Doc. 87/21).

Page 8, Section 3 (line 2): "....discrimination of the cod stock components in Div. 2J+3KL..."

Page 8, Section 4 (line 1): "....Subcommittee (M. Stein, Chairman) had met...."

Page 14, Section VIII(2): Replace heading and part of the first line of text with the following:

"2. Provisional Report of January 1987 Meeting (SCS Doc. 87/01)

The Council formally approved, with minor amendments, the summary report of its Special Meeting on Shrimp, held during 28 January-02 February 1987 in Copenhagen, Denmark.

The question of the need for future special meetings on shrimp, however, was discussed further, and the Council expressed regret that progress..."

Page 15, line 2, last word: "significant"

Page 43, first line below text table: change to the following: "STACFIS noted that commercial catches in the area outside the 200-mile fishery zone increased...."

Page 47, line 4: delete the first "the".

Page 47, Fig. 13: change "1984 biomass" above arrow to "1989 biomass".

Page 53, Section 13(a), line 6: "....about 12,000 tons was the ...."

Page 54, 3 lines from bottom: change "However" to "Because".

Page 73. Table 1 additions:

Subarea	Div.	Month	Type of survey	Nature of survey	No. of sets
			CANADA (Q)		
3+4	3P+4RST	1	S	Groundfish	184
4	RST	9-10	S	Shrimp	97
4	T	4	0	Crab tagging	53
4	T	5	0	Herring tagging	...
4	RS	5-6	0	Ichthyoplankton	190
4	TV	6-7	0	Mackerel larvae	138
4	T	7	0	Blue mussel feeding	...
4	T	7	0	Mackerel larvae	...
4	ST	7	0	Scallops	71
4	T	8	0	Scallops	88
4	ST	7-8	0	Lobster (diving)	...
4	T	10	0	Blue mussel	...
			POLAND		
5	Z	4-5	S	Mackerel	241
6	ABC	2-5	S	Mackerel	254

Page 74. Table 2 additions:

Subarea	Div.	Type of survey	Nature of survey	Dates
		CANADA (Q)		
3+4	PRST	S	Groundfish	Jan-07-28
4	RST	S	Groundfish	Aug 03-28
4	RS	S	Shrimp	Aug
4	T	O	Mackerel larvae	Jun 15-Jul 10
4	RS	O	Shrimp larvae and ichthyoplankton	Apr 27-May 15
4	S	O	Crab tagging	Jun 01-12
4	S	O	Shrimp acoustics	Aug 10-18
4	R	O	Herring acoustics	Oct
		POLAND		
2	HJ	O	Greenland halibut	Feb-May
3	K	O	Greenland halibut	Feb-Jun
5	Z	S	Mackerel	Apr-May
6	ABC	S	Mackerel	Jan-Apr
		JAPAN-GREENLAND		
E. Greenland		S	Bottom trawl	Jul-Aug
Subarea 1		S	Bottom trawl	Nov-Dec