Northwest Atlantic Fisheries Organization

Serial No. N1523

NAFO SCS Doc. 88/20

SCIENTIFIC COUNCIL MEETING - JUNE 1988

Provisional Report of Scientific Council, June 1988 Meeting

CONTENTS

PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

June 1988 Meeting

Chairman: J. S. Beckett Rapporteur: T. Amaratunga

The Scientific Council met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada during 8-23 June 1988, to consider and report on the various matters listed in its agenda.

The Executive Committee met briefly prior to the opening session of the Council and the provisional Agenda (NAFO Circular Letter 88/21) and work plan were reviewed.

Representatives attended the various sessions of the Council and its Committees, including the Environmental Subcommittee and working group meeting on shrimp from Canada, Cuba (June 14th onward), Denmark (Greenland), European Economic Community (EEC), Japan and Union of Soviet Socialist Republics (USSR). Experts from Iceland attended the shrimp meetings. The NAFO Executive Secretary and Assistant Executive Secretary were in attendance.

Under agenda item 1.4, the Executive Secretary informed the Council that he held proxy votes of abstention for 3 Contracting Parties (Bulgaria, Iceland and Norway) which guaranteed a quorum in case the need arose for a formal vote.

The Council members welcomed the new Assistant Executive Secretary, Mr. T. Amaratunga, who assumed duties in April 1988 and wished him well, and thanked the Executive Secretary for his efforts in the appointment of his new Assistant Executive Secretary.

The Chairman brought to the attention of the Council members that in the provisional agenda, the request from the Fisheries Commission for information on the status and acquisition of scientific data for the establishment of an annual scientific program in the Regulatory Area had been inadvertently omitted. The Chairman proposed that this agenda item be added to the work of STACREC and the manner of incorporating this work be assigned to STACREC. This was unanimously accepted.

With respect to Agenda Item II.3(b) it was noted that Canada as a coastal state had requested scientific advice on Cod in Subdivision 3Ps. It was brought to the attention of the Council that the EEC (telex [see Appendix V, Annex 4] dated 5 May 1988 to the Secretariat was circulated) had requested the deletion of this agenda item because the area of fisheries jurisdiction in which this cod stock occurs had not been defined and the Scientific Council consequently would be unable to give scientific advice on the stock restricted to the Canadian area, as required by Article VII in the text of the NAFO Convention. Canada had responded to the EEC request of 5 May 1988 (in a letter [see Appendix V, Annex 5] received and circulated through the Secretariat on 7 June 1988 and to the Scientific Council representatives on the first day of the meeting) stating that under Article VII, it is mandatory for the Scientific Council to provide advice when requested by a coastal state. After prolonged discussions, it was apparent that the Scientific Council did not wish to address legal matters, and suggested that mediation between the two parties was probably the most appropriate method to find a solution. The Council requested the Executive Secretary to contact the authorities representing the two parties and seek a joint or parallel request for

advice or withdrawal of one of the opposing views. The Scientific Council postponed further consideration until 15 June 1988.

On 15 June 1988, the Executive Secretary reported back to the Council that his mediation had failed. Further prolonged discussions on the question of addressing the agenda item resulted in the Council agreeing by majority vote to leave on the agenda the assessment of cod in Subdivision 3Ps. It was further decided by majority vote that the record would not contain the agruments presented by the various representatives. It was agreed further that the Council would report to the General Council that the Scientific Council was in danger of having its work undermined by political and legal matters including bilateral problems, and a clear message be carried to the General Council that such matters should be addressed in other fora. In particular the Scientific Council requests the General Council to provide a statement as to whether Article VII of the NAFO Convention limits the advice that may be requested by a coastal state to resources entirely within its zone of jurisdiction.

With respect to further comments on the provisional agenda made during the opening session, the EEC representative cited Article VI.1.d to propose that a new Agenda Item be inserted under Section II.3(e) of the Provisional Agenda. The item "Cod in Div. 2J+3KL as required for the purpose of the Fisheries Commission" was proposed with the same terms of reference put forward by the Fisheries Commission for other stocks. It was noted that insertion of new Agenda items required a unanimous agreement of the members of the Scientific Council. There was no such agreement and consequently the proposal was not accepted.

In adopting the report of STACFIS on 23 June 1988, discussion occurred as to whether the advice on cod in Subdivision 3Ps should be framed to respond solely to the Canadian request, or whether a range of catch options should be provided. The Council decided by majority vote to specifically mention only the catch option requested by Canada.

The reports of the Standing Committees, as adopted on 23 June 1988, are given in Appendix I (STACFIS), Appendix II (STACREC) and Appendix III (STACPUB). The amendments to the Rules of Procedure are given in Appendix IV, the adopted agenda in Appendix V. The lists of research (SCR) and summary (SCS) documents and the list of participants are given in Appendix VI and VII respectively. Brief summaries of the committee reports and other matters considered by the council follow in Sections I to VII.

I. FISHERY SCIENCE (APP. 1)

1. General Fishery Trends

From provisional statistics for 1986 and 1987, the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) increased (3.5%) from 2.88 million (metric) tons in 1986 to 2.98 million tons in 1987 (see Appendix I, Table 1). For the same years the total "groundfish" catch decreased (6%) from 1.33 million tons to 1.27 million tons, the "pelagic fish" catch increased significantly (30%) from 518,000 tons to 674,000 tons, the "other finfish" catch decreased (11%) from 154,000 tons to 138,000 tons and the "invertebrates" catch increased 3% from 876,000 tons to 898,000 tons. With respect to the nominal catches by subarea, increases were recorded for Subarea 1 (89,000

to 107,000 tons), Subarea 2 (50,000 to 112,000 tons), Subarea 5 (397,000 to 422,000 tons) and Subarea 6 (800,000 to 884,000 tons) and decreases were recorded for Subarea 0 (3,000 to 2,000 tons), Subarea 3 (764,000 to 690,000 tons) and Subarea 4 (787,000 to 767,000 tons).

2. Assessment of Finfish and Invertebrate Stocks

The Council noted that STACFIS had reviewed the status of certain stocks in Subareas 0 to 4, as requested by Canada, Denmark (Greenland) and the Fisheries Commission, and had advised on catch levels corresponding to reference levels of various fishing mortality. Advice was found in terms of $F_{0.1}$, two-thirds of the fishing effort associated with the maximum sustainable yield, F_{max} or $F_{current}$, according to the different requests. 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 had been 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 on the same basis as the 1988 TACs, where known, are listed in the last column of Table 1. Details of the stock assessments are given in the Report of STACFIS at

Table 1. Summary of recent catches (1982-87) and TACs (1982-88) for stock reviewed at the June 1988 Meeting of STACFIS, with advised TACs for 1989.

Species	Stock area	Nominal catches (000 tons)						TACs (000 tons)							
		1982	1983	1984	1985	1986	1987[1]	1982	1983	1984	1985	1986	1987	1988	1989
Cod	1	56	63	33	15	7	19	62	62	68	28.3	12.5	1.25		( )[2]
	3M	13	10	13	14	15	8	12.4	12.4	13	13	13	13	[3]	(0)[3]
	3NO	32	32	27	37	50	41	17	17	26	33	33	33	40	(25)
	3Ps	34	38	37	51	32	50	33	33	35.8	44.6	60.6[8]	60.6[8]	...	(20.5)[2]
Redfish	1	8	8	6	4	5	1	...	...	....	...	...	...	...	(...)[4]
	3M	15	20	20	20	29	45	20	20	20	20	20	20	20	(20)
	3LN	22	20	15	21	42	55	25	25	25	25	25	25	25	(25)
Silver hake	4VWX	60	36	74	75	83	62	80	80	100	100	100	100	167	(235)
A. plaice	3M	1	2	1	2	4	6	2	2	2	2	2	2	2	(2)
	3LNO	50	38	38	48	56	52	55	55	55	49	55	48	40	(32)
Witch flo.	3NO	4	4	3	9	9	8	5	5	5	5	5	5	5	(5)
Yellowtail	3LNO	12	9	15	21	23	16	23	19	17	15	15	15	15	(5)
G. halibut	0+1	9	9	7	10	9	10	25	25	25	25	25	25	25	(25)
	2+3KL	26	28	25	19	15	28	55[5]	55[5]	55[5]	75	100	100	100	(10)
R. grenadier	0+1	+	+	+	+	+	+	8	8	8	8	8	8	8	(8)
	2+3	4	4	4	5	7	8	27	11	11	11	11	11	11	(11)
Wolffishes	1	4	3	2	2	2	2	...	...	5-6	5-6	5-6	5-6	5-6	(5-6)
Capelin	3LNO	27	25	33	25	48	21	30[6]	60[6]	38[6]	60[6]	130[6]	293[7]	100[7]	(363)[9]
Squid-Illex	3+4	13	+	1	1	+	2	150	150	150	150	150	150	150	(150)
Shrimp	0+1	44	47	43	54	63	71	35	35	35	42	36	42		(36)[2]

[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 in 1987 and 15,000 tons in 1988 for Div. 3NO and remainder for Div. 3L.
[8] Effective TAC - combined Canada and EEC.
[9] Div. 3L TAC is 335,000 tons, Div. 3NO TAC is 28,000 tons.

Appendix I. Some general observations are as follows:

a) The cod stock in Subarea 1 has declined greatly from levels seen in the 1960's, but the recruitment of the very abundant 1984 year-class is resulting in stock rebuilding. This year-class may be as big as any seen in the past, but catch projections have been provided to

illustrate the impact of other year-class sizes than that assumed. The 1985 year-class is considered average but that of 1986 to be very low. Management options, yield-per-recruit calculations and answers to specific questions are available in Appendix I.

b) For the cod stock in Div. 3M, the biomass (age 3+) continues to be at a very low level (less than 30,000 tons) relative to the target biomass of 85,000 tons which was set by the Fisheries Commission. This target biomass will not be reached in the near future, because the year-classes of cod older than age 5 are at very low levels and the fishery has been exploiting incoming year-classes at too early an age. To achieve the target level of biomass as quickly as possible, continuation of the moratorium on fishing is advised.

c) Analytical assessment of the cod stock in Div. 3NO indicates a lower stock size than assessed in 1987, and a new yield-per-recruit analysis suggests lower fishing mortalities for the reference levels. The projected catch in 1989 at $F_{0.1}$ is 25,000 tons, rather than the 40,000 tons advised for 1988.

d) For the cod stock in Subdiv. 3Ps, which was last assessed by the Scientific Council in 1986, it is now possible to provide much firmer advice than at that time. Catches have increased substantially since 1984 to over 50,000 tons annually, largely in response to increased effort, but also due to improved recruitment. The catch in 1989 that is estimated to generate the $F_{0.1}$ level of fishing mortality (recalculated this year as F = 0.15) would be 20,500 tons.

e) For American plaice in Div. 3LNO, the advised TAC in 1989 at $F_{0.1}$ is 32,000 tons. The Council was concerned in 1987 about the actual magnitude of the decline in population size, that was indicated by the assessment at that time. The new assessment, however, largely confirms the decline. The Fisheries Commission established an interim TAC for 1988. It is now considered that this will, if caught, generate an F = 0.43, over 50% above $F_{0.1}$ (F = 0.26).

f) For witch flounder in Div. 3NO, catches in the past three years have been reported as 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 and there was no basis for advising a change in the current TAC of 5,000 tons for Div. 3NO. The Council reiterates its opinion that the stock is unlikely to be able to support the recent high catch levels without declining in abundance.

g) For the stock of yellowtail flounder in Div. 3LNO, the Council has expressed concern for the past two years over the reports that catches were double the TAC but has not been able to provide firm advice. There is again no quantitative assessment this year, but given the available information from trawl surveys that shows major declines in biomass and poor recruitment prospects, the Council advises that total catches, including those by non-members should not exceed 5,000 tons. The representative of the EEC noted that "the

consequences of projected catches at 5,000 tons or more seem not possible and the calculations of such a precise figure do not appear in the text, therefore the advice that catch in 1989 should not exceed 5,000 tons does not adequately answer the request of the Fisheries Commission".

h) For capelin in Div. 3L, recruitment of the strong 1986 year-class will increase biomass greatly and it is estimated that the catch in 1989, that would represent about 10% of the spawning stock, would be 335,000 tons.

i) The biomass of capelin in Div. 3NO is considered to have averaged about 280,000 tons since 1981, and should the 1986 year-class also be strong for this stock, the biomass would be at least as large as the average. Removals of 18,000 tons would represent 10% of this average biomass.

j) For the silver hake stock in Div. 4VWX, it is estimated that the recruitment of the very large 1985 year-class and the large 1986 year-class will result in a major increase in the biomass. Using an assumption that the catch in 1988 will be 110,000 tons, the estimated catch at the $F_{0.1}$ level in 1989 would be 235,000 tons.

k) For squid in Subareas 3 and 4, the Council notes that the unpredictable nature of the fluctuations in stock availability, means that no catch projection can be made. Advice in recent years has been that there is "no reason to change the existing advice". The phrasing used this year is an accurate statement of current predictive abilities for this stock, but it should be noted that this is not a recommendation for a zero TAC but a recognition that insufficient information is available to assess the impact on the population of any particular catch level. The species is a by-catch in other fisheries and, in years of high abundance, may comprise a major part of catches in small meshed fisheries such as those directed at silver hake.

l) No change in TAC was advised for redfish in Div. 3M and 3LN, American plaice in Div. 3M, witch flounder in Div. 3NO (also see Section f), Greenland halibut in Subareas 0+1 and SA 2 plus Div. 3KL, and roundnose grenadier in Subareas 0+1 and 2+3. The EEC representative stated when the STACFIS report was being adopted that "for at least stocks on which scientific advice has been expressed by the Scientific Council (i.e. redfish in 3M, 3LN, A. plaice in 3M, witch flounder in 3NO, roundnose grenadier in Subareas 2 and 3) it used the expression "STACFIS has no basis to advise a change from the present TAC of ...". In other words, this means that it has no basis to advise on any precise level of TAC. This is a normal situation given the fact that it was only requested to make catch projections and to comment on their effects on the fishable stock size, spawning stock biomass, recruitment prospects, catch rates, for the next year and in the long term. Therefore such sentences are inappropriate and should be deleted. Advice should be rephrased to comment on any consequences of possible catch levels."

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

n) For shrimp, the Scientific Council addressed assessments at this meeting rather than in the winter as in the recent past. In Subareas 0+1, catches have increased markedly since 1984 and over 52,000 tons was reported caught offshore in 1987. There is no quantitative assessment and the Council cannot predict whether the present catches can be maintained. Catch rate and size frequency information suggest that recent catches have not depressed stock size although a time lag of several years would be expected particularly as it is now thought that shrimp in the catches may be older than thought previously. The Council therefore advises that, should it be desired to investigate more vigourously the level of catch that can be sustained, controlling offshore catches at the 1986 level (44,000 tons) might be a safe approach. A higher catch level such as 50,000 tons would demonstrate more rapidly whether a higher yield can be maintained. This experimental approach would require catch levels to be held constant for several years in order to detect the impact on the population. The higher the catch level, the greater the risk that drastic reductions in effort might be necesary should the stock start to decline. In response to a request concerning the need for management of shrimp in grounds north of 71°N, the Council advises a separate but cautious approach, but in response to a second request it was not able to evaluate the present Regulatory Area off Disko Bay.

o) With respect to shrimp in Denmark Strait, biomass estimates from research surveys conducted by Norway over a three-year period indicate some stability in the resource despite increasing catches. Given the indications of biomass size and stability, the Council advises that the recent level of catches appears to be a safe level and that maintaining catches at this level (10,000 tons) might be adopted as a precautionary measure until the database has been improved and an assessment performed. In answering a request about exploratory fishing, it is advised that this should only be conducted in areas well separated from grounds exploited currently.

3. Response to Questions by the Fisheries Commission

The Council concurred with the information provided by STACFIS in response to the specific question regarding the proportion of the biomass of cod in the Regulatory Area relative to the whole of Div. 3L.

4. Environmental Research

The Council noted that the Environmental Subcommittee (M. Stein, Chairman) had met on 13 June 1988 and had considered 14 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 was now sufficient progress to

warrant a second workshop on the ageing of shrimp, and that an invitation had been received to hold this in Iceland in 1989. The Council was pleased to learn of an exchange of American plaice otoliths between Spain, Portugal and Canada and encouraged further cooperative study of growth. The Council endorsed also, continuation of a Canada/Cuba/USSR exchange of silver hake otoliths.

6. Gear and Selectivity

The Council received no new information on this item.

7. Review of Scientific Papers

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

8. Other Matters

a) Special session in September 1988

The Council noted that about 19 papers were expected for the special session during 7-9 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" which will be convened by J. C. Rice (Canada).

b) Special session in September 1989

The Council deferred nomination of a convener for the special session in September 1989 on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes".

c) Topics deferred for consideration in September 1988

i) Convener for special session in 1989.

ii) Topic for special session in 1990.

II. RESEARCH COORDINATION (APP. II)

1. Fishery Statistics

Submission of STATLANT 21A reports is generally complete but that of the more detailed STATLANT 21B continues to cause problems for publication of the Statistical Bulletin. Four such forms remain outstanding for 1986 and the bulletin cannot be published until these are received. The Council agreed with STACREC's recommendation that it would be beneficial to its work if the Assistant Executive Secretary were to attend the inter-agency meeting on fishery statistics that will be held at the beginning of October in Norway. This group will prepare for the 14th Session of the CWP which is scheduled for February 1990.

2. Biological Sampling

It was noted that one component of the four that report for Canada (i.e. Canada (Quebec)) had not been submitting information to NAFO, although such material would be appropriate to the NAFO data bank.

3. Biological Surveys

The Council reviewed the inventory of biological surveys that were carried out in 1987 and of surveys planned for 1988 and early 1989. It was noted that data records were not complete for two reporting components from Canada, in this case both Canada (Quebec) and Canada (Gulf).

4. Request of the Fisheries Commission concerning an Annual Scientific Program in the Regulatory Area

Information on the status of biological information for the Regulatory Area and on the means of acquiring it was requested by the Fisheries Commission. Detailed consideration is contained on a stock by stock basis in the Report of the Standing Committee on Research Coordination (Appendix II). The Council noted that because it is an overview, the STACREC report tends to suggest that there are fewer problems with respect to the scientific database than there in fact are. Assessment of the individual stocks is compromised frequently because one or more sources of information cannot be used for certain years for one or more of a wide variety of reasons. Thus, expansion of existing initiatives such as biological sampling or research surveys are extremely important even for those stocks for which the data coverage is categorized as "satisfactory".

5. Other Matters

a) International Scientific Observer Scheme

The number of days devoted to this continues to decline, to 25 in 1987, and it was noted that the implementation of an Annual Scientific Program (ASP) by NAFO might subsume the observer program. The Council will evaluate the usefulness of the latter in the light of implementation of the ASP.

III. PUBLICATIONS (APP. III)

1. Review of Scientific Publications

The Council learned that the second issue of Volume 7 of the Journal was published in December 1987 and Volume 8 will be limited to one issue, owing to the limited number of suitable papers. In addition, Studies No. 12 was issued in March 1988.

2. Editorial Matters

The Council was advised that the duties of the new Assistant Executive Secretary include serving as Editor of the Studies and as Technical Editor of the Journal.

Following discussions with three Associate Editors, new guidelines were established for the respective responsibilities of the Technical Editor and of the Associate Editors. The Council agreed to the STACPUB proposal to expand the number of Associate Editors by two, with new appointments in the field of Vertebrate Fisheries Biology.

The Council agreed that the vacancy created by the resignation of W. G. Doubleday would be offered to R. K. Mohn (Canada) for the position of Associate Editor, Biomathematics, and that one of the new positions created for Associate Editor for Vertebrate Fisheries Biology be offered to W. R. Bowering (Canada). The Council expressed hope that G. P. Ennis would continue as Associate Editor

for Invertebrate Fisheries Biology and deferred until September a decision on that position and the selection of a candidate for the remaining position of Associate Editor of Vertebrate Fisheries Biology.

3. Promotion and Distribution of Scientific Publications

Council agreed that the Journal while a primary publication, caters mainly to a regional interest. Thus, it should complement rather than compete with major international journals and as such might accommodate larger papers and papers of more regional interest than would be accepted by other vehicles.

4. Papers for Possible Publication

The response of authors to invitations to upgrade Research Documents has improved with 62% of the 26 papers nominated from the 1987 meetings being submitted. The response rate in 1985 and 1986 was only about 50% and the present rate is comparable to the long-term average.

Consideration of papers submitted to the June 1988 Meeting resulted in 11 papers being identified as suitable for the Journal or Studies.

5. Other Matters

The Council expressed its appreciation to Dr. W. G. Doubleday for his work as Associate Editor and thanked warmly Mr. H. Champion for handling publication matters so ably between the retirement of Mr. Hodder and the arrival of Mr. T. Amaratunga.

IV. RULES OF PROCEDURE (APP. IV)

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

The Council adopted amendments to Rule 2 (Appendix IV) with respect to the modalities of voting by mail or other forms of teledocumentation.

V. COLLABORATION WITH OTHER ORGANIZATIONS

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

It was noted that ICES had not been requested to provide a response to the questions implied in the Council's consideration of this matter at the 1987 meeting. The Chairman undertook to convey to ICES the Council's interest in learning more about modalities of referrals for advice.

VI. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting and Special Session in September 1988

The Council will meet in conjunction with the Annual Meeting of NAFO in Ottawa, Ontario, Canada, during 12-16 September 1988. That meeting will be preceded on 7-9 September 1988 in Dartmouth, Nova Scotia, by the special session on "Impact of Changes in Environmental Conditions in the North Atlantic on Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Regions during the Early 1980's".

2. Scientific Meeting in June 1989

The Council reviewed its earlier tentative decision on dates of the June 1989 Meeting and agreed to meet, together with its Standing Committees and Subcommittee, at NAFO Headquarters in Darmouth, Nova Scotia, during 7-21 June 1989. This meeting will deal with requests for scientific advice on fisheries management and with other fishery-related research and statistical activities.

3. Special Session and Annual Meeting in September 1989

The Scientific Council, considering that the Annual Meeting is scheduled for 11-15 September 1989, reaffirmed its earlier tentative decision that the special session be held on 6-8 September 1989. The theme for that session is "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes".

VII. OTHER MATTERS

1. STACPUB Membership

Following receipt of notice of resignation from M. G. Larrañeta (Spain), the Council elected W. R. Bowering (Canada) as his replacement. The contribution to the work of STACPUB by Dr. Larrañeta was recognized by the Council.

VIII. ADJOURNMENT

The Chairman thanked all attendees for their contributions and particularly the chairmen of the Standing Committees (A. Maucorps, A. Vazquez and Sv. Aa. Horsted) and the Environmental Subcommittee (M. Stein). He noted the long hours worked by STACFIS and the additional work this had placed on the Secretariat, and expressed the Council's appreciation to the Secretariat staff, noting that despite this they had, as always, supported the work of the Council with great efficiency and cheerfulness.

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

Chairman: A. Maucorps Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 8-23 June 1988, 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 Appendix V for agenda). Representatives attended from Canada, Cuba, Denmark (Greenland), EEC, Iceland, Japan and USSR.

Discussions on all matters, except environmental research and the informal meeting of some experts to evaluate West Greenland shrimp samples (agenda item 8(a)), 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 (Section I-III, V-VIII below). The report of the Subcommittee on Environmental Research (Chairman: M. Stein) is summarized in Section IV below and given in detail in Annex 1.

I. FISHERY TRENDS

1. Introduction

For the third year in succession, sufficient STATLANT 21A reports were available (although data from 8 countries were forwarded during the June meeting) for the Secretariat to compile provisional nominal catches for the preceding year. The 1987 data are tabulated in SCS Doc. 88/18. Provisional data given in Table 1 for 1986 and 1987 are compiled from 21A reports received by the NAFO Secretariat.

Table 1. Provisional nominal catches (000 tons) by subarea for 1986 and 1987. (+ indicates less than 500 tons.)

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
Atlantic cod	-	+	7	19	25	58	373	303	210	173	36	39	+	+	652	592
Haddock	-	-	-	-	-	-	13	9	33	18	9	8	-	+	54	35
Atlantic redfishes	-	-	5	1	4	3	112	133	47	57	3	2	-	-	171	196
Silver hake	-	-	-	-	-	-	1	+	83	62	14	12	4	4	102	78
Red hake	-	-	-	-	-	-	+	+	+	1	2	2	+	+	2	3
Pollock	-	-	-	-	-	-	7	6	43	44	27	24	+	+	77	74
American plaice	-	-	+	+	+	+	72	64	13	15	5	4	+	+	90	83
Witch flounder	-	-	-	-	+	1	15	13	5	6	5	3	+	+	24	23
Yellowtail flounder	-	-	-	-	-	-	23	17	1	2	8	6	+	+	32	25
Greenland halibut	+	+	9	10	8	15	7	14	7	11	-	-	-	-	31	50
Other flounders	-	-	+	+	+	+	3	4	10	8	15	14	8	10	37	36
Roundnose grenadier	+	-	+	+	+	1	7	8	+	-	-	-	-	-	7	9
White hake	-	-	-	-	+	-	6	10	12	15	6	6	+	+	24	31
Wolffishes	-	-	2	2	+	+	2	2	2	1	1	1	-	-	6	6
Other groundfish	-	-	4	3	+	+	1	2	5	6	10	16	5	6	25	33
Atlantic herring	-	-	+	-	+	+	5	20	173	221	32	40	+	+	210	281
Atlantic mackerel	-	-	-	-	+	+	12	10	14	14	7	4	28	32	61	60
Atlantic menhaden	-	-	-	-	-	-	-	-	-	-	17	15	215	302	232	317
Other pelagics	-	-	-	-	-	-	1	1	1	1	6	6	7	8	15	16
Capelin	-	-	1	+	10	29	69	32	4	1	-	-	-	-	84	62
Other finfish	-	-	1	1	1	2	24	33	13	9	-	9	22	22	70	76
Squids	-	-	-	-	-	-	+	1	+	+	9	5	14	17	24	23
Clams	-	-	+	-	-	-	-	-	6	15	51	49	335	325	391	389
Scallops	-	-	-	+	+	+	2	1	16	16	80	103	28	68	126	188
Other molluscs	-	-	-	-	+	-	+	+	3	3	19	26	81	53	103	82
Shrimp	3	2	60	71	2	3	-	+	10	12	5	5	1	+	79	93
Crabs	-	-	-	-	+	+	8	6	34	21	1	3	50	34	94	64
Lobsters	-	-	-	-	-	-	1	1	36	35	19	19	2	2	58	57
Other invertebrates	-	-	-	-	-	-	-	-	+	+	1	1	+	1	1	2
Total	3	2	89	107	50	112	764	690	781	767	397	422	800	884	2882	2984

2. General Trends for the Northwest Atlantic

The provisional overall catch (round fresh weight) of all finfish and invertebrates stocks was 2.98 million (metric) tons in 1987, a 3.5% increase over the 1986 catch of 2.88 million tons. The

total "groundfish" catch, which represented 43% of the overall catch in 1987, was 6% less than in 1986 (1.33 and 1.27 million tons in 1986 and 1987 respectively). Significant decreases were noted for cod (10%), haddock (35%), silver hake (24%) and yellowtail flounder (22%) and increases noted for redfish (15%), Greenland halibut (61%) and white hake (30%). The total "pelagic fish" catch, which represented 23% of the overall catch in 1987, increased significantly (30%) from 518,000 tons in 1986 to 674,000 tons in 1987, due to increased catches of herring and menhaden. The total "other finfish" catch, which represented about 5% of the overall catch in 1987, decreased by 11% from 154,000 tons in 1986 to 138,000 tons in 1987, due mainly to a decrease in the capelin catch. The total catch of "invertebrates", which represented 30% of the overall catch in 1987, increased very slightly (3%) from 876,000 tons in 1986 to 898,000 tons in 1987. Increases were noted for scallops (49%) and shrimp (17%) but these were offset by decreases in other molluscs (26%) and crabs (32%).

3. Fishery Trends by Subarea

a) Subarea 0

The total nominal catch (from STATLANT 21A reports) of all species in 1987 was slightly higher than 2,000 tons and consisted mainly of shrimp. However, it was noted that the shrimp catch considered for STACFIS assessments was over 6,000 tons.

b) Subarea 1

The total catch of all species increased (20%) from 89,000 tons in 1986 to 107,000 tons in 1987, due mainly to increases in cod and shrimp. Shrimp continued to be the dominant species with 66% of the overall catch with cod (18%) and Greenland halibut (9%) the next highest.

c) Subarea 2

The total nominal catch of all species increased sharply (124%) from 50,000 tons in 1986 to 112,000 tons in 1987. This was due to an increase in cod from 25,000 tons to 58,000 tons and an increase in capelin from 10,000 tons to 29,000 tons. Greenland halibut remained in third place with 15,000 tons.

d) Subarea 3

The total catch declined (10%) from 764,000 tons in 1986 to 690,000 tons in 1987. This was due mainly to a decrease (9%) in groundfish which accounted for 85% of the total catch. Although increases were noted for redfish (19%) and Greenland halibut (50%) these were offset by decreases in cod (19%) and other flounders (14%). Pelagic species increased (72%) from 18,000 tons to 31,000 tons due mainly to increased catches of herring (5,000 tons to 20,000 tons). Finfish decreased 30% due mainly to capelin (69,000 tons to 32,000 tons). Invertebrates remained virtually unchanged.

e) Subarea 4

The total nominal catch of all species decreased slightly (2%) from 781,000 tons in 1986 to 767,000 tons in 1987. Decreased catches were noted for cod (18%), haddock (45%), and silver hake (25%) while redfish catches increased (21%). There was a 25% increase in pelagic species due mainly to herring (28%), and decreases were noted for finfish (41%) and invertebrates (3%). Cod (23%) and herring (29%) continued to be the most significant components of the catch, followed by redfish (7%), silver hake (8%) and pollock (6%).

f) Subarea 5

The total nominal catch of all species increased (6%) form 397,000 tons in 1986 to 422,000 tons in 1987. There was a 14% increase in invertebrate species, mainly due to increases in scallops (29%) and other molluscs (37%). The invertebrate species comprise 50% of the total catch. There was a slight decrease in groundfish species (3%) but this was offset by increases in pelagics (6%), notably herring (25%) from 32,000 tons to 40,000 tons.

g) Subarea 6

The total catch increased (10%) from 800,000 tons in 1986 to 884,000 tons in 1987. There was an increase (36%) noted for pelagic species, mainly due to menhaden (40%). Invertebrates, which comprise 57% of the total, were down slightly (10%) in spite of an increase in scallops (142%). Decreases were noted for other molluscs (35%) and crabs (32%).

II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 88/31, 42, 43, 44, 45, 46; SCS Doc. 88/4, 13, 16)

a) Introduction

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

In 1987, no directed trawl fishery by vessels greater than 80 GRT was allowed in the first 10 months. The poundnet fishery was restricted to places where, based on experience, at least 30% of the catch by weight would be above 40 cm. Similar regulations were introduced in 1986 in order to protect small cod, especially the 1984 year-class.

The nominal catch in 1987 was about 19,300 tons or 3 times greater than the 1986 landings, but still at a low level compared with the landings in the last decade, 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.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Trawlers	53	57	16	14	29	42	20	7	1	6[1]	
Other vessels	20	42	38	39	27	21	13	8	6	13[1]	
Total (000 tons)	73[2]	99[2]	54[2]	53	56	63	33	15	7	19[1]	
TAC (000 tons)	-[4]	-[4]	20[3]	50	62	62	68	28.5	12.5	12.5	40
CPUE (tons/hr)	33.3	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 by-catches.

Since a directed trawl fishery was not allowed in 1986 and 1987, the catch-per-unit-effort series could not be extended to these years. 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% each year to a low level of only 6,600 tons in 1986, the lowest catch on record since ICNAF began compiling statistics. The increase in 1987 is due to the beginning recruitment of the very abundant 1984 year-class.

In 1987, a new statistics program was introduced for vessels below 80 GRT. This program supplied statistics of the landings by division, gear, month, and size group for cod whether above or below 55 cm. In 1987, this program covered 75% of the landings from those vessels. The remaining part was only broken down by division and month. The ICES Working Group on Cod Stocks off East Greenland used this information to set up a table of catches in 1987 by gear and division (SCR Doc. 88/45, table 6.1.2) when it met in February 1988.

b) Commercial fishery data

i) Age composition

The commercial Greenland catch was rather poorly sampled in 1987, not covering all areas nor all gears types. It was, thereby, not possible to get the full benefit of more detailed catch statistics, including information on proportions of different size groups, now supplied by Greenland for the estimation of landings by age groups.

Trawl catches in the first quarter of the year were dominated by age groups 8, 7, and 6 (1979, 1980 and 1981 year-classes), whereas the large catch in the last quarter was heavily dominated by the recruiting 1984 year-class (82% by number). The overall age composition showed that the recruiting 1984 year-class accounted for about 2/3 by numbers followed by the 1983 year-class (14%) and the 1981 and 1979 year-classes (7% each).

ii) Weight-at-age data

In the 1979-85 period, mean weight-at-age decreased, but increased again in 1986. The

mean weights found in 1987 generally exceeded the 1986 values, especially for the 3-year olds.

The overall mean weight was high in 1986 (2.34 kg) but dropped (by 1 kg) to 1.30 kg for the 1987 landings due to the high amount of 3-year-old fish in landings. Mean weight in landings from poundnets was only 1 kg while that for trawlers was about 1.55 kg.

c) Research survey data

i) Stock size and age composition

Trawl surveys by the Federal Republic of Germany. Stratified-random bottom surveys off West Greenland have been conducted in late autumn since 1982. Cod biomass and abundance estimates for the total survey area off West Greenland are given in Table 3. Confidence intervals are given at the 95% level of significance.

Table 3. Cod in Subarea 1: estimate of biomass and abundance (with 95% confidence limits) and mean weights from autumn research vessel surveys off West Greenland, 1982-87.

Year	Biomass (tons)	Abundance ('000)	$\bar{w}$ kg
1982	179,934 ± 37.0%	109,039 ± 36.1%	1.65
1983	98,843 ± 28.5%	59,362 ± 26.5%	1.67
1984	24,945 ± 39.7%	16,104 ± 39.1%	1.55
1985	31,860 ± 60.1%	52,466 ± 33.3%	0.61
1986	76,220 ± 30.8%	134,716 ± 31.8%	0.57
1987	464,286 ± 47.0%	582,868 ± 42.6%	0.80

The surveys were carried out in November-December in 1982, 1983 and 1985 and in October-November in 1984, 1986 and 1987. The R/V Walther Herwig was used each year except in 1984 when, for technical reasons, it was replaced by 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 did not differ significantly provided that equal standard survey gears as well as towing speeds were used.

From 1982-1984, the survey results reveal a drastic decline in cod biomass and abundance which was observed not only for the whole survey area but for all divisions. Confirmation of the reduced stock size in 1983 and 1984 was also obtained from continuous echosounder recordings throughout the survey area and from the trends in commercial catch and effort. The survey results of 1985-1987 indicated a stabilization of the 4+ biomass slightly above the low level of 1984 until 1986 around 30,000 tons, but an increase to 55,000 tons in 1987. The total survey biomass and abundance, however, increased considerably since 1984 and very steeply in 1987 by factors of 18 and 36 respectively. This was due to increasing recruitment, mainly of the outstanding 1984 year-class which amounted to 86% of the total survey biomass and 88% of the abundance in 1987. Cod of age 4 and older accounted for only 12% of the total biomass and 5% of the abundance, and the predominating year-classes were those of 1983, 1981 and 1979.

Japanese groundfish survey. In 1987, a groundfish survey was carried out by the Japanese research trawler Shinkai Maru in a joint programme between the Japan Marine Fishery Resource Research Center (JAMARC) and the Greenland Home Rule Trawling Company (GHT). The survey covered both East and West Greenland waters.

The West Greenland survey was carried out in July and August covering the areas south of 70°N latitude (i.e. the southern part of NAFO Division 1A and Div. 1B-1F). Stratification was done by NAFO division and depth zones. Stations were allocated to strata in proportion to the area.

The distribution pattern of cod and the order of magnitude of the estimated biomass was, in general, in accordance with the Federal Republic of Germany findings, however, the confidence interval was much wider.

Greenland surveys. Estimates for the inshore stock components by division were derived from longline surveys conducted by Greenland in inshore and offshore areas of Div. 1C-1E in 1987, at the same time as the trawl survey of the Federal Republic of Germany. The results revealed that the offshore cod biomass and abundance, as estimated from the trawl survey, accounted for only about 75% of the total stock size.

During July and August 1987, Greenland carried out a gillnet survey on young cod in three inshore areas of West Greenland: Quaqortoq (Div. 1F), Nuuk (Div. 1D), and Sisimiut

(Div. 1B). A total of 3,991 cod was caught out of the 223 net settings made. Based on the stratified sampling techniques, indices of year-class strength were calculated. Only two 1-year-old cod were taken. As 1-year-old cod (13-20 cm) have previously been caught efficiently by this method, the present results indicate a very low abundance for the 1986 year-class in the West Greenland area. By comparing the abundance of cod at age 2 in the 1987 survey with the value in the 1986 survey, the size of the 1985 year-class is estimated to be 22% of the 1984 year-class.

ii) Maturity-at-age

Data from the 1987 Greenland longline survey suggest that the proportion of maturity-at-age 1987 is different to the 1986 ogive, but very similar to the 1983 and 1985 maturity pattern. It was, therefore, agreed to use the same maturity ogive as used in the 1985 assessment.

d) Assessment results (SCR Doc. 88/45)

The results of the more recent stock assessment are presented in Table 4. The stock in numbers-at-age at the end of the survey year has been calculated from the abundance estimate of the autumn survey with the appropriate fraction of the natural mortality and deducting the post-survey catch in numbers-at-age. Total mortality (Z) was calculated from this estimate and the corresponding one from the preceding survey for each age group.

Table 4. Cod in Subarea 1: assessment table for 1987 (revised, June 1988). (Z = total mortality, F = fishing mortality, M = natural mortality and E = emigration coefficient).

Age	Year class	Survey stock Sep-Oct	Catch after survey	Stock size 1 Jan[1]	Stock size 31 Dec	1987 catch	Z	F	M	E	Losses due to M	Losses due to E
				A	B	C	D	E	F	G	H	I
3	1984	681,421	1,821	140,365	657,291	9,436	-1.544	0.028	0.2	-1.772	66,965	-593,327
4	1983	17,193	145	4,837	16,487	2,103	-1.226	0.221	0.2	-1.648	1,900	-15,653
5	1982	5,559	117	760	5,262	419	-1.935	0.180	0.2	-2.315	465	-5,386
6	1981	12,657	135	10,532	12,109	1,040	-0.140	0.092	0.2	-0.432	2,260	-4,877
7	1980	1,659	73	1,203	1,533	666	-0.242	0.489	0.2	-0.932	272	-1,268
8	1979	4,609	191	4,098	4,270	1,078	-0.041	0.258	0.2	-0.499	837	-2,087
9	1978	(2)	1	145	1	11	4.977	0.380	0.2	4.397	6	127
10+	<1978	462	9	653	438	60	0.399	0.111	0.2	0.088	108	47
Total 3+		723,562	2,492	162,593	697,391	14,813	-1.456	0.040	0.2	-1.696	72,813	-622,424
Total 6+		19,389	409	16,631	18,351	2,855	-0.098	0.163	0.2	-0.462	3,483	-8,058

[1] From previous year's survey. Catch and stock numbers in thousands.

Calculation steps:
1. Calculation of col. B from autumn survey estimate.
2. Calculation of Z: [ln(col. A / col. B)].
3. Calculation of col. H: [col. A - 0.2/Z(1-exp-Z)].
4. Calculation of col. I: [col. A - (col. B + col. C + col. H)].
5. Calculation of col. E and G: allocation of Z proportionally to cols. C, H, and I.

The total mortality estimates were apportioned to: (i) Natural mortality (0.2); (ii) fishing mortality; and (iii) emigration coefficient.

As explained in Section (c) and (e), the stock abundance estimates from the Federal Republic of Germany survey have been raised to account for the portion of the stock which is present in the inshore and fjord region and, therefore, not included in the groundfish survey results. Since the inshore/offshore proportions are different for the divisions with an increasing gradient from north to south, the calculation was done separately for each division using the respective factors for all survey results since the series began. With this revision as the basis for the assessments, it was necessary to revise the previous assessments. This procedure did not affect the trends shown previously, but the absolute values of stock size estimates increased between 30% and 40% while fishing mortality estimates decreased correspondingly.

The results of the assessments are summarized in Table 5.

The average fishing mortality in 1987 over age-groups 6-9 was estimated as 0.30, i.e., only slightly below the 1983-1985 level, but about 40% above that of the previous year (0.22).

For almost all age groups up to age 8, the emigration coefficients as well as the Z values are negative. This can be interpreted for the younger age groups as additional recruitment to the stock covered by the survey from other areas or from mid-water. For the older age

Table 5. West Greenland Cod, Summary of the Assessments

Year	Total stock no. (3+)	Total stock biom. (3+)	Spawn. stock no.	Spawn. stock biom.	$F_{(6-9)}$	Catch no.	Catch weight
1983	143	274	53	147	0.36	35	58
1984	79	147	30	75	0.32	18	31
1985	20	35	9	20	0.42	8	15
1986	23	51	14	37	0.22	3	7
1987	163	175	10	29	0.30	15	19
1988[1]	698	801	33	73	-	-	-

[1]Preliminary estimates, not including age group 3.
Estimates of stock size refer to 1 January.
Weights in '000 t, numbers in millions.

groups, immigration from East Greenland cannot be excluded as a possible reason since the assessment of that stock results in negative immigration rates indicating emigration out of the East Greenland area in addition to the already incorporated emigration to Iceland.

These results were taken as an indication that, at present, the tendency of the West Greenland cod to migrate to East Greenland is not very strong. Therefore, the traditional emigration rate of 0.05 derived form earlier tagging experiments was used to estimate the contribution in 1988 to the East Greenland stock from West Greenland compared to a value of 0.30 used in last year's assessment.

The historic development shows a declining spawning stock biomass from the high level at the beginning of the 1960's to very low levels in the mid-1970's. This trend 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, particulary during 1983 and 1984. The spawning stock size was at its lowest level on record in 1985 followed by some improvement in 1987 due to the contribution of the 1981 year-class and possibly immigration from East Greenland.

The assessment results show significant improvement in stock size in 1987-1988 as a result of the abundant 1984 and 1985 year-classes now making up the outstanding part of the estimated biomass.

Throughout the period when stratified-random trawl surveys have been conducted in Greenland waters, i.e. since 1980, the working group has used the results of the surveys as absolute estimates of stock size and explained variation between years and between East and West Greenland, by migration. It should, however, be noted that the variability in survey results adds some uncertainty to this approach.

e) Recruitment prospects

Year-class of 1984. This year-class is now recruiting to the fisheries, and as predicted, it has been observed as dominating landings in 1988 nearly completely and as a strong year-class.

As was reported last year, the initial approach to estimate the strength of the year-class was to use the conventional estimate for a good year-class of 200 million cod at age 3 derived from historical data. However, data from surveys in 1987 and other information indicate that the estimate of 200 million recruits is, indeed, an underestimate of the 1984 year-class.

The trawl survey by the Federal Republic of Germany in the autumn of 1987 indicates that the year-class could account for as much as 513 million fish in the offshore survey area at that time. Danish (Greenland) longline surveys, carried out simultaneously with the trawl survey, indicate that the trawl-survey estimate for Div. 1C-1E accounts for only 78% of the total stock in these divisions. Taking data from the Danish survey into account leads to an estimate of 681 million fish at the time of the surveys, corresponding to about 800 million fish as of 1 January 1987. This estimate as compared to results of stock analysis (VPA) previously carried out for the West Greenland stock would mean that the 1984 year-class was the largest year-class observed over the years for which such analyses have been carried out.

However, the 1984 year-class is far from having been observed as young fish as abundant as former very strong year-classes (e.g. those of 1947, 1953, 1957 and 1961) at the coast and in the fjords. Furthermore, the former strong year-classes occurred at a time when cod was much more abundant and distributed over a much wider area at West Greenland than at present when few cod occur in Div. 1A-1B (including Store Hellefiske Bank).

The Committee considered various possible reasons for this discrepancy between former and recent observations and estimates. Part of that discussion focussed on the trawling method. It was generally agreed that escapement of fish from trawl, and the fact that some fish may be found pelagically, tend to give an underestimate of the amount of fish present in the area. Attention was, however, also drawn to the fact that the herding effect of the trawl sweeps (the rope(s) between the otter boards and the trawl wings) could play a major role for the estimate of the area actually fished by a haul. The area actually fished may be notably larger than the swept area when the latter is based on distance between trawl wings as in the present trawl surveys at West Greenland. Noting the discrepancy between former and present observations of strong year-classes and not being able to quantify factors influencing the trawl-survey abundance estimates, the Committee agreed to consider the 1984 year-class as being of the same order of magnitude as former very good ones (i.e. about 500 million fish at age 3). The Committee futhermore agreed to carry out projections which would show the implication on fisheries and stock should the true year-class strength differ (up or down) by 100 million fish while management options for 1989 were based on the 500 million projections.

Year-class of 1985. The abundance index of 0-group cod off East Greenland from the Icelandic 0-group survey in August 1985 was the third highest observed since 1973, but considerably lower than those of 1973 and 1984 (SCR Doc. 88/45, table 3.1). From the trawl surveys as well as form the inshore young-cod surveys, the 1985 year-class is estimated to be approximately one-fourth of the size of the 1984 year-class. Analyses were, therefore, carried out with an estimate of 125 million fish for this year-class and with deviations of ±25 million fish.

Year-class of 1986. The abundance index obtained from the Icelandic 0-group survey off East Greenland in August 1986 was extremely low. Also, in the trawl surveys in 1987 the abundance estimate for 1-year-old fish was only 1% of the age 1 abundance of the 1984 year-class. In the young-fish inshore surveys virtually no fish of the year-class has been found. Pending further observations, it was agreed to set the recruitment figure for the 1986 year-class at the conventional figure for poor year-classes (i.e. 20 million fish at age 3).

Year-class of 1987. The abundance indexed obtained from the Icelandic 0-group survey off East Greenland in August 1987 was relatively low. A small number of 0-group cod was, however, observed in the bottom-trawl survey catches off West Greenland in the autumn of 1987. Pending further observations, and since at present the year-class does not seem to be more than a minor one, a preliminary figure of 20 million fish at age 3 was used.

f) Projections of catch and stock size for 1989-91

The parameters which were used to project catch and biomass of the cod stock (age 3+), as well as spawning stock biomass (SSB), are given in Table 6. As in last year's report 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. The relative natural mortality incorporates an emigration coefficient of 0.05 from age 6 onwards.

Table 6. Cod in Subarea 1: stock sizes at beginning of 1988 for three levels of recruitment and other parameters used in projection of stock size and catch.

Age (yr)	Year class	① stock size 1 Jan 1988	② stock size 1 Jan 1988	③ stock size 1 Jan 1988	Relative M[1]	Relative F[2]	Mean Weight (kg)	Percent Mature
(yr)		('000)	('000)	('000)	1.0	0.216	(kg)	
3	1985	125,000	100,000	150,000	1.0	0.721	0.90	0
4	1984	400,846	318,972	482,717	1.0	1.0	1.07	2
5	1983	16,487	←		1.25	1.0	1.80	11
6	1982	5,262	←		1.25	1.0	2.12	42
7	1981	12,109	←		1.25	1.0	2.61	82
8	1980	1,533	←		1.25	1.0	3.24	96
9	1979	4,270	←		1.25	1.0	4.30	99
10+	<1979	438	←		1.25	1.0	4.70	100

Recruitment at Age 3

① in 1987 = 500 mio, in 1988 = 125 mio

② in 1987 = 400 mio, in 1988 = 100 mio

③ in 1987 = 600 mio, in 1988 = 150 mio, in 1989+ = 20 mio

$F_{0.1}$ = 0.235

F_{max} = 0.567

$F_{(6-9)\ 87}$ = 0.305

[1] Mean emigration coefficient for ages 6+ (0.05) 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.

These parameters have also been used to calculate a yield-per-recruit curve (Fig. 1) from which $F_{0.1}$ and F_{max} were estimated as 0.235 and 0.567 respectively. The numbers by age group for age 5+ cod at the beginning of 1988 were derived from the assessment (see Section (d)) which is based on results of the 1986 and 1987 groundfish surveys. Year-class strength for recruiting year-classes as derived in Section (e) was used in the projection. For the following year-classes, the conventional figure for a poor year-class of 20 million recruits was used in the calculation. Projections were carried out for a catch level of 40,000 tons in 1988 corresponding to the TAC set by Greenland.

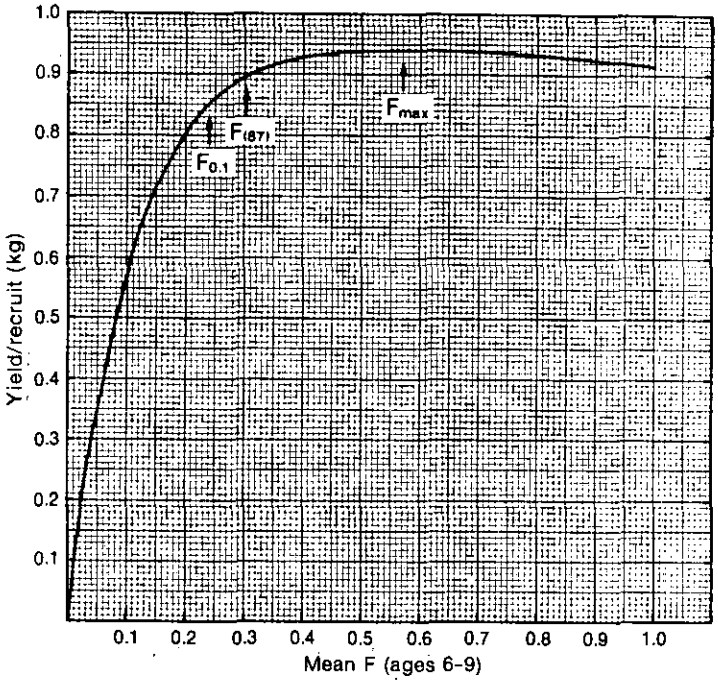


Fig. 1. Cod in Subarea 1: yield-per-recruit curve.

The results of the projections of catches in 1989 and SSB at the beginning of 1990 for a range of fishing mortalities are shown in Fig. 2. Five management options were selected to cover the range of the fishing mortality of 0.107 generated by the 1988 and F_{max} = 0.57. In addition, management options were calculated corresponding to the maintenance of the 1989 catch levels derived from the various options which are related to a given fishing mortality. The results of the medium-term projections are given in Table 7. They show that with a fishing mortality at or below the $F_{0.1}$ level, a substantial increase in SSB to a level above 300 KT can be achieved by 1991 when the 1984 year-class is almost fully recruited to the spawning stock.

Exploitation levels higher than $F_{0.1}$ and particularly the F_{max} option considerably reduces the contribution to the spawning stock by the 1984 year-class due to initial high catches and this management option should, therefore, not be seriously considered. The above comments also apply to the stable catch option of 170 KT or higher.

In order to illustrate the effects which an underestimate or an overestimate of the size of the 1984 year-class by 100 million recruits might have, further projections were carried out using the same parameter except the abundance figures for the 1984 and 1985 year-classes (see Table 6). The results are given in Table 7 and are illustrated in Fig. 3. In general, overestimating the size of the 1984 year-class leads to higher fishing mortalities and lower SSB while underestimation results in lower F-values and higher SSB compared to the levels intended by managers in setting a TAC based on projections using 500 million recruits. The magnitude of these effects is dependent on (a) the level of catch, and (b) the time period until the estimate can be corrected. With catch levels up to above 100 KT, the deviations remain in the order of 20-25% in the first management year (1989 and 1990 for F and SSB respectively) but increasing with higher catch levels to about 30-35%. In the second management year, if no corrections have been made, deviations of about 30-35% occur at low catch levels and high deviations up to 50% and above at higher catch levels. For SSB, the deviations are almost symetrical for over or underestimates of the 1984 year-class, while fishing mortality show higher deviations for overestimation. The interpretation of these results clearly is that, lower catch levels reduce the risk of overexploitation, and is a consideration if uncertainty exists about the size of the year-class dominating the population.

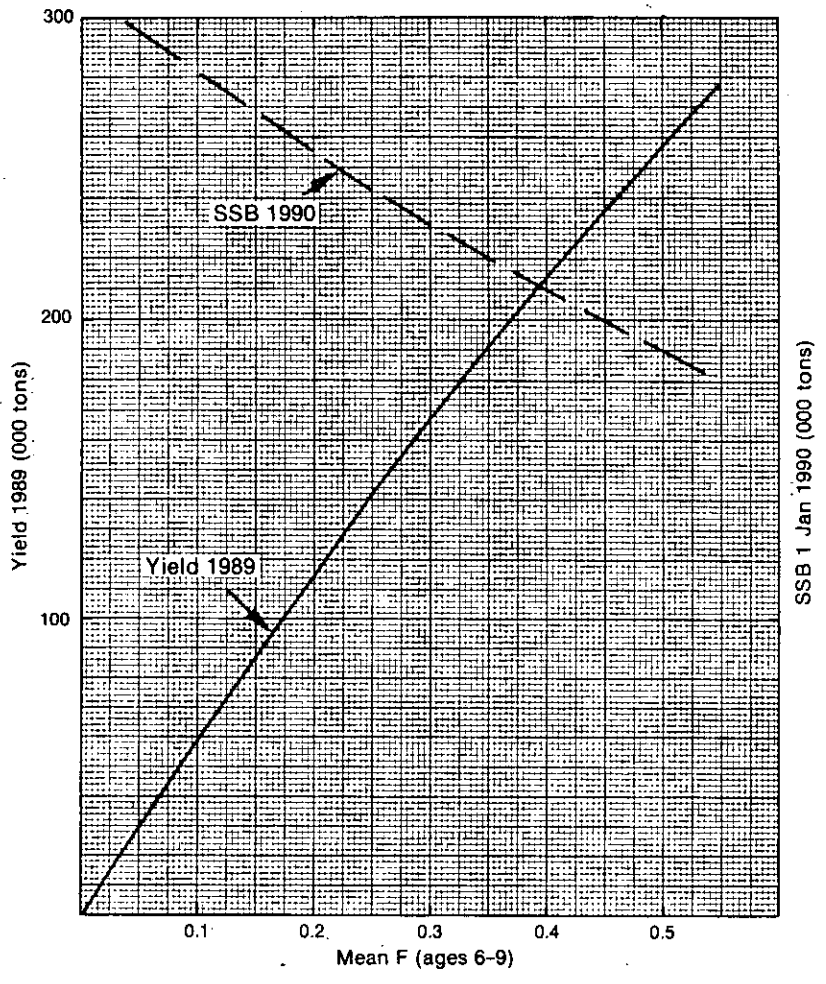


Fig. 2. Cod in Subarea 1: calculated yield in 1989 and spawning stock biomass (SSB) at beginning of 1990 for various levels of fishing mortality in 1989.

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

Information on stock distribution during summer is available from the Greenland young-cod survey for inshore areas only. In this survey the 1984 year-class was found in high densities from Nanortalik (Div. 1F) to Sisimiut (Div. 1B). The 1985 year-class was abundant in the south (Div. 1F) and in the north (Div. 1B) but densities were low in Div. 1D (Nuuk area). The same spatial distribution pattern was found for both year-classes during 1986. Autumn distribution (October-November) of the stock is known from the Federal Republic of Germany trawl survey (SCR Doc. 88/45) and from the Greenland long-line survey. In this period high densities of the 1984 year-class of cod were found from the southern part of Div. 1C and further south to Div. 1F. The 1985 year-class was distributed more southernly with highest densities in Div. 1E and 1F. The same spatial distribution pattern for both year-classes was also seen in the 1986 trawl surveys.

From evaluation of tag return patterns a high degree of regularity in cod migration can be argued which is in line with the constant year-to-year distribution patterns found in the surveys. For this reason, inference on future distribution might be based on the known distribution of the 1984 and 1985 year-classes. The following distribution pattern might be expected.

i) In the offshore area the 1984 year-class could be expected to be abundant from Div. 1D to 1F in autumn-winter. The 1985 year-class will be found more southernly (Div. 1E-1F) in winter. During summer both year-classes might be expected to migrate somewhat more to the north.

Table 7. Cod in Subarea 1: projections of age 3+ biomass (B(3+)) and spawning stock biomass (SSB) at beginning of year and catch during the year for different management strategies (weights in 000 tons).

		Stable Fishing Mortality					(1) 1984 Year-class = 500 mio age 3 Cod Stable Catch Level				
Year	Parameter	$F_{(88)}$	Mean $F_{(87)}$-$F_{(88)}$	$F_{0.1}$	$F_{(87)}$	F_{max}	TAC= 65 KT	TAC = 120 KT	TAC = 135 KT	TAC = 170 KT	TAC = 283 KT
1988	B(3+)	639	→								
	SSB	67	→								
	$\bar{F}$(6-9)	0.107	→								
	Catch	40	→								
1989	B(3+)	755	→								
	SSB	127	→								
	$\bar{F}$(6-9)	0.107	0.206	0.235	0.305	0.567	0.107	0.206	0.235	0.305	0.567
	Catch	65	120	135	170	283	65	120	135	170	283
1990	B(3+)	715	654	637	598	474	715	654	637	598	474
	SSB	279	253	246	230	178	279	253	246	230	178
	$\bar{F}$(6-9)	0.107	0.206	0.235	0.305	0.567	0.112	0.241	0.284	0.402	1.160
	Catch	62	104	114	135	176	65	120	135	170	283
1991	B(3+)	632	529	503	444	283	629	512	480	407	171
	SSB	435	358	339	295	177	433	346	323	268	98
	$\bar{F}$(6-9)	0.107	0.206	0.235	0.305	0.567	0.128	0.319	0.397	0.667	B(3+)<TAC
	Catch	55	84	90	100	103	65	120	135	170	
1992	SSB	472	354	325	265	124	460	305	263	168	
1993	SSB	453	309	277	212	79	423	206	149	25	

		(2) 1984 Year-class = 400 mio Age 3 Cod					(3) 1984 Year-class = 600 mio Age 3 Cod				
Year	Parameter	TAC = 65 KT	TAC = 120 KT	TAC = 135 KT	TAC = 170 KT	TAC = 283 KT	TAC = 65 KT	TAC = 120 KT	TAC = 135 KT	TAC = 170 KT	TAC = 283 KT
1988	B(3+)	529	→				749	→			
	SSB	66	→				69	→			
	$\bar{F}$(6-9)	0.128	→				0.092	→			
	Catch	40	→				40	→			
1989	B(3+)	613	→				897	→			
	SSB	113	→				142	→			
	$\bar{F}$(6-9)	0.133	0.261	0.298	0.391	0.760	0.089	0.170	0.193	0.249	0.454
	Catch	65	120	135	170	283	65	120	135	170	283
1990	B(3+)	570	508	492	453	329	861	800	783	744	619
	SSB	226	199	192	175	122	332	307	300	284	232
	$\bar{F}$(6-9)	0.144	0.325	0.390	0.580	3.178	0.092	0.191	0.223	0.307	0.746
	Catch	65	120	135	170	283	65	120	135	170	283
1991	B(3+)	491	374	342	268	40	769	652	620	546	308
	SSB	331	244	221	167	9	536	449	425	371	197
	$\bar{F}$(6-9)	0.169	0.474	0.624	1.340	B(3+)<TAC	0.103	0.240	0.291	0.447	4.700
	Catch	65	120	135	170		65	120	135	170	283
1992	SSB	337	185	144	54		584	428	386	288	2
1993	SSB	293	85	33	B(3+)<TAC		554	334	274	140	B(3+)<TAC

ii) In the inshore area the 1984 year-class can be expected to be abundant in all inshore areas from Div. 1B-1F. The distribution of the 1985 year-class is less regular. This year-class might become more important in the southern areas but some concentrations might also be expected further north.

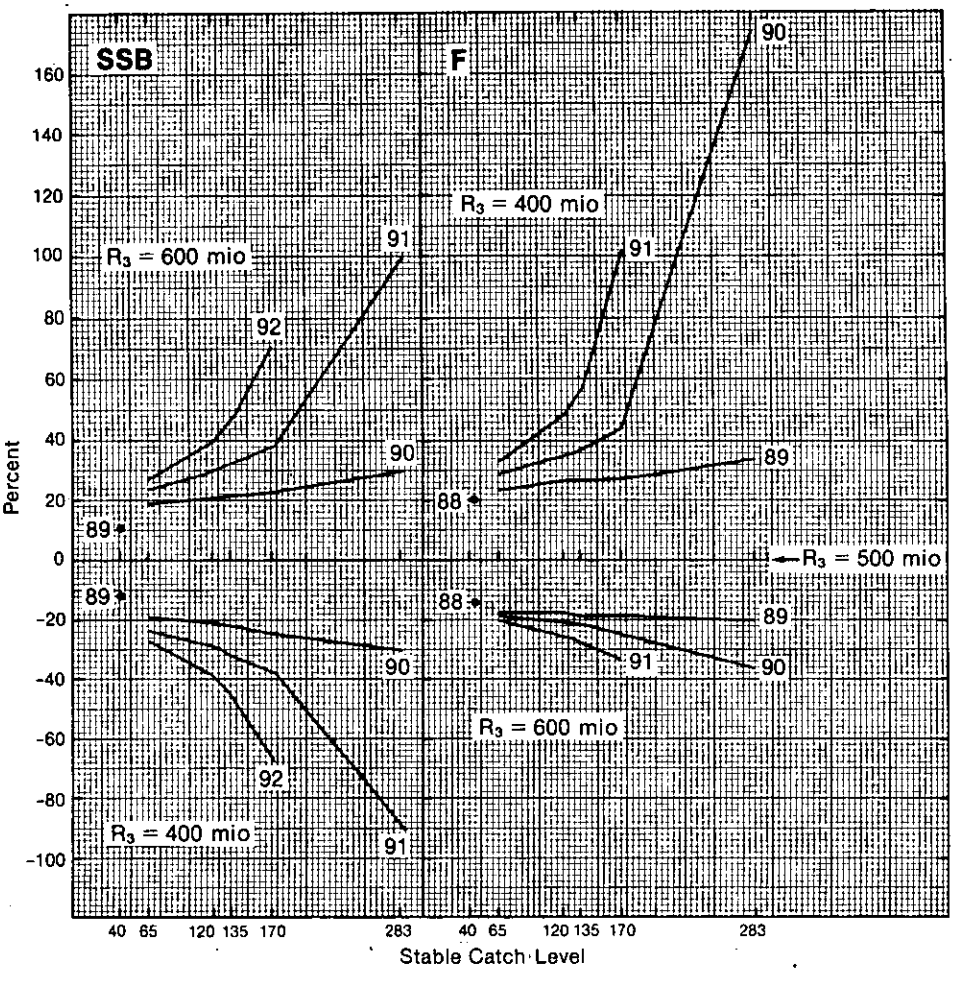


Fig. 3. Cod in Subarea 1: effects on SSB and F of overestimating and underestimating the size of the 1984 year-class for stable catch (TAC) levels 1989-91.

h) Expected length distribution 1988-90

Denmark (Greenland) requested information on length distributions of the stock in 1988, 1989 and 1990 in relation to the proportion below 40 cm, between 40 and 55 cm and above 55 cm.

As the 1984 and 1985 year-classes together will account for more than 90% of the stock in those years, only the size distribution of these two year-classes have been analysed. Assuming that these two year-classes will have similar growth patterns and a relative year-class size at 4:1 leads to the size distribution given in Fig. 4.

During 1988 a considerable proportion of the stock (30-10%) will be below the landing size. From 1989 onwards the number of cod below 40 cm will, however, be insignificant. The proportion of cod above 55 cm is small during 1988 but will increase markedly during 1989. In 1990, the cod above 55 cm should dominate the stock as well as landings. However, the size compositions in catches will depart from the size composition in the population due to gear selection.

i) Trawling will favour the catches of cod above 47 cm and it might be expected that more than 50% of the catch weight will exceed 55 cm by late 1988 or early 1989.

ii) Longlines are very inefficient in catching cod smaller than 55 cm and this gear will, therefore, catch mostly large cod during the period.

iii) Pound net retains cod above approximately 25 cm and catches of this gear should, therefore, reflect the size distribution shown in Fig. 4. Considerable discarding is expected during 1988 and about 50% of the catch weight in 1989 might be of fish smaller than 55 cm.

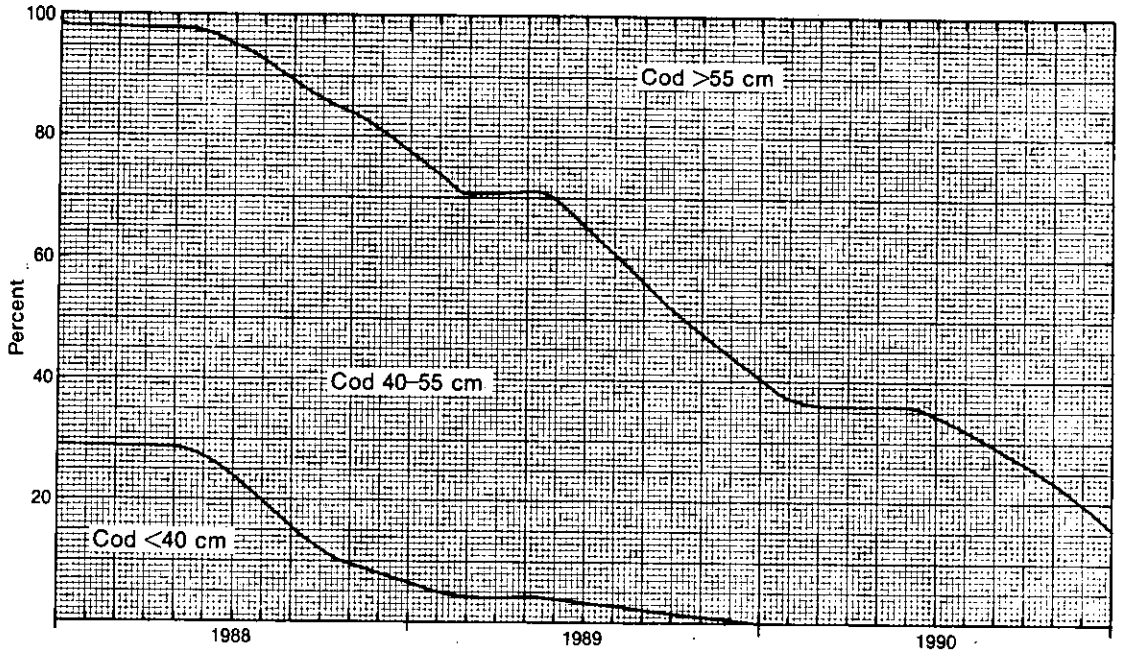


Fig. 4. Expected size distribution during 1988-90 of the year-classes 1984 and 1985 combined assuming relative year-class size of 4:1.

2. Cod in Division 3M (SCR Doc. 88/24; SCS Doc. 88/12, 14, 15)

a) Introduction

Nominal catches in the 1976-79 period ranged from 22,000 to 33,000 tons. Stock biomass at the end of this period had declined and the TAC for 1980 was reduced to 13,000 tons from the 1979 level of 40,000 tons. Recent catches and TACs (000 tons) were as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	40	40	13	12.7	12.4[1]	12.4[1]	13	13	13	13	0
Catch	33	30	10	14	13	10	13	14	15[2]	6[2]	

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

b) Input data

i) Commercial fishery data

Age compositions derived from biological sampling in 1987 showed a predominance in Spanish catches of cod of ages 5-7 years in January-March, ages 4-6 years in August-September, and ages 4-5 years in October. In the Portuguese catches, a small biological sample in August showed an age distribution comprised largely of ages 4-6 years. In November, however, cod of ages 2-3 years accounted for about 90% of the Portuguese catch based on samples from one vessel. About 120 tons of the Portuguese catch was taken in November. STACFIS notes that the age compositions reported by Portugal refer to catches before discards while those reported by Spain are for catches retained after discarding.

STACFIS recommends *that the sampling of discards be continued or initiated and the data made available at assessment meetings.*

Standardized catch rates as reported for Spanish pair trawlers for 1983-87 indicated a decline from 1984 to 1987. The 1987 index was about half that of 1986.

ii) Research vessel data

Biomass and abundance estimates for 1983-87 derived from groundfish research vessel surveys conducted by the Soviet Union are as follows:

	1983	1984	1985	1986	1987
Abundance (millions)	65.4	60.5	37.1	37.2	36.8
Biomass (000 tons)	23.0	31.1	28.1	26.1	12.3

The biomass estimate in 1987 was about half that of 1986 while the abundance estimate remained unchanged. This resulted mainly from the presence of the incoming 1986 year-class which dominated (75%) research catches. In these survey results, the 1981 year-class was predominant in 1984 and 1985 and still strong in 1986. In 1987 this year-class was no longer strong. The 1984 year-class as 3 year olds comprised about 10% of the 1987 survey catch. The 1985 year-class (2 year olds) does not appear to be strong.

In 1987, an acoustic estimate of cod biomass in the pelagic area above the survey trawl amounted to an additional 9.3 thousand tons. Similar information for other years is not available.

c) Assessment results

Cohort analysis was not attempted because of perceived inadequacies in the database for the 1980's (NAFO Sci. Coun. Rep., 1986, page 51). 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 to about 200,000 tons in the 1960-65 period. The halving in commercial Spanish catch rates from 1986 to 1987 and a similar decline in biomass estimates from research surveys suggest that a further reduction in biomass occurred in 1987.

d) Catch projections

No specific catch projection at the standard reference levels can be provided because the status of the stock in 1987 could not be precisely defined. STACFIS has already expressed its concern about the too early exploitation in recent years of incoming year-classes. Soviet research vessel survey results indicate that the 1986 year-class at age 1 year in 1987 may be strong. STACFIS is unable to provide advice on the present level of spawning stock and consequently cannot determine if it is adequate to provide recruitment at long-term average levels.

To protect the remaining spawning stock biomass and to allow the present year-classes, particularly the 1986 year-class, to contribute towards the most rapid rebuilding of the biomass from its present low level, STACFIS advises that the moratorium on fishing should continue. STACFIS notes with satisfaction that the Soviet Union plans to continue its spring survey in 1988 and that the EEC will conduct a survey in July 1988.

3. Cod in Divisions 3N and 3O (SCR Doc. 88/16, 19; SCS Doc. 88/12, 13, 14, 15)

a) Introduction

Nominal catches of cod from this stock declined from a peak of about 225,000 tons in 1967 to a low of about 15,000 tons in 1978. The catches for 1985 and 1987 were similar and averaged about 38,000 tons while the catch for 1986 of 51,000 tons was highest since 1974. Most of the catch in recent years has been taken in Div. 3N, and about 80% of the 1987 catch came from this division. Canadian catches were similar for the 1985-87 period (average = 18,000 tons) while catches for both Spain and Portugal increased from 1985 to 1986 but decline in 1987. A strike by Spanish fishermen during the early months of 1987 was the major reason the Spanish catch declined from 1986 (23,000 tons) to 1987 (16,000 tons). Recent TACs and catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	15	25	26	26	17[1]	17[1]	26	33	33	33	40
Catch	15	28	20	24	32	29	27	37	51[2]	39[2]	

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

b) Input data

i) Commercial fishery data

Catch and effort data for 1977-85 were obtained from NAFO Statistical Bulletins, while

those for the Canadian otter-trawl fleet for 1986 and 1987 were provided by the Department of Fisheries and Oceans, Canada. Spanish pair-trawl data for 1986 were those presented in the Spanish Research Report for that year (SCS Doc. 87/13). Catch-rate indices for otter trawls and pair trawls were derived separately from multiplicative analysis using data for the 1977-87 and 1977-86 periods respectively.

Pair-trawl catch rates were also derived from a multiplicative analysis using official Spanish statistics for the 1982-87 period. This index agreed quite well ($r^2 = 0.94$), for overlapping years, with the index derived from the 1977-86 data. The 1987 index, taken from the Spanish statistics, was adjusted by the relationship between catch rates in both pair-trawl series for these overlapping years and appended to the 1977-86 pair-trawl catch-rate series.

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

At the June 1987 Meeting of STACFIS, it was recommended that alternate methods of determining directed fishing effort for the Canadian otter-trawl fishery be considered for the next assessment of this stock. The current method for estimating directed fishing effort for the Canadian otter-trawl fleet is to aggregate for each month all vessels' trips which have cod specified as main species. Main species is determined as the species which comprises the largest portion of the catch. The alternate analyses selected only those months when cod comprised 50%, 60% and 70% of the total groundfish catch as months when cod was the directed species. Catch rate standardization using a multiplicative analysis was conducted for each of these data sets.

Catch rates from analyses when the monthly cod catches were 50% and 60% of the total indicated the same trends as the original Canadian otter-trawl analysis. Significance was marginal for the analysis when directed effort was determined as those months when the cod catch was 70% of the total groundfish. It was noted, however, that for a more appropriate analysis, the percentage cod catch of the total should be estimated on a trip basis and appropriate trips aggregated to obtain monthly totals. STACFIS, therefore, recommends *the analysis using alternate methods to determine directed fishing effort for the Canadian otter-trawl fleet be completed, using the percentage cod catch of the total groundfish on a more disaggregated basis than month, for the next assessment of this stock.*

ii) Research-vessel survey data

Stratified-random research vessel surveys have been conducted by Canada in Div. 3N for the 1971-88 period, with the exception of 1983, and in Div. 3O for the years 1973-88 with the exception of 1974 and 1983. To account for incomplete coverage in certain years, estimates of abundance for non-sampled strata were obtained using a multiplicative analysis. Abundance and biomass estimates over the survey period showed no consistent trend up to 1983, but estimates for the 1984-88 period were high relative to the earlier period. The 1987 survey estimates at age were not consistent with those from adjacent years and indicate that results from this survey may be anomalous. These results suggest that the age 6+ abundance for this stock had increased by a factor of 5 from 1986 to 1987 and then declined by about the same factor during 1988. The survey results for 1984 were also considered anomalous because of similar inconsistencies, but the degree of inconsistency for the 1987 survey result was much greater than that of 1984

A preliminary examination of the average bottom temperature (°C) by stratum and depth-zone for the 1984-88 period was conducted to determine if this factor may have affected distribution and resulted in an extreme estimate of abundance from the 1987 survey. Although temperatures were variable over this period, there were no extreme values during 1987 that may have affected the results of that survey. Strata in Div. 3L and 3NO which are contiguous with the Div. 3L/3NO boundary were compared for the 1977-87 period to determine if migrations between these divisions affect survey biomass. Although there may be incidents of a slight shift in divisional abundance in some years, during 1987 when biomass estimates increased in the Div. 3NO strata, it also increased in the Div. 3L strata that are contiguous with Div. 3NO. Total abundance estimated from Canadian surveys during 1988 was at its lowest level since 1980. This decline may be due in part to the very weak 1983 and 1984 year-classes.

Surveys by the USSR have been conducted on a stratified-random basis since 1983. Results of surveys from the 1977-82 period, which employed different survey methodology,

were reanalyzed to make this series comparable to the 1983-87 period. Abundance and biomass generally increased from 1979 to 1985 and have subsequently declined. The abundance and biomass estimates for 1985 are the highest in the 11-year time period, and estimates for the 1984-87 period were high relative to the earlier period, similar to estimates from the Canadian survey. The age structure estimated from the 1985 survey is not consistent with those from adjacent years and was considered anomalous. Discrepancies in the age structure estimated from the 1987 USSR survey were identified and they precluded the use of these data in further analysis. The dominant year-classes in the 1986 USSR survey were those of 1981 and 1982.

The Canadian and Soviet survey indices for ages 6 and older, although not displaying a one to one correspondence, showed the same general trend; that of lower abundance for the early years in the time series with subsequent increases. Results from both of these surveys were combined to produce a single index of abundance from research vessel surveys. Estimates of abundance from years that were considered anomalous were not included in this combination. The combined survey index for ages 6 and older indicates a general increase to 1986 with a slight decline (about 6%) to 1988. This index indicates that the average 6+ population abundance has generally increased by a factor of about 3 from the late 1970's to the present.

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 the mean weight-at-age of the commercial catch in 1987. Average weights-at-age for the pair-trawl catch were larger at most ages than those from the Canadian otter-trawl fishery. A sum of products check, using the combined average weights-at-age, indicated that the calculated catch was about 97% of the reported catch. The 1980-82 year-classes were most abundant in the total catch-at-age and the Canadian catch-at-age. The Spanish age composition was dominated by the 1981-84 and the 1977-78 year-classes. It is not uncommon for the Spanish pair-trawl age composition to include more fish at older ages than the Canadian otter-trawl age composition.

c) Estimation of parameters

i) Partial recruitment

The partial-recruitment vector for 1987 was estimated by iteration as an average over the 1981-85 period. The values are as follows:

Age (years)	3	4	5	6	7	8	9	10	11	12
Partial recruitment	0.08	0.29	0.67	0.79	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 1959-87 period were used in cohort analysis. 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 as shown above.

A method of assessing this stock with natural mortality varying by age was discussed. A review of this technique is included in the 1986 NAFO Scientific Council Report (pages 85-86). It was noted at that time that work on variable rates of natural mortality for fish of different ages seemed to be very interesting, but it was clear that age-specific natural mortality calculations could not be adopted without considering how the natural mortality vector interacts with other parts of the VPA. Interaction with the partial-recruitment vector is obvious, but less obvious interactions with other terms in the VPA are also possible. It was also noted at that time that if assessments were to use variable rates of natural mortality, traditional reference standards for fisheries management, specifically $F_{0.1}$ and F_{max}, are expected to be different and recalculation of these reference levels would be necessary. With these issues still unresolved, STACFIS recommends *that simulation studies be conducted to determine how age-specific natural mortality rates interact with other components of VPA. These simulations should include at least an exploration of how age-specific natural mortality: (1) interacts with partial-recruitment vectors; (2) changes with changing fishing mortality; and (3) affects the calculation of reference fishing levels.*

iii) Fishing mortality in 1987

Average exploitable biomass values from cohort analyses over a range of fully-recruited fishing mortalities in 1987 were compared with the combined otter trawl and pair trawl catch-rate index, but the relationships were not significant. This may be due to an inappropriate definition of directed effort for the Canadian otter-trawl portion of this fishery. An alternative method of determining directed fishing effort for this fishery (Section b(i)) did not results in any change in the Canadian otter trawl catch-rate index. A further analysis of these data has been recommended for the next assessment of this stock. As the Spanish pair-trawl fishery operates in only about 20% of the stock area, it was concluded that the catch-rate index from this fishery may not reflect trends in total stock biomass.

Abundance indices for ages 6 and older from Canadian, Soviet and a combination of Canadian/Soviet research vessel survey results since 1977 were related with ages 6+ from cohort. Years for which survey results were considered anomalous, described in Section b(ii), were not included in these relationships. For each of these relationships the r^2 values increase as the level of terminal fishing mortality decreases because of the high survey indices in the most recent years. The only apparent discrimination between various terminal fishing mortalities was the pattern of residuals in the most recent few years. If the residuals for the 1984-86 (1987 considered anomalous) were minimized, the resultant F_T would be in the range of 0.20-0.25.

Results of a Canadian survey conducted during 1988, and not included in the above relationships, indicate that the age 6+ abundance is only about 10% larger than that of 1985-86. It may be reasonable to assume, therefore, that the age 6+ average population abundance is relatively stable over the 1985-87 period, although it is about three times larger than the earlier period (1977-79). This general increasing trend is about the same as that observed in surveys conducted by the USSR. Average population abundance estimated from a cohort analysis with terminal fishing mortality of 0.20 is consistent with these trends in survey abundance. STACFIS concluded that $F_{1987} = 0.20$ would be appropriate for this assessment. Trends in fishing mortality for ages 7-10 and nominal catch for the 1959-87 period are presented in Fig. 5.

iv) Recruitment

Abundance estimates for age 3 from both the Canadian (1977-88) and USSR (1977-87) research vessel surveys were examined as indicators of year-class strength. Data for years which R/V results were considered anomalous (Section b(ii)) were not included in this examination. The value for age 3 abundance of the 1983 year-class from the USSR survey conducted during 1986 is higher than the comparable Canadian result and is inconsistent with the relatively low commercial catch of this year-class during 1987. This value was also excluded from subsequent analysis. Both these survey indices at age 3 were correlated ($r^2 = 0.77$) for overlapping years (1977-82), so they were normalized to their respective means and averaged to provide a single estimate of year-class strength.

The relationship of this index with corresponding abundance estimates for the 1974-80 year-classes from cohort analysis indicated a significant regression ($r^2 = 0.89$). STACFIS was encouraged by the correlation between survey and cohort abundance at age three, but noted that two of the four year-classes to be predicted (1981 and 1983 year-classes) were outside the range of the data examined, and there was no index from which to predict the 1984 year-class. It was also noted that as more data becomes available from both the surveys and the cohort analysis, the research-vessel recruitment index will become useful. The sizes of the 1981-83 year-classes were determined by the average partial recruitment values at ages 4-6 in 1987. These values are as follows:

Year-class	Cohort Age 3 Number (Millions)
1981	58.5
1982	46.4
1983	9.6

The 1983 year-class is the smallest observed for this stock. This is consistent with both the Canadian survey results and the commercial catch of this year-class at age 4 during 1987. If the size of the 1983 year-class at age 3 in 1986 were set at the level of the lowest age 3 cohort abundance in the 1977-83 period, the implication would be an unreasonably low partial recruitment value at age 4 in 1987. The 1984 year-class was

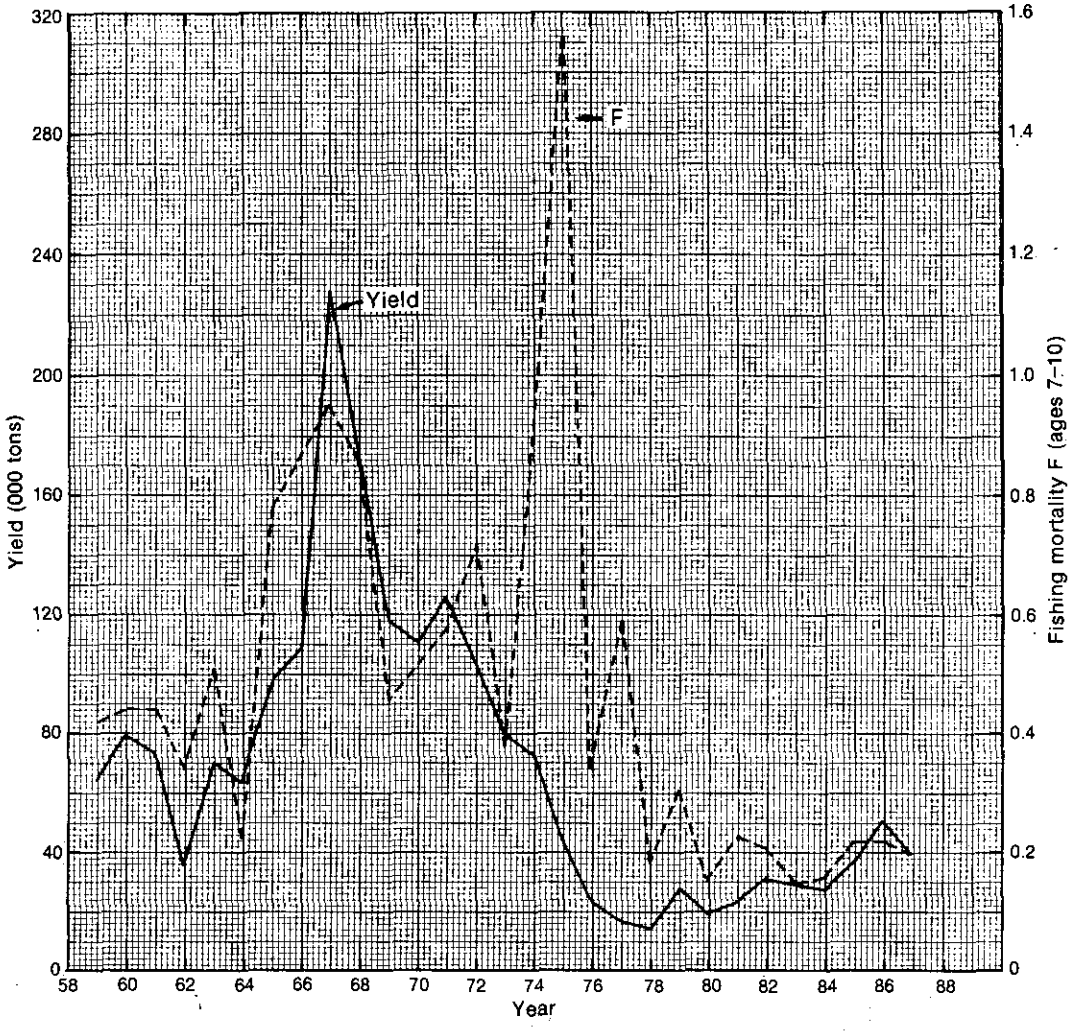


Fig. 5. Cod in Div. 3NO: trends in nominal catch and fishing mortality (ages 7-10), 1959-87.

also considered weak from results of the Canadian surveys and set at the lowest age 3 cohort abundance observed in the 1977-83 period (23.5 million fish). To obtain this year-class size the partial recruitment value at age 3 in 1987 was changed from 0.08 to 0.115. The size of the 1985 and 1986 year-classes were assumed to be the geometric mean of age 3 cohort abundance for the 1977-83 period (1974-80 year-classes) of 33 million fish. The 1984-87 age 3 cohort abundance estimates were not included in the calculation of the geometric mean as these values are affected by changes to input partial recruitment. Spawning stock biomass and age 3 recruits for the corresponding year-class abundance, as estimated from cohort analysis, are shown in Fig. 6.

v) Yield-per-recruit analysis

For previous assessments of this stock, $F_{0.1}$ and F_{max} reference levels were estimated to be 0.18 and 0.22 respectively. Data used to determine these values were not available and consequently could not be evaluated or compared with recent data. A new yield-per-recruit analysis was considered using annual weights-at-age from the commercial fishery and partial-recruitment estimates from selectivities presented in the 1987 assessment of this stock averaged over the 1977-86 period. Data on catch-at-age from the commercial fishery from 1959-87 indicated that cod up to age 20 have not been uncommon and this range was considered appropriate for use in yield-per-recruit analysis. The current analysis, using data presented in Table 8 estimated $F_{0.1} = 0.15$ and $F_{max} = 0.25$ (Fig. 7) with corresponding yields-per-recruit of 1.24 and 1.33 kg.

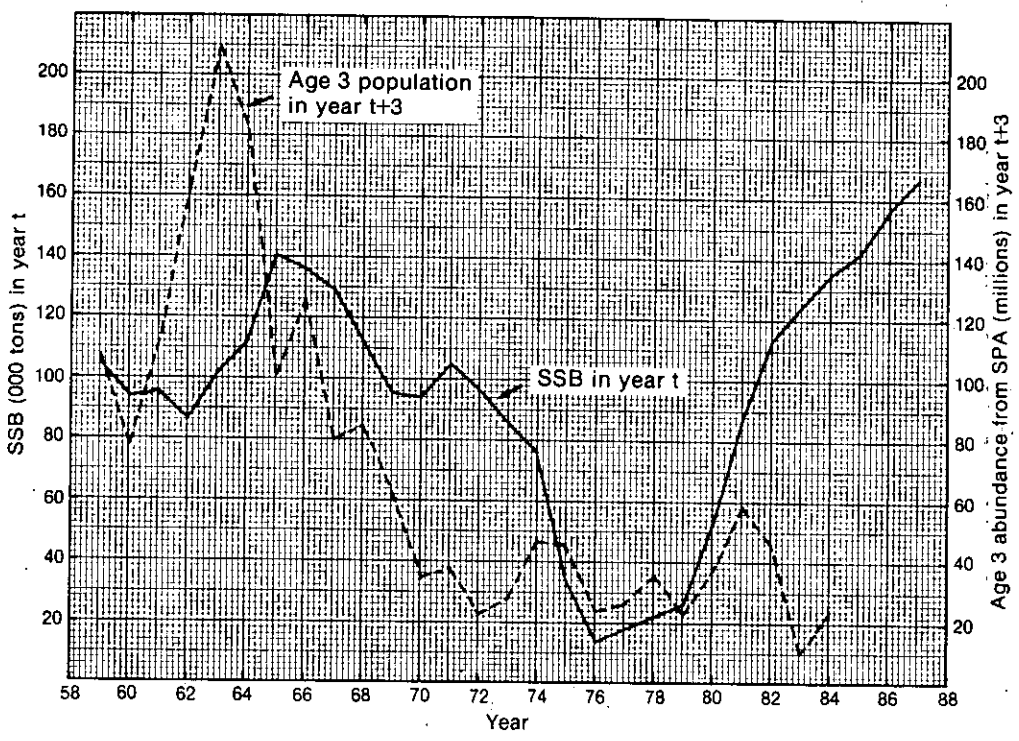


Fig. 6. Cod in Div. 3NO: trends in spawning stock biomass and abundance of age 3 recruits from cohort analysis for 1959-87.

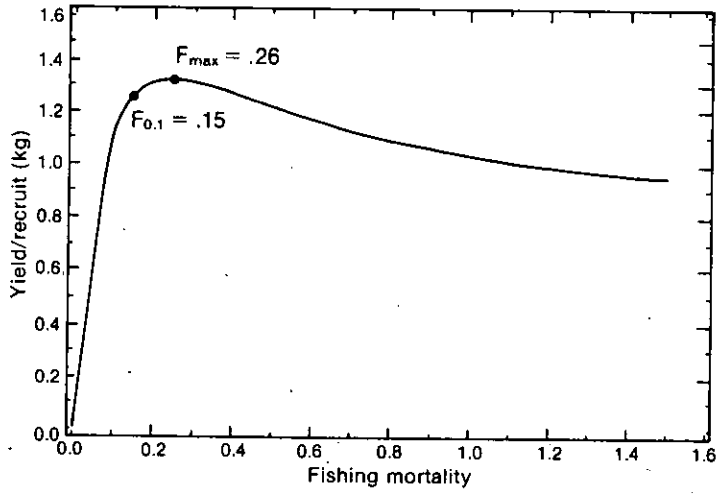


Fig. 7. Cod in Div. 3NO: yield-per-recruit for a range of fishing mortalities.

d) Catch projections

The parameters which were used to project stock sizes are given in Table 8. The partial-recruitment vector was that used for 1987 from cohort analysis. Mean weight-at-age values were averages of commercial weight-at-age data from 1985-87. The sizes of incoming year-classes were as described in the section on recruitment (e(iv)). The 1988 catch was assumed to be the 1988 TAC of 40,000 tons. Projections of catch for 1989 are given in Table 9. The projected 1989 catches for $F_{0.1}$ = 0.15 and Fmax = 0.25 are 25,000 tons and 40,000 tons respectively. Projections of catch in 1989 and spawning stock biomass at the beginning of 1990 over a range of fishing mortalities are presented in Fig. 8. The TAC of 40,000 tons for 1988 would now imply a fully-recruited fishing mortality of 0.24. STACFIS notes that the

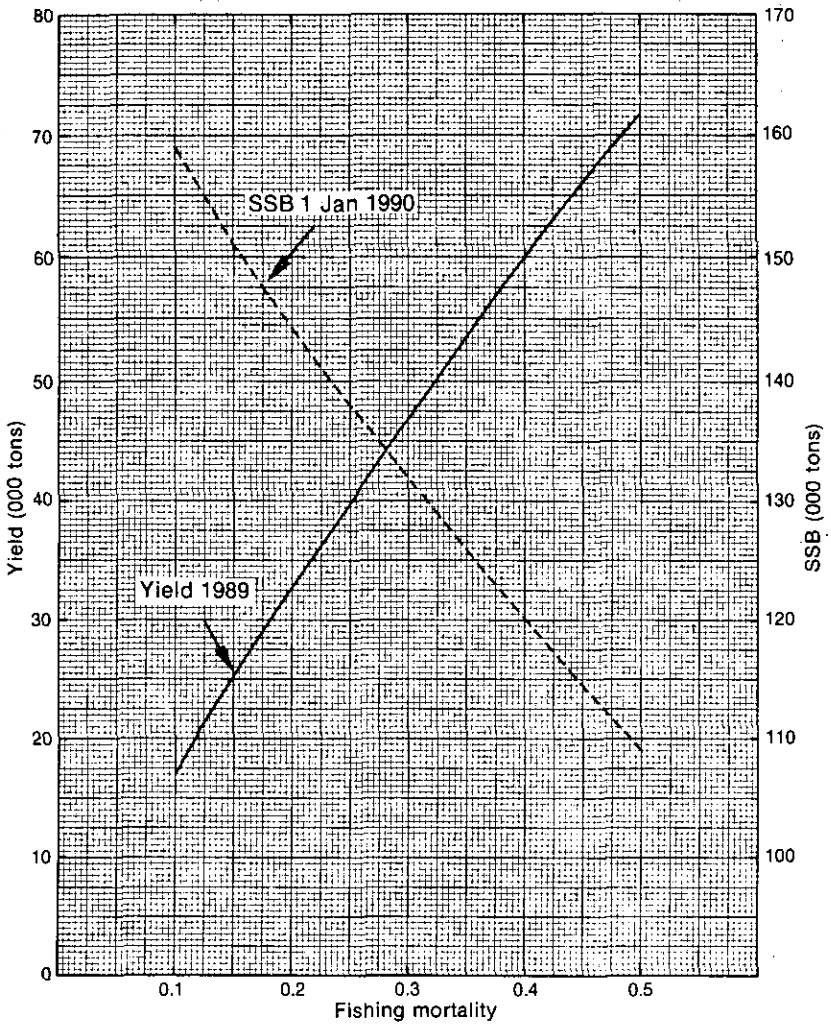


Fig. 8. Cod in Div. 3NO: projection of catch for 1989 and spawning stock biomass (SSB) at the beginning of 1990 for a range of fishing mortality.

reason for the relatively low levels of projected catch in 1989 is the revised estimates of the size of the 1983 and 1984 year-classes. Last year the 1984 year-class at age 3 was set at the 1977-86 geometric mean of 35 million fish, but this year research vessel survey indices indicate that this is a weak year-class and it was set at 23.5 million fish. Another year-class important to the 1989 catch is that of 1983. Last year this year-class at age 3 was estimated to be 21.5 million fish, but the average partial recruitment as well as additional survey information indicates that this year-class is less than previously

Table 8. Cod in Division 3NO: parameters used in projections of stock biomass and catch.

Age (yr)	Stock size 1 Jan 1988 (000)	Mean Weight (kg)		Percent Mature	Partial Recruitment
		Mean Annual	Start of Year		
3	33,000	0.45	0.32	0	0.115
4	18,862	0.89	0.63	4	0.29
5	5,954	1.44	1.13	22	0.67
6	20,422	2.01	1.70	64	0.79
7	16,864	3.21	2.54	94	1.00
8	4,567	4.95	3.99	99	1.00
9	2,476	7.28	6.00	100	1.00
10	3,221	9.01	8.10	100	1.00
11	1,891	9.64	9.32	100	1.00
12	1,521	11.21	10.40	100	1.00

Table 9. Cod in Div. 3NO: Projections of catch and spawning stock biomass (SSB) at various reference levels of fishing mortality assuming catch in 1988 = 40,000 t.

SSB (1.1.1989)	Reference fishing mortality level	Catch (1989)[a]	SSB (1.1.1990)
147,000 t	$F_{0.1}$ = 0.15	25,000 t	151,000 t
	$F_{(88)}$ = 0.20	33,000 t	144,000 t
	F_{max} = 0.25	40,000 t	138,000 t

estimated and is now estimated to be 9.6 million fish. The size of this year-class is less than one-half of the next lowest year-class in the entire time period examined. Additionally, recalculated reference levels used for stock and catch projections are different from those used in previous assessments. A comparison of projected catch at both the previous and revised reference levels is given, along with projections of catch and spawning stock biomass at the standard reference levels (Table 10).

Table 10. Cod in Div. 3NO: input parameters for yield-per-recruit analysis.

Age	Average Weight 1977-86 Average	Partial Recruitment 1977-86 (Average)
3	0.70	0.06
4	1.07	0.32
5	1.58	0.69
6	2.33	0.86
7	3.48	1.00
8	4.85	1.00
9	6.73	1.00
10	8.37	1.00
11	9.56	1.00
12	11.41	1.00
13	12.60	1.00
14	14.82	1.00
15	16.17	1.00
16	14.82	1.00
17	18.85	1.00
18	16.14	1.00
19	18.75	1.00
20	22.65	1.00

The mean 3+ biomass for this stock has increased from 47,000 to 242,000 over the 1976-86 period. The estimated biomass for 1987 is about 15% lower than that of 1986. The major reason for this decline between 1986 and 1987 is the size of the weak 1983 and 1984 year-classes at ages 3 and 4 respectively in 1987. It has been noted previously that these weak year-classes have also contributed to the relatively low level of projected catch for 1989.

4. Cod in Subdivision 3Ps (SCR Doc. 88/70, 71, 72, 73, 74, 75)

a) Introduction

Nominal catches have ranged from a high of 84,000 tons in 1961 to a low of 27,000 tons in 1978. Catches since 1984 have averaged over 55,000 tons and are the highest since 1971. Since 1977 only Canada and France have prosecuted this fishery. Catches, by inshore gears (cod trap, gillnets, linetrawl and handline) which have traditionally obtained the largest proportion of Canadian catches, remained relatively stable since 1983 with a slight increase in 1987. Catches by both the gillnet and codtrap components have shown increasing trends since 1981. Longline catches were highest in 1980 and 1981 but have declined and been somewhat stable in recent years. Canadian offshore otter-trawl catches were highest (8,700 tons) in 1971 but have generally fluctuated between 2,000 and 4,000 tons. Catches have increased in recent years but have been limited by management restrictions.

French catches since 1959 have been obtained by a long distance freezer fleet (OTB2-TC 6-7) and by St. Pierre et Miquelon based inshore and offshore fleets. Landings by the OTB2-TC6-7 fleet have ranged from 0 to 12,000 tons, but averaged 8,700 tons since 1984. St. Pierre landings were mainly by inshore gears from 1959 to 1977. Since 1977, these landings have been relatively low while offshore otter-trawl (OTB2-TC5) landings increased substantially and are currently the highest in the time series.

TAC's for this stock have been set separately by Canada and the EEC or France, both including a share between Canada and France. Catches and TACs (000 tons) for the period 1977-87 are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Advised TAC[1]	25	25	28	30	33	33	33	41[2]	[3]	[3]	[4]
Effective TAC	25	25	28	39	33	33[5]	35.8[5]	44.6[5]	60.6[5]	60.6[5]	60.6[5]
Catch	27	33	38	39	34	38	37	51	57[6]	57[6]	

[1] Advice provided by CAFSAC for 1978 to 1984 ($F_{0.1}$)

[2] Projection provided by NAFO Scientific Council ($F_{0.1}$)

[3] No advice given by Scientific Council projections at $F_{0.1}$: 26,000 to 61,000 tons (1986) and to 58,000 tons (1987)

[4] No advice given by Scientific Council; projections at $F_{0.1}$: Range 26,000 to 61,000 tons (1986) and 26,000 tons to 58,000 tons (1987).

[5] Effective TAC is obtained by combining the Canadian quota (as established by Canada) and the French quota (as established by EEC-France) of the TACs set by each party.

[6] Provisional data

b) Stock discrimination

In the 1987 assessment of this stock information was presented with respect to the relationships between cod in Subdiv. 3Ps and adjacent areas. Additional information available on this subject was examined.

i) Tagging

In a tagging study conducted in March 1986, 6,454 cod were tagged in Subdiv. 3Ps as follows: Burgeo Bank (3,190); southern St. Pierre Bank (1,923); and southern Green Bank (1,341). The distribution of returns in 1986 and 1987 from the Burgeo Bank tagging experiment was similar to that observed in previous studies. There appeared to be a migration of a portion of the northern Gulf stock (NAFO Subdiv. 3Pn and Div. 4RS) to Burgeo Bank during the winter with a subsequent return to the Gulf during the summer. However, the largest number of returns during the summer were from Subdiv. 3Ps which might indicate that most of the cod found on Burgeo Bank during the winter remain in Subdiv. 3Ps throughout the year.

Returns from the southern St. Pierre Bank and Green Bank experiments suggest that concentrations found in these areas during the winter tend to stay offshore and migrate to the shallow water of the southern and central Grand Bank during the summer and autumn.

Tag returns were examined by location with reference to quarter and length group at the time of tagging. Cod representing all size groups that were tagged on Burgeo Bank were recovered subsequently in Subdiv. 3Pn and Div. 4RS. Recaptures from Burgeo Bank and the rest of Subdiv. 3Pn did not represent the full range of sizes that had been tagged. This suggested that during March 1986, there may have been a considerable migration of cod from Subdiv. 3Pn and Div. 4RS into Burgeo Bank and that these cod migrated back to Subdiv. 3Pn and Div. 4RS in the year of tagging and in the succeeding years.

STACFIS noted that the tagging results did not take into account the influence of different levels of fishing effort in the areas from which recaptures were reported.

In general, the recent tagging studies indicated that during winter, cod in the northwest part of Subdiv. 3Ps include a portion of cod from the Gulf of St. Lawrence and that cod in the south and southeast of the Subdivision include a portion of cod from the Grand Bank. These variable mixtures may be substantial but cannot be precisely quantified.

STACFIS recommends that the results of other cod tagging studies in the Subdiv. 3Ps stock area and the adjacent 4RS 3Pn stock area be provided for the next assessment.

ii) Meristics, nematode burden, and average length-at-age

Samples of approximately 100 specimens were taken in winter 1987 and 1988 from each of 3 areas (NAFO Subdiv. 3Pn, Burgeo Bank, and northwestern St. Pierre Bank). Two of the 6 meristic characteristics examined, mean number of rays in the second anal fin and mean number of vertebrae, indicated a significant difference between areas for the 1987 samples while there were no significant differences between any of the characteristics for the 1988 samples.

Samples of cod described above were also examined for the presence of parasitic nematodes in the fillets and napes (belly flaps). Comparison of the three sampled areas in 1987 indicated that prevalence was highest in Subdiv. 3Pn (68%), lower on Burgeo Bank (50%) and lowest in northwestern 3Ps (31%). The 1988 samples indicated similar prevalences except that the level for Burgeo Bank was higher than in 1987 and was very similar to that for 3Pn.

Average length-at-age data derived from independent samples taken from Burgeo Bank and Subdiv. 3Ps in 1986 and between those areas and Subdiv. 3Pn in 1987 and 1988 indicated that the length-at-age pattern of cod on Burgeo Bank was intermediate between those of Subdiv. 3Pn and the remainder of 3Ps. Values for Burgeo Bank in 1988 were lower than those in 1986 and 1987.

iii) Maturity-at-length

Values of the length at which 50% of cod were mature (males and females combined) from French surveys over the period 1978-88 indicated that cod on Burgeo Bank matured at a smaller size than those of St. Pierre Bank, except for 1979 when values were similar. The values for 1986, one of the years reported in the tagging study, were the lowest in the time series.

iv) Conclusions

The comparison with regards to meristics, nematode burden, and average length-at-age suggest that there were differences in cod from the three areas and that the variation observed between years may have resulted from timing of sampling or from the degree to which bordering stocks intermingled in a particular year. The extent of stock intermingling cannot be precisely defined with present data.

c) Input data

i) Commercial catch and effort data

Catch and effort (hours fished) data for Canada, France (SPM), Portugal and Spain were available from ICNAF/NAFO Statistical Bulletins for the period 1959-85 with the exception of certain years for France (SPM). Data were also available from national laboratories for the French fleet for 1980 and 1983-87, and for Canada for 1986-87. Analyses using the multiplicative model were completed for two time periods, 1959-87 and 1977-87. The latter period was done separately to determine if the changes in the fishery since 1976, namely the reduction of catch and the exclusion of participants other than Canada and France, had resulted in a change in the pattern of catch-rates.

Both series indicated strong seasonal trends, with catch-rates being highest in the winter months. Each series showed an increase from 1980-85, a substantial decrease in 1986 and a further slight decrease in 1987.

Some concern was expressed that the French catch-rates in 1987 might not be comparable to those of previous years because of restrictions which prevented the fleet from fishing in the Burgeo Bank area after April 1, 1987. However, it was decided that this restriction was not considered to have substantially affected the 1987 index as most catches in the Burgeo Bank area have historically been taken in the 1st quarter. Concern was also expressed concerning the comparability of future catch-rate data because of further restrictions of French fishing activity in 1988. STACFIS therefore recommends *that a method to obtain catch-rate data for earlier years on a finer spatial and temporal scale than has previously been used be investigated before the next assessment of this stock.*

Catch-rate information from the Canadian inshore fishery was available in the form of catch per purchase slip for the 1980-86 period for traps, gillnets, handlines and longlines and for two vessel categories; <35' and 35-64' in length. It was assumed that a purchase slip would represent one day's fishing. In general, for the smaller vessels, no trends were apparent in gillnet and handline catch-rates. There may have been a slight decline in longline catch-rates while those for cod traps increased after 1982. For larger vessels, catch-rates increased for cod traps and gillnets since 1981 and 1982 respectively and remained stable for handline and line trawl.

Catch-rates by the French (OTB2-TC6-7) fleet were only available on catch-per-day. It has been noted previously that these should only be considered as approximate. These catch-rates have declined from a level of about 30 t/day in 1983-84 to about 20 t/day in 1986-87.

ii) Catch-at-age

The 1987 age compositions of the French and Canadian landings were both derived from extensive sampling. The age compositions were similar, with 5 and 6-year-old cod being dominant. Age compositions of French catches for the period 1978-83 were used in the current assessment. For earlier assessments French catches for this period had been adjusted to numbers-at-age based on Canadian age compositions.

iii) Research surveys

Stratified-random surveys have been conducted in Subdiv. 3Ps by France since 1978 and by Canada since 1972. The fishing gears used in the two series were different but the stratification scheme, method of sampling and analyses of results have been the same. The Canadian surveys were conducted in different months over the years. Since there are changes in the distribution of cod during the year, the abundance estimates were seasonally adjusted to correspond to February-March surveys by the use of monthly estimates corresponding to the pattern observed in the offshore commercial fishery. Surveys conducted by France have all taken place in February-March and there was therefore no need to adjust these abundance estimates for seasonal variation.

Results from both survey series were variable but showed an increasing trend over the 1978-88 period. However, since 1986, biomass estimates from French surveys have declined while those from Canadian surveys have increased. The results of a limited number of comparative tows (9) in 1987 between the Canadian and French research vessels indicated that the French vessel caught younger cod more efficiently but were relatively consistent for older fish. It was therefore considered appropriate to combine survey results for cod aged 6 and older. The variable nature of the values observed for both survey series and resultant inconsistencies observed in year-class abundances between years, suggest that results of surveys for some years may be anomalous. For this reason subsequent calibrations using these data were conducted after omitting data for these years. The age 6+ estimate for 1981 in the Canadian survey was not used as it was 5 times that of 1980 and twice the 1982 value. Large fluctuations in results of French surveys for the 1984-86 period indicate that either the 1985 estimate or the 1984 and 1986 estimates may be anomalous. A combined Canada/France age 6+ survey abundance index was derived using the data sets without years described above after normalizing each series to their respective means. The estimate for 1981 was that from the French survey only while those used for 1984-86 were from the Canadian survey only.

As mentioned previously, a comparison of the research data from both series also indicated that the French survey caught young fish more efficiently and consequently abundance estimates at age 2 and 3 from the French survey were used to obtain a recruitment index.

d) Estimation of parameters

i) Partial recruitment

The partial recruitment vector for 1987 used in calibrations of the cohort analyses was estimated by iteration from historical cohort averages over the period 1978-84. The values are as follows:

Age (years)	3	4	5	6	7	⟶	14
Partial recruitment	0.02	0.21	0.45	0.82	1.00	⟶	1.00

ii) Cohort analysis

Catch and average weight-at-age data from the commercial fishery from 1959-87 were used in a cohort analysis. Natural mortality was assumed to be 0.20 and fishing mortality on the oldest age group (14) in each year was set equal to the total fishing mortality for the fully recruited age groups (7-11).

iii) Fishing mortality in 1987

Calibrations of cohort analysis using commercial catch-rates and research vessel abundances with cohort biomass and abundance were used in an attempt to determine fully recruited F in 1987 using regression analyses.

The relationships considered were as follows:

1. CPUE *vs* offshore exploitable biomass (1977-87)

2. Survey 6+ numbers (Canada) *vs* cohort 6+ abundance (1978-80, 82-88)

3. Survey 6+ numbers (France) *vs* cohort 6+ abundance (1978-84, 86-88)

4. Survey 6+ numbers (Canada & France) *vs* cohort 6+ abundance (omitting 1981 (Canada) and 1984-86 (France))

5. Survey 6+ numbers (Canada & France) *vs* cohort 6+ abundance (1978-88)

The relationships examined were over a range of fully recruited fishing mortalities between 0.40 and 0.70. All of the above relationships were significant ($p<0.05$) (except Number 3) but in general r^2 values were low and intercepts were high which made them difficult to discriminate between various levels of terminal F using the standard criteria.

The general increase in age 6+ abundance from research vessel surveys from the 1978-82 to the 1986-88 periods, is consistent with trends in age 6+ abundance from cohort analysis using terminal fishing mortality of 0.45. Alternatively, trends in commercial CPUE over the same time periods agree with trends in exploitable biomass from a cohort analysis using $F_t = 0.65$. STACFIS was unable to precisely define a level of terminal fishing mortality within this range, but accepted the midpoint of the above range (0.55) as the most appropriate level of terminal fishing mortality for 1987. Average catchabilities over the period 1977-82 indicated fully recruited F at approximately 0.59. Trends in nominal catch and fishing mortality for ages 7-11 in the 1959-87 period are shown in Fig. 9.

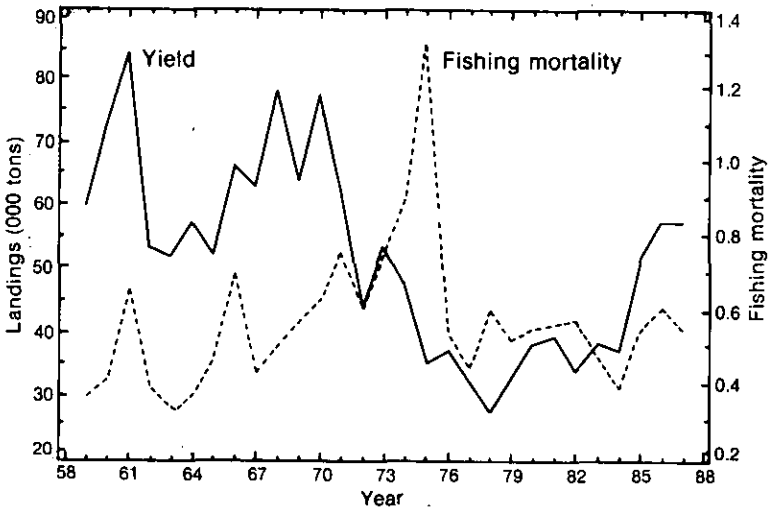


Fig. 9. Cod in Subdiv. 3Ps: fishing mortality and landings for the period 1959-87.

iv) Recruitment

Age 2 and 3 cod from French research vessel surveys were examined as indicators of year-class strength. The objective of this examination was to determine the strength of the 1981-86 year-classes from the relationships between cohort and survey population estimates of the 1975-80 year-classes. There was correspondence between age 2 and age 3 estimates from French surveys, so these indices were normalized to their respective 1976-85 means and averaged to produce a single estimate of year-class strength. The relationship of this index with corresponding abundance estimates for the 1975-80 year-classes from cohort analysis indicated a significant regression ($r^2 = 0.87$). The survey index values for the 1981,1982 and 1984 year-classes were larger than values observed in the relationship, therefore, the size of these year-classes was assumed to be at least the size of the largest year-class in the relationship (78 million fish). The size of the 1983 year-class was estimated to be about 54 million fish.

Partial recruitment values originally used as input for cohort analysis were adjusted to reconcile year-class strengths at age 3 as described above. The adjusted partial recruitment vector is as follows:

Age (years)	3	4	5	6	7	8	9	10	11	12	13	14
Partial recruitment	.015	.14	.52	.77	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

These adjusted partial recruitments are similar to those used during the last assessment of this stock.

Spawning stock biomass and age 3 recruits for the corresponding year-class abundance, as estimated from cohort analysis, are shown in Fig. 10.

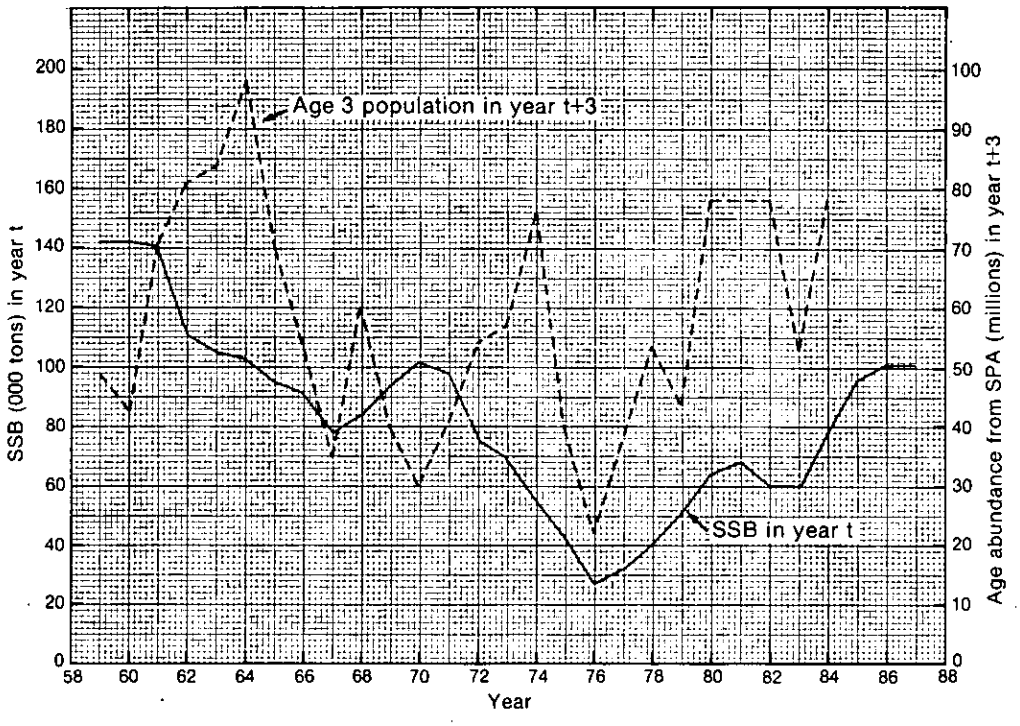


Fig. 10. Cod in Subdiv. 3Ps: trends in spawning stock biomass and abundance of age 3 recruits from cohort analysis for 1959-87.

v) Yield-per-recruit

For the previous assessments of this stock values of $F_{0.1}$ and F_{max}, obtained from a yield-per-recruit analysis, were 0.20 and 0.33 respectively. Other analyses have suggested values of $F_{0.1}$ ranging from 0.17 and 0.20 and F_{max} from 0.27 to 0.32. A new yield-per-recruit analysis was considered using average weight-at-age data from the commercial fishery for years 1977-86 and partial recruitment estimates for the same period from selectivities presented in the 1987 assessment of the stock. The values used were as follows:

Age (years)	3	4	5	6	7	8	9	10	11
Partial recruitment	0.015	0.214	0.533	0.780	1	1	1	1	1
Average weight	0.33	0.78	1.21	1.80	2.50	3.30	4.37	5.61	6.36

Age (years)	12	13	14	15	16	17	18	19	20
Part. recruit.	1	1	1	1	1	1	1	1	1
Ave. weight	8.13	9.11	10.52	12.08	13.74	14.16	16.51	17.05	19.04

Catch-at-age from the commercial fishery from 1959-87 indicated that fish up to age 20 were not uncommon in catches and this range of years was considered appropriate for use in yield-per-recruit analyses. Reference levels from the current analysis are $F_{0.1}$ = 0.15 and F_{max} = 0.27 with yields-per-recruit of 0.91 and 0.98 kg respectively. This revised yield-per-recruit is shown in Fig. 11.

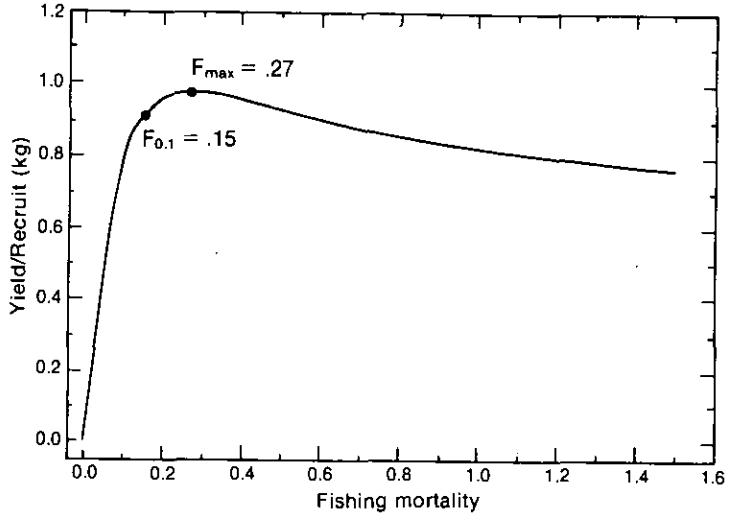


Fig. 11. Cod in Subdiv. 3Ps: yield-per-recruit for a range of fishing mortalities.

The revised levels of $F_{0.1}$ and F_{max} are quite different from those used by the Committee in the past.

STACFIS concluded that the yield-per-recruit calculations of the past values of F at $F_{0.1}$ and F_{max} are no longer valid and the revised values of F must be used for catch projections.

These revised reference fishing mortality values should be kept constant until it is clear that the input parameters are fluctuating around different levels than those inherent in the yield-per-recruit calculations on which the current values are based.

e) Catch projections and prognoses

The parameters which were used to project stock sizes are given in Table 11. The partial recruitment vector was that used for 1987 (adjusted to reconcile year-class strengths) in the cohort analysis. Mean weight-at-age values were averages of the commercial weight-at-age data from 1985-87. The size of the 1985 and 1986 year-classes were determined from the recruitment relationship described in the previous section. The indices for both of these year-classes were larger than values observed in the relationship and the size of these year-classes was assumed to be at least the size of the largest year-classes in the relationship (78 million fish). The 1988 catch was assumed to be 57,000 tons. This is slightly less than the effective TAC of 60,600 tons, but consistent with the total catch during both 1986 and 1987.

Table 11. Cod in Subdivision 3Ps: parameters used in projections of stock biomass and catch.

Age (yr)	Stock Size 1 Jan 1988 (000)	Mean Weight: Mean Annual	Mean Weight: Start of year	Percent Mature	Partial Recruitment
3	78,000	0.58	0.49	0	0.015
4	68,236	0.82	0.69	5	0.14
5	32,878	1.25	1.01	29	0.52
6	29,323	1.84	1.52	67	0.77
7	16,144	2.47	2.13	91	1.00
8	6,313	3.26	2.84	98	1.00
9	1,654	4.30	3.74	100	1.00
10	1,449	5.21	4.73	100	1.00
11	395	5.90	5.54	100	1.00
12	192	8.39	7.04	100	1.00
13	92	9.13	8.75	100	1.00
14	146	10.37	9.73	100	1.00

A catch of 57,000 tons in 1988 will imply a fishing mortality level of 0.50 for that year.

Projections of catch for 1989 and spawning stock biomass at January 1st, 1990 over a range of fishing mortalities with catches in 1988 assumed to be 57,000 are presented in Fig. 12.

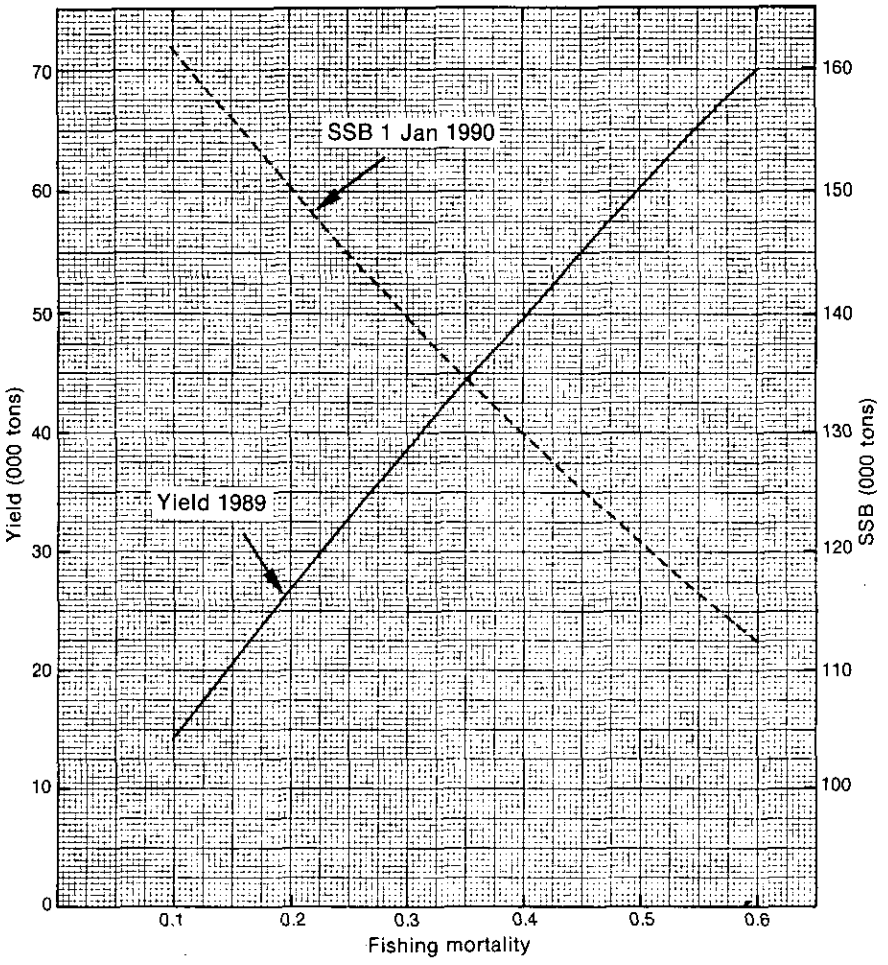


Fig. 12. Cod in Subdiv. 3Ps: projection of catch for 1989 and spawning stock biomass at the beginning of 1990 for a range of fishing mortality.

The current assessment for this stock indicates that fully recruited F's since 1984 have been in excess of 0.50. The estimated value for 1986 (0.61) is substantially higher than that estimated in the 1987 assessment (0.45). These high fishing mortalities are not inconsistent with the catch levels of recent years which also suggest high effort levels. The relatively stable catch of recent years (ave. 55,000 tons since 1984) and declining CPUE index also suggest an increase in effort. Survey abundance indices from French surveys have shown a decrease since 1986 while similar Canadian survey results have shown an increase.

A recruitment index based on the results of French surveys at age 2 and 3 estimated the size of the 1981, 1982 and 1984 year-classes since 1980 to be at least as large as the largest in the time series (78 million fish) with the exception of that for 1983 (54 million fish). These values were lower than estimates of the same year-classes from the 1987 assessment (100 million and 68 million fish respectively). Average weight used for projections in the previous assessment were slightly higher than those estimated in the current assessment. Although recruitment of incoming year-classes is estimated to be at or above the long-term mean of 55 million, continued high catches can be expected to maintain F's at current high levels. Recent stock sizes are still the highest since the early 1950's. The long-term potential and stability of the fisheries are dependent upon the level of recruitment which has shown large fluctuations over the period observed.

5. Redfish in Subarea 1 (SCR Doc. 88/31, 35, 76; SCS Doc. 88/13, 16)

a) Introduction

Redfish landings consisted almost exclusively of golden redfish (*Sebastes marinus*). The total

nominal catch declined drastically from 2,800 tons in 1986 to only 1,200 tons in 1987, which was the lowest catch level of the last 10 years. The decrease of catch levels since 1984 was due to a considerable effort reduction of the mixed redfish-cod fishery by trawlers from the Federal Republic of Germany. During the same period the redfish catch has been taken mainly in a directed redfish fishery by Japanese trawlers in a joint-venture arrangement with Greenland. Japanese vessels caught about 2,000 tons in 1986 but only about 400 tons in 1987.

Recent catches (000 tons) were as follows:

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

[1] Provisional data

Small juvenile beaked redfish (*S. mentella*) were quite abundant in the northern Divisions 1A and 1B where large numbers were taken and discarded as by-catch in the shrimp fishery. By-catch levels of small *S. mentella* were estimated around 900 tons in recent years.

b) Input data

i) Commercial fishery data

Directed fishing effort data from the commercial redfish fishery are available only for Japanese trawlers since 1984. Analyses of sampling data on length and age composition obtained from the commercial fishery by Greenland and the Federal Republic of Germany in recent years are in preparation for the June 1989 Meeting of the Scientific Council.

ii) Research vessel survey data

Biomass estimates for *Sebastes marinus* and *S. mentella* derived from results of a stratified random bottom trawl survey conducted jointly by Japan and Greenland with R/V *Shinkai Maru* in July/August 1987 in Subarea 1 amounted to 3,980 and 8,109 tons respectively. Higher biomass estimates of 28,305 tons for *S. marinus* and 12,302 tons for *S. mentella* resulted from the stratified-random bottom trawl survey conducted by the Federal Republic of Germany with R/V *Walther Herwig* in October/November 1987, although the survey was designed for cod and the allocation of trawling positions was not in accordance with the distribution pattern of redfish.

The assumption that the northern part of Subarea 1, especially Div. 1B, being a nursery area for *S. mentella* was confirmed by both surveys, the vessels showing high abundances of almost exclusively small juvenile *S. mentella*. Both surveys also confirmed increasing sizes for both species from north to south as well as with increasing depths.

Detailed analyses of the redfish data obtained from Federal Republic of Germany surveys since 1982 are in preparation and will be made available for the June 1989 Meeting of the Scientific Council.

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.

The Committee presently has no basis on which to advise if a catch of 9,000 tons in 1988 will correspond to 2/3 MSY effort.

6. Redfish in Division 3M (SCR Doc. 88/22, 24, 25; SCS Doc. 88/12, 13, 14, 15, 17)

a) Introduction

Nominal landings from this stock have been in the range of 14,000-36,000 tons since 1976. The present TAC of 20,000 tons has been achieved each year since 1983. Provisional catch data indicate the TAC was exceeded by 9,000 tons in 1986 and by 15,000 tons in 1987 due to increased landings reported by the EEC (primarily Portugal). Up until 1987, the USSR fleet was predominant in this fishery accounting for at least half of the reported landings in each year and in some years as much as 77%.

Catch statistics for which associated effort is available suggest that there has been a steady increase in the utilization of midwater trawls from 1976 to 1986 such that is now apparently the principal gear in the fishery. Recent TACs and catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	16	20	20	20	20	20	20	20	20	20	20
Catch	17	20	16	14	15	20	20	20	29[1]	36[1]	

[1] Provisional data.

b) Input data

A catch and effort database was compiled from ICNAF and NAFO Statistical Bulletins for the 1959-85 period and preliminary NAFO data for 1986 and utilized in a multiplicative model to derive a standardized catch-rate series. There was a general decline from 1961 to 1967 followed by a sharp increase to the highest rate recorded in the series in 1970. Subsequently, catch rates declined sharply to 1972 but since then have shown relative stability with the standardized catch rate between 1.6 and 2.1 tons per hour. The catch rate increased from 1985 to 1986. Standardized effort has been in the range of 12,000 hours since 1983.

Commercial length frequencies for 1987 were available from the Portuguese fishery and the Cuban fishery. These indicated a mean length of about 26 cm, and also that the relatively strong year-classes of the early 1980's are well represented in the fishery. Research length frequencies and percentage age compositions for 1987 (based on ageing by scales) available from a USSR survey indicated that 7 and 8-year-old fish were well represented. This survey also indicated a pulse of recruitment of 1 and 2-year-olds which appear to be relatively stronger than other year-classes in recent years. A biomass estimate from this survey of 106,000 tons indicated a decrease from the 1986 estimate of 310,000 tons. However, an acoustic survey estimated more than 350,000 tons in pelagic waters.

c) Estimation of parameters

Catch-rate and standardized effort were utlized in equilibrium general production analyses using values of effort lagged 6, 8 and 10 years.

The lag 6, 8 and 10 year effort relationships with catch rate were all significant. The general production results from these relationships are quite similar indicating that MSY is in the range of 18,000 tons and 2/3 effort to take MSY would result in a yield in the range of 16,000 tons. However, it was noted that these results are derived from regressions that are highly influenced by the 1970 and 1971 data and in fact are not significant when these points are removed from the analyses. This has been noted for a few years now (NAFO Sci. Coun. Rep., 1987, page 50) and so these results are to be considered with caution.

There was concern expressed that one may get spurious correlation with the above analysis because the effort term appears in both the dependent and independent variables. A quadratic relationship forced through the origin between catch and standardized effort ($C = af + bf^2$) was therefore used to overcome this. The relationships using lag 6, 8 and 10 year effort with catch were all significant, but in all regressions, the quadratic term was not significant indicating a relationship other than a parabolic one. The resutls of equilibrium general production analyses were therefore not considered meaningful.

The catch and standardized effort were also utilized in a non-equilibrium version of a general production model (Schaefer type). Using the parameter estimates from the 1987 assessment as starting values, the model would not converge. One possible explanation is that, last year, the data only marginally met the assumption of the model with regard to logistic growth.

d) Catch projections

Length frequencies from the commercial fishery indicated the year-classes of the early 1980's were well represented in the fishery. An age composition expressed in numbers-per-thousand from a USSR research survey in 1987 revealed that the early 1980's year-classes were dominant in the research catch. This survey also indicated a pulse of juveniles (1-2-year-olds) that is relatively more abundant than 3 to 4-year-old fish, but it is unknown the extent to which they are recruited to the survey gear. Since the non-equilibrium general production model was used last year, projections were made to 1989 using the parameter estimates derived from that analysis. The actual catches for 1986 and 1987 were used, and it was assumed that the catch in 1988 will equal the TAC of 20,000 tons. The following results were obtained:

Exploitable biomass at the beginning of 1989 = 284,294 tons.

	Effort (hours)	Yield (tons)	Exploitable biomass beginning 1990 (tons)
@ MSY	18,504	26,050	278,109
@ 2/3 fMSY	12,236	17,627	286,342

Concern was expressed about all the shortcomings of both equilibrium and non-equilibrium general production analyses. STACFIS has no basis to advise a change from the present TAC of 20,000 tons.

7. Redfish in Divisions 3L and 3N (SCR Doc. 88/27; SCS Doc. 88/12, 13, 14, 15)

a) Introduction

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 for the 1959-87 period is about 23,000 tons with about 60% being taken in Div. 3N. Provisional statistics for 1986 and 1987 indicate catches above 40,000 tons each year. These increases are the result of increased catches by Portugal and the USSR. The USSR shifted fishing effort in 1987 from Div. 3N to 3L. Recent catches and TACs (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	16	18	25	25	25	25	25	25	25	25	25
Catch	12	14	16	24	22	20	15	21	42[1]	44[1]	

[1] Provisional data.

b) Input data

i) Commercial fishery data

Catch and effort data from ICNAF/NAFO Statistical Bulletins for 1959-85 were combined with preliminary NAFO data for 1986 and preliminary Canadian statistics plus Canadian Observer data for 1987. These were utilized in multiplicative analyses to derive standardized catch-rate series for Div. 3LN combined as well as for Div. 3L and 3N separately. Examination of residuals from the combined analysis indicated different trends in each of the Divisions over time. This is a violation of one of the assumptions of the model and the indication was that the data for the two Divisions should not be combined in this type of analysis. This conclusion is the same as that arrived at in 1987 (NAFO Sci. Coun. Rep., 1987, page 51). The results of the analysis for Div. 3L also indicated that there were no significant trends in catch rates over the years 1959-87.

Analysis of the Div. 3N data indicated significant differences between years, however, STACFIS noted that the significance was only marginal; a result of the high 1966 and 1974 catch rates. In general, catch rates have been fairly stable in this Division as well.

Commercial frequencies from the Portuguese fishery indicated a mode of 29-30 cm in Div. 3L in August-October, while somewhat larger fish (mode at 33-35 cm) were caught in November and December. Relatively small fish (mean length 21 cm) were caught in Div. 3N in August. Larger fish were taken there in November (mean length 27 cm) and December (32 cm).

Samples from the Spanish fishery in Div. 3N in February and April indicated catches with modal lengths of 21-24 cm.

ii) Research data

Research length frequencies from USSR surveys in Div. 3L and 3N separately from 1980-87 indicated that the year-class(es) of 1979-80 were relatively stronger than those immediately preceding and after in Div. 3N, but not in Div. 3L. Data from the 1987 survey confirmed that the 1979-80 year-classes are relatively strong in Div. 3N. Generally, larger fish were present in Div. 3L.

Biomass estimates were also available from these surveys for 1983-87. The biomass was estimated to be about 125,000 tons in 1983 and 199,000 tons in 1984, but has been below 100,000 tons since then. It was noted that varying proportions of redfish were detected up off the bottom in the different years and this may have affected the trawl survey results.

c) Estimation of parameters

Because revised analysis of the Div. 3L data indicated no significant trends in the catch-rates with time, STACFIS concluded that general production analysis is not appropriate. It was noted that the significant relationship between catch-rate and effort obtained in 1987 (NAFO Sci. Coun. Rep., 1987, page 51) was due to the 1986 point which had been derived using very little information. Inclusion

of the revised catch and effort values for 1986 changed the position of this point significantly resulting in non-significant relationships.

General production analysis of the catch rates for Div. 3N using effort data lagged 6, 8 and 10 years and incorporating both a linear model ($C/f = a + bf$) and a quadratic form ($C = af + bf^2$) resulted in MSY yields of 15,000-20,000 tons and yields at 2/3 MSY effort of 14,000-18,000 tons.

d) Catch projections

Similar to the fisheries of 1985 and 1986, larger fish were taken in Div. 3L than in Div. 3N in 1987. Once again the USSR survey results indicate that the 1979-80 year-classes are relatively strong in Div. 3N, but not in Div. 3L.

General production analysis was not considered appropriate for Div. 3L catch and effort data because there is not significant contrast in these data. Catches in Div. 3L were close to 28,000 tons in 1986 and 1987. Although the impact of sustained catches of this magnitude cannot be predicted at present, STACFIS did note that there was no indication of strong recruitment during the 1980's.

STACFIS observed that although there were significant differences in catch rates for Div. 3N, there was in general, poor contrast in these data as well and the results of the general production analysis should be viewed with caution. Landings from Div. 3N have remained fairly stable from 1985-87 in the range of the estimated yields at MSY and 2/3 MSY effort. The year-classes of 1979-80 have begun to appear in the commercial catches and increased recruitment of these year-classes to the fishery over the next few years should result in a gradual increase in catch rates in this Division.

It was concluded that overall, catch rates have been fairly stable for this stock over the 1959-87 period but, based on the available data, STACFIS has no basis upon which to advise a change in the TAC from the present level of 25,000 tons.

8. Silver hake in Divisions 4V, 4W and 4X (SCR Doc. 87/98, 88/4, 29, 30, 51)

a) Introduction

Nominal catches of silver hake since 1970 ranged from a maximum of 300,00 tons in 1973 to a minimum of 36,000 tons in 1983. Since 1977 catches have increased from 37,000 tons in 1977 to 82,000 tons in 1986. Prior to 1977, the fishery was not restricted by season or area. However, since 1977 the fishery has been restricted to the months of April through November and to the area seaward of the small mesh gear line (SMGL). The Div. 4VWX silver hake fishery is conducted by large otter trawlers using small-meshed bottom trawls. Recent catches and TACs (000 tons) are as follows:

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	70	80	70	90	80	80	80	100	100	100	100	120
Catch	37	48	51	45	43	60	36	74	76	83[1]	62[1]	-

[1] Provisional data.

Prior to 1982 most of the catch was taken by the USSR. In 1987, as in the most recent years, the highest catches were taken by the USSR fleet (41,000 tons) with Cuba taking most of the remaining catch (20,000 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 and the late arrival of certain fleets on the fishing grounds.

b) Input data

i) Commercial fishery data

During the 1987 meeting of STACFIS, Cuban catch and effort were added to an existing catch-rate series. Examination of the catch and effort series for this assessment indicated discrepancies in the amount of effort, but not the catch, reported to NAFO and Canada by the USSR for the 1985 fishery. The USSR reported to NAFO, almost 400 more days-on-ground than were licensed by Canada. The Canadian International Observer Program (IOP) estimated the USSR fleet fished an average of 13 hours per day in 1985. Thus, the USSR overestimate of effort in 1985, by more than 5,000 hours fished, has made the reported 1985 catch rate lower than that observed by Canada during the fishery. Similarly, the 1985 standardized catch rate based on the NAFO data and presented in the previous assessment was unexplainably below both the 1984 and 1986 values. For this

assessment, observed USSR catch and effort from the IOP was substituted for the NAFO statistics in a multiplicative model.

The relationship between CPUE and fishable biomass from SPA from 1977 to 1987 did not appear to be comparable to that of the pre-1977 period. It was considered that this inconsistency was partly due to the method used to construct the catch-at-age for 1970-76. As a result, only the post-1976 catch and effort was used in the calibration of the SPA. Catch and effort data from ICNAF and NAFO for 1977-84 were combined with the 1985-87 IOP data using a multiplicative model. The standardized catch rates used in this assessment are as follows:

Year	CPUE	Year	CPUE	Year	CPUE
1977	3.323	1982	6.098	1987	6.362
1978	2.461	1983	3.058		
1979	2.821	1984	4.909		
1980	2.089	1985	5.620		
1981	2.359	1986	6.454		

The catch rates have generally increased from 1980 to 1987 with the exception of 1982. The catch rate in 1982 is much higher than adjacent years. It was considered unlikely that the drastic change in catch rate seen in 1982 was representative solely of a change in biomass.

The age composition of the catches in 1970-86 were taken from the previous assessment (SCR Doc. 87/56), with adjustments to reflect revisions in the reported nominal catches in 1985, 1986 and 1987. The changes were generally small and involved changes in catch-by-month rather than total tonnage.

The age composition in 1987 was calculated from the IOP sampling. The IOP observed 95% or 58,000 tons of the 62,000 tons reported to Canada. More than 470,000 length measurements and 2,800 otoliths were taken. As well, extensive sampling and ageing was conducted by USSR and Cuban samplers. As in previous assessments, the results of sampling from the latter two sources have not been used in this assessment due to previously noted discrepancies in age and length compositions. The 1987 age composition of the catch was dominated by the 1985 year-class at age 2 (55% by number). The 1984 year-class at age 3 (24%) was below average.

ii) Research vessel indices

The Canadian research vessel survey series in July, which provides abundance estimates from 1972 to 1987, indicated that stock abundance in 1987 was comparable to that in the immediately preceding years but higher than in the late 1970's. There was a good correspondence between survey biomass and commercial CPUE in the period 1977-87. These surveys provide general indications of year-class strengths at ages 1 and 2, but no predictive relationships have yet been developed.

The July survey data were completely re-edited since the last assessment and has resulted in minor changes. The most substantial change involved a reduction in the estimate of the size of the 1983 year-class at age 1.

The joint USSR-Canada 0-group silver hake surveys have been conducted in a standard manner since 1981. The standard index of year-class size from these surveys, in comparison to indices from the July surveys at ages 1 and 2 are as follows:

Year-class	1981	1982	1983	1984	1985	1986	1987
Age 0 (0-gp. survey)	579	9	232	43	285	198[1]	102
Age 1 (July survey)	192	114	190	100	561	148	-
Age 2 (July survey)	108	69	155	77	264	-	-

[1] Revised value-provisional value used last year = 231.

STACFIS reviewed the results of research on vertical distribution of 0-group silver hake and encouraged continuation of such work as a basis for improvement in survey estimates.

c) Estimation of parameters

i) Introduction

Three stock assessment documents were reviewed. The first described an alternative method of determining TACs based on the cumulative contributions of known relative sizes of year-classes (e.g. from surveys). However, the "relative TACs" determined did not take into account changes in annual exploitation patterns nor were they scaled to some target exploitation rate. The second described a standard SPA and projection calculation, but was based on limited sampling of the 1987 catches (USSR fleet only) and used a value of M = 0.50 (see (ii) below). The third document was based on comprehensive sampling data for 1987 catches and used the previously accepted value of M = 0.40. The last document was taken as the basis for this assessment.

ii) Natural mortality

A paper was presented which derived estimates of M using a variety of methods. The results suggested that M may be about 0.50, but the methods used were in some cases inherently imprecise and in others very sensitive to input data. The Committee found the results presented to be inconclusive but encouraged further work on this most important population parameter. For the present assessment, the Committee had insufficient basis to change the value of M = 0.40 as used in previous assessments.

iii) Recruitment

All year-classes up to and including that of 1984 (i.e. age 3 and older) were fully recruited to the 1987 fishery. Their sizes were taken as determined by SPA. Estimates of the size of the 1985 and 1986 year-classes were obtained from research vessel surveys. The 0-group survey indicated that the 1985 year-class was the same size as that of 1983, whereas the July survey indicated that it was two or three times that size based on estimates at age 2 and age 1 respectively. A conservative approach was taken and the 1985 year-class (at age 1) was taken as being twice the strength of the 1983 year-class. Both in the 0-group survey and at age 1 in the July survey, the 1986 year-class was about the same size as the 1983 year-class and thus was taken as equal to the 1983 year-class at age 1. The 1987 year-class was set at the level of the geometric mean of the 1976-84 year-classes at age 1. The resultant value was in general agreement with the estimate of the size of this year-class obtained in the 0-group survey in 1987.

iv) Partial recruitment

Partial recruitment levels at ages 1 and 2 in 1987 were a function of the year-class strengths determined as above.

v) Fishing mortality in 1987

The relationships between fishable biomass from SPA and standardized commercial catch rates between 1977 and 1987, were examined for a range of 1987 F values. The 1982 point was an outlier and was discounted as in the previous assessment. The most recent years had the highest values of CPUE and, as a result, it was not possible to discriminate among a wide range of possible 1987 F values. Ratios between catch rates, survey biomass estimates and standardized fishing effort among groups of years were also examined, and the 1987 F values which gave fishable biomass estimates most consistent with these ratios were determined. These comparisons suggested that F in 1987 was low, and a value of F = 0.20 in 1987 was arbitrarily chosen to provide a basis for catch projections.

vi) Yield-per-recruit

The $F_{0.1}$ level of fishing mortality was taken as 0.474, the corresponding yield-per-recruit being 0.063 kg. These are the same values as used in the past two assessments.

d) Catch projections

The parameters which were used to project stock sizes and catches are given in Table 12.

Mean weights are the average of those observed in annual catches in 1977-87. Partial recruitments are the average of those in the SPA for the years 1977-85. Two projections were conducted based on different assumptions about the size of the 1988 catch; firstly that the 1988 TAC of 120,000 tons is taken, and secondly, that the catch in 1988 is 110,000 tons. This latter value was chosen based on the assumption that all non-Canadian allocations, totalling 96,500 tons, will be taken and that the Canadian developmental fishery will be moderately successful. The results of these projections are given in Table 13. The catch of 167,000 tons calculated in last year's assessment at $F_{0.1}$ would now correspond to an F of 0.29.

Table 12. Silver hake in Div. 4VWX: parameters used in projections of stock sizes and catches.

Age (yr)	1988 stock size (000)	Mean W (kg)	Partial Recruitment
1	1,005,347	0.055	0.045
2	1,651,539	0.142	0.301
3	2,735,794	0.199	1.000
4	354,679	0.251	1.000
5	159,203	0.302	1.000
6	50,139	0.362	1.000
7	27,876	0.475	1.000
8	2,116	0.597	1.000
9	993	0.755	1.000

Table 13. Silver hake in Div. 4VWX: projections of potential catches at $F_{0.1}$ in 1989 based on two assumptions of 1988 catch.

Catch in 1988 (t)	F in 1988	Catch in 1989 at $F_{0.1}$ (t)
120,000	0.20	232,000
110,000	0.18	235,000

The Committee advises that the TAC associated with fishing at $F_{0.1}$ in 1989 is 235,000 tons.

e) Future research

STACFIS noted that much of the difficulty in determining current stock status of silver hake stems from the fact that current recruitment levels and stock sizes are outside the range of historical data. Accumulation of additional years of data can be expected to strengthen the relationships between SPA outputs, commercial CPUE, fishing effort and survey estimates of stock size and recruitment. STACFIS recommends *further exploration of the relationships between SPA outputs, commercial CPUE, fishing effort and survey estimates of stock size and recruitment, and their full use in future assessments, and in particular, that the impact of high catches on traditional measures of CPUE be investigated.*

The Committee was pleased to note that the cooperative Canada-USSR research program on the influence of abiotic and biotic factors on silver hake behaviour and distribution, previously recommended, is now being implemented.

Attempts to improve current estimate of M are recognized to be of great importance and further work is encouraged.

9. American plaice in Div. 3M (SCS Doc. 88/12, 15)

a) Introduction

From 1974, when TAC regulation was introduced, to 1985, reported catches from this stock ranged from about 600 to 1,900 tons. The catch has increased sharply from about 1,700 tons in 1985 to 3,800 in 1986 to 5,600 in 1987. Virtually all of this recent increase has been due to increased catches by Spain (4,100 tons in 1987) and Portugal. Catches by the USSR, the other major prosecutor of this fishery, were relatively stable from 1982-86 at around 1,000 tons, then declined to about 500 tons in 1987.

STACFIS noted that there were no estimates of discarding available for this stock, and no estimate of catch by non-member countries known to fish in this area. Therefore some doubts were expressed about the accuracy of catch levels from this stock.

Recent TAC's and nominal catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	4	2	2	2	2	2	2	2	2	2	2
Catch	1.3	0.8	1.2	0.6	1.1	1.9	1.3	1.7	3.8[1]	5.6[1]	

[1] Provisional data.

b) Input data

i) Commercial fishery

Only 2 length frequency samples (236 measurements) were available from this stock in 1987, those being from the Portuguese fishery in November. These data indicated most of the A. plaice to be in the 36 to 44 cm range.

ii) Research vessel surveys

Surveys by the USSR in Div. 3M have shown the biomass to be relatively stable in 1983-85 and 1987. The estimate for 1986 was about 2.5 times higher and is likely to be anomalous, as noted by STACFIS in 1987 (Sci. Coun. Rept., pg. 56).

c) Catch projections

STACFIS noted that the increase in reported catch in 1986 and 1987 was likely to relate to increased effort, mainly by freezer trawlers, rather than an increase in abundance. Given the apparent stability of this stock in earlier years, when catches averaged about 1,000 tons, and the stability indicated by the recent USSR surveys, the Committee has no basis to advise a change in the TAC from the current level of 2,000 tons.

10. American plaice in Divisions 3L, 3N and 3O (SCR Doc. 88/28, 37; SCS Doc. 88/12, 14, 15)

a) Introduction

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

STACFIS noted that catch statistics for this stock are not adequate and that for some non-member nations, substantial catches in some recent years have been included in the assessments, based on estimates of catch and effort from Canadian surveillance authorities. For example, in 1986 about 4,600 tons of the total catch came from the surveillance estimates. STACFIS also noted that there was very little information on discarding for this stock and that reported catches continue to reflect landings, rather than actual removals.

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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	47	47	47	55	55	55	55	49	55	48	40[3]
Catch	50	49	49	50	51[1]	39[1]	39[1]	54[1]	61[2]	53[2]	

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

b) Input data

i) Commercial fishery

Catch and effort data from the commercial fishery during 1956-87 were analyzed using a multiplicative model to obtain a catch-rate series. As was done in the 1987 assessment of this stock, data from Canada (N) trawlers (tonnage classes 4 and 5) were used in the model, and the same procedure was followed in the analysis. The results show a decline in CPUE from about 1.3 t/hr in the late 1950's, to about 1.0 t/hr in 1961-67, and a further decline to about 0.45 t/hr in 1974-78. Catch rates subsequently increased to about 0.66 t/hr in

1983-85, then declined almost 30% to about .48 t/hr in both 1986 and 1987. The CPUE in the last 2 years is very similar to the lowest level observed for this stock, which is about 0.45 t/hr in the mid-1970's.

The age composition and average weight-at-age data from the 1987 fishery were derived from two sources: length and age samples of the landings of Canadian vessels fishing in Div. 3L and 3N, and length and age samples of the landings of Spanish freezer trawlers fishing in Div. 3N. STACFIS noted that the recommended exchange of otoliths from American plaice caught in Division 3N had taken place between Canada, Spain and Portugal since the last assessment of this stock. The results suggest good agreement between the readers of all 3 countries, and so the age compositions calculated independently for the Spanish and Canadian fisheries in Div. 3N in 1987 were acceptable.

STACFIS also noted that the apparent differences in ageing of American plaice otoliths referred to in 1987 (Sci. Coun. Rep., 1987, p. 57) may have been caused by an invalid comparison, i.e. the Canadian otoliths were from a research vessel survey over the entire area of Div. 3N, while the Spanish otoliths were taken from the fishery in the Regulatory Area in Div. 3N. It has been observed by Canadian age readers that A. plaice caught from this area (southern portion of Div. 3N) generally have a higher mean length-at-age than do those which are caught in the northern portion of Div. 3N. Therefore STACFIS recommends *to ensure comparability of the age readings planned by Spain for A. plaice caught in Div. 3L with those of Canadian agers, an exchange of otoliths from A. plaice from Div. 3L between the same 3 countries (Canada, Portugal and Spain), prior to the 1989 assessment.*

At the recommendation of STACFIS in 1987, available sampling data from non-Canadian catches were examined for recent years. A considerable amount of length frequency data was available for the Spanish catches in 1985 and 1986 and these data, along with age-length keys from Canadian spring surveys in these years, were used to calculate catch-at-age and average weights-at-age for the non-Canadian portion of the catch in 1985 and 1986. A comparison of numbers-at-age from separate analyses of sexed (normal for this stock) and unsexed samples from the 1986 Spanish catches showed minimal differences, so the 1985 data, which was unsexed, was considered acceptable.

Further analysis will be conducted on this matter before the next assessment of this stock.

No major differences were observed for 1985 and 1986 in the recalculated catch-at-age. In 1986 and 1987, substantial numbers of smaller fish were observed in the Spanish catches and this is reflected in the age compositions for these years. The percent catch-at-age for most age groups in these 2 years is similar to the pattern observed for this stock for many years prior to 1981, with proportionally more young fish in the catch than were estimated for 1981-85. However STACFIS noted that the catch of older fish (aged 13+) from this stock was close to the lowest level in the 23-year series.

With the trend toward smaller fish in the catch in 1986 and 1987, catch numbers-at-age 5 became quite high in these years. Therefore it was necessary to extend the catch-at-age matrix back from age 6 to age 5. For 1965-79, the catch at age 5 was taken from the 1980 assessment (NAFO SCR Doc. 80/VI/110), while the values for 1982-84 were available in recent assessment documents. No figures for age 5 in 1980 and 1981 could be found, and the data were not available to calculate them at this time. Therefore, these values were estimated, based on the ratio of the numbers at age 5 to age 6 in 1979 and 1982. STACFIS considered this to be acceptable, given that it was not likely to have an effect on the assessment, but recommends *that the values be calculated from the sampling data for these years.*

Average weights-at-age were recalculated to include the additional sampling in 1985-86, and also to correct a minor error in the calculations for 1982-84. The increasing trend in the average weights in the older ages noted in previous assessments is still obvious and may be explained by the high proportion of the total catch taken from the Tail of the Bank in Div. 3N, where A. plaice tend to be larger at age than from other areas on the Grand Bank. A sum of products check, using the revised catch- and average weights-at-age showed good agreement with the nominal catch in Div. 3LN, particularly for most recent years.

ii) Research vessel surveys

Stratified-random groundfish surveys - Canada. Data from Canadian spring surveys in Div. 3L, 3N and 3O are available from 1971-88, excluding 1983. At the recommendation of STACFIS in 1987, a multiplicative analysis was used to provide estimates of abundance, filling in values for strata not surveyed each year. To obtain age-by-age estimates of abundance, age compositions from previous analyses of selected strata were used for Div. 3L, while for Div. 3N the age compositions were taken from the analysis of all strata, as the selected strata estimates differed from the totals for some years examined. The analyses show that the abundance is substantially lower in recent years than in the 1976-82 period. In Div. 3L, the average total (age 1+) abundance in 1985-87 is about half the average from 1976-82,

and is comparable to the average in 1972-74. Age 9+ abundance, used by STACFIS as an approximation of spawning stock, was lower in Div. 3L in 1985-87 than in any other year, at about 35% of the average from 1976-82 and about 68% of the average of the previous lows observed in 1972-74. However, there was some evidence of improved recruitment in the 1987 survey in Div. 3L, as the abundance at ages 6, 7 and 8 was higher than in recent years, with the estimate at age 7 being the third highest in the 16 year series, about 40% above average.

In Div. 3N, the total abundance values in 1986-87 were among the lowest in the series, comparable to the 1972-75 period, and about 50% of the average from 1976-82. The trends in 9+ abundance in Div. 3N were similar to those for total abundance. However there were no indications of good recruitment in the 1987 survey in Div. 3N. As estimated from these analyses, the total population size in Div. 3L, on average, is about 5 times as large as that in Div. 3N from 1971-87.

STACFIS noted that information was available from the 1988 survey just completed in Div. 3LNO, although this information could not be incorporated into the multiplicative analysis described above in time for this meeting. However, survey coverage was comparable to other recent years, permitting comparison of the biomass estimates. In Div. 3L, the biomass estimate in 1988 was 193,000 tons, which is similar to the average from 1985-87. In Div. 3N, the biomass had declined from an average of about 64,000 tons in 1984-85 to about 32,000 tons in 1988. To examine trends in biomass in the regulatory area in Div. 3N, all strata less than 368 m which are located fully or almost fully in the regulatory area were selected. These strata show a steady decline in biomass from 1984 to 1988, totalling 79%. Over the same period, the biomass in the other strata in Div. 3N decreased by only 44%, and the decline was not continuous over the 5 years. In 1984-86, the strata in the regulatory area contained, on average, about 26% of the total biomass in Div. 3N. This figure declined to about 13% in 1987 and about 11% in 1988. STACFIS noted that these figures are not inconsistent with the increase in catch in the regulatory area in Div. 3N, up to 1986 and the subsequent decrease in catch observed in 1987. In Div. 3O, the biomass has fluctuated between 48,000 tons and 77,000 tons in the past five surveys, with the 1988 estimate being 51,000 tons.

There was some indication of good recruitment at younger ages in Div. 3O in 1987, although only 4 years (1984-87) were available in a comparable format for comparison.

In additon to the annual spring surveys in Div. 3LNO, a number of seasonal surveys have been conducted by Canadian vessels in Div. 3L from 1983-88. Coverage in all years was virtually complete to depths of 366 m and in some years was extended to 732 m, although catches of A. plaice were usually quite small in the deeper areas. In 1983-84, the average biomass from the two surveys was almost 300,000 tons, declining to an average of about 210,000 tons from four surveys in 1985. In 1986, the three surveys gave widely differing estimates, ranging from 46,000 tons in winter to about 175,000 tons in spring to about 130,000 tons in fall. The three surveys in 1987 produced an average of 184,000 tons, close to the value observed in spring 1988.

STACFIS noted that the results of these 13 surveys indicated a decline from 1983-84 to 1986-88, and that the biomass had been relatively stable over the last six surveys (spring 1986 to spring 1988). Only the value for winter 1986 appeared to be anomalous in this time series.

In addition to the surveys described above, autumn surveys also exist in Div. 3L for 1981 and 1982, permitting a comparison (after applying the vessel/gear conversion factors) of autumn survey results from 1981-87. STACFIS noted that the population estimates for 1985-87 are relatively stable, but much lower (about 50% on average) than the estimates for 1981-84. It was also noted that while ages 7 and 8 were dominant in the autumn 1987 survey, as they were in the spring of 1987, these year-classes did not appear to be as strong (relative to others at the same age) as indicated in the spring surveys in Div. 3L. It was pointed out that all three surveys in 1987 (spring, summer, autumn) in Div. 3L showed virtually the same age composition, with ages 7 and 8 comprising about 50% of the catch in numbers.

Juvenile flatfish surveys - Canada. A stratified-random survey of the Grand Bank in depths less than 91 m was conducted in November of 1987. In Div. 3N 80% of the abundance of 1-4 year-old A. plaice were found in stratum 360 on the Tail of the Bank, predominantly outside the 200-mile limit. These results are similar to those from the 1986 juvenile survey. A comparison of abundance estimates-at-age for stratum 360 showed a 40% reduction in juveniles (1-4 years) from 1986 to 1987 while there was an 80% reduction in age 5+ abundance estimates. These relatively large catches of juveniles on the Tail of the Grand Bank for the second year in a row lend strong support to the hypothesis of a shallow water nursery on the Tail of the Bank which supports the southern Grand Bank plaice population.

Stratified-random groundfish surveys - USSR. USSR surveys have shown a decline in the

abundance and biomass of A. plaice from 1983 to 1987. In 1987, the abundance was about 25% lower than in 1986, and about 55% lower than the average in 1983-84. The trend in total biomass was also similar. Length frequency data from Div. 3L indicated that the catches comprised mainly of fish between 26 and 38 cm, corresponding closely to the data from Canadian surveys in Div. 3L in 1987.

Other surveys in deep water on the slope of Div. 3L. In April 1987, several large catches of A. plaice were taken on the northeastern Slope of the Grand Bank in Div. 3L, in depths of about 520 m. To further investigate this unusual distribution of A. plaice, a series of line transects was conducted in the same area in April 1988. Large catches of A. plaice were again taken in the same locations although commercial catch-rates were very low a few weeks later. As was also the case in 1987, surveys in the area shortly after April caught virtually no A. plaice. Using the existing stratification scheme to post-stratify the sets on the line transects allowed estimates of biomass to be calculated. STACFIS noted that the total biomass estimated in the area was between 5,000 and 10,000 tons, compared to recent estimates in the remainder of Div. 3L of about 180,000 tons.

c) Estimation of parameters

i) Partial recruitment

The partial recruitment (PR) values used were those calculated in 1987 from a preliminary sequential population analysis, from the average (1965-86) fishing mortalities, normalized at age 12. In the 1987 assessment, the PR used was calculated from average F's in the 1973-77 period, a time when the catch-at-age was similar to that from the 1986 fishery. Given the change in the proportions of the catch taken in Div. 3L to 3N in 1987 from 1986, and the subsequent shift in the age composition to a pattern similar to that observed in many years prior to 1981, it was felt that the long-term average PR was more realistic. The following table shows the different PR values used in the 1986-88 assessments:

Age	5	6	7	8	9	10	11	12	13-19
1988	.011	.041	.116	.233	.374	.536	.745	1.00	1.00
1987	-	.050	.127	.284	.465	.665	.833	1.00	1.00
1986	-	.025	.100	.220	.300	.470	.560	.730	1.00

ii) Natural mortality

The value of M = 0.2 was retained.

iii) Fishing mortality

Using average exploitable biomass from 1965-87 against CPUE series to calibrate SPA resulted in a best estimate for terminal F in 1987 (F_T) of between 0.50 and 0.55, based primarily on minimizing the sum of squares of the 1986 and 1987 residuals from the least squares regression. Use of the data from 1977-87 only, did not produce a significant relationship over a reasonable range of F_T values in 1987. Using age 9+ average population numbers from SPA for 1965-87 against age 9+ population numbers from the new analysis of Canadian spring survey data showed F_T to be somewhat higher than 0.7, based on minimizing the last two residuals and an increasing value of the correlation coefficient (r) as F_T in 1987 increased. However, the 1987 point was virtually on the regression line for F_T = 0.7 in 1987. To compare the calibration using the revised age 9+ survey population numbers with the results using the 9+ survey numbers calculated in the manner used previously for this stock (using only selected strata), a calibration using these old numbers was performed. The results indicated terminal F_T to be in the range of 0.65-0.70, similar to the analysis using the revised survey population numbers. The relationship using 9+ SPA numbers against 9+ revised survey numbers for the years 1977-87 only, showed that r increased with F_T, and that the relationship was significant only at F_T = 0.7 and higher, because the last two points moved further from the regression line as F_T increased. Virtually the same situation existed for the calibration with age 12+ numbers from 1971-87, although the relationships were only marginally significant for F_T of .60 and higher. No significant relationships were obtained over a reasonable range of F_T's for the calibration with 12+ numbers from 1977-87 only. However, it was noted that the 1977 point was an outlier in these regressions, and the calibrations with this point excluded produced significant relationships and indicated F_T to be slightly lower than 0.70, based on the position of the 1986 and 1987 points relative to the regression line. Based on these calibrations, and focussing primarily on the first two described above, which were the relationships used in the last assessment, STACFIS concluded that the best value for fishing mortality in 1987 was 0.6, which is midway between the values of F_T suggested from the calibrations using the CPUE data and those using the survey data.

iv) Yield-per-recruit

Based on the changes in the fishery in recent years, both in terms of locations of effort and age composition of catches, a reexamination of yield-per-recruit was recommended by STACFIS in 1987. Using the partial recruitment which was input to the SPA in 1987, the average weights-at-age for 1987, and an age span of 5-18 (18 being the highest age observed in the 1987 catch), $F_{0.1}$ was calculated as 0.23 (Y/R = .21 kg) and F_{max} was 0.46 (Y/R = .23 kg). The currently used Y/R analysis for this stock, calculated using an age span of 5 to 20 and average weights-at-age and partial recruitment from 1960-80 (Table 14), estimates $F_{0.1}$ to be 0.26 (Y/R = .18 kg) and F_{max} >3.0, due to a long segment of the Y/R curve being flat-topped (Fig. 13). STACFIS does not consider the present situation to be representative of the long-term average for this stock, particularly for the average weights-at-age, the current high values which have a significant effect in lowering the reference F levels. The presently accepted yield-per-recruit analysis is given in Table 14, and STACFIS recommends *that the use of the presently accepted yield-per-recruit analysis be maintained, and that $F_{0.1}$ be kept at 0.26.*

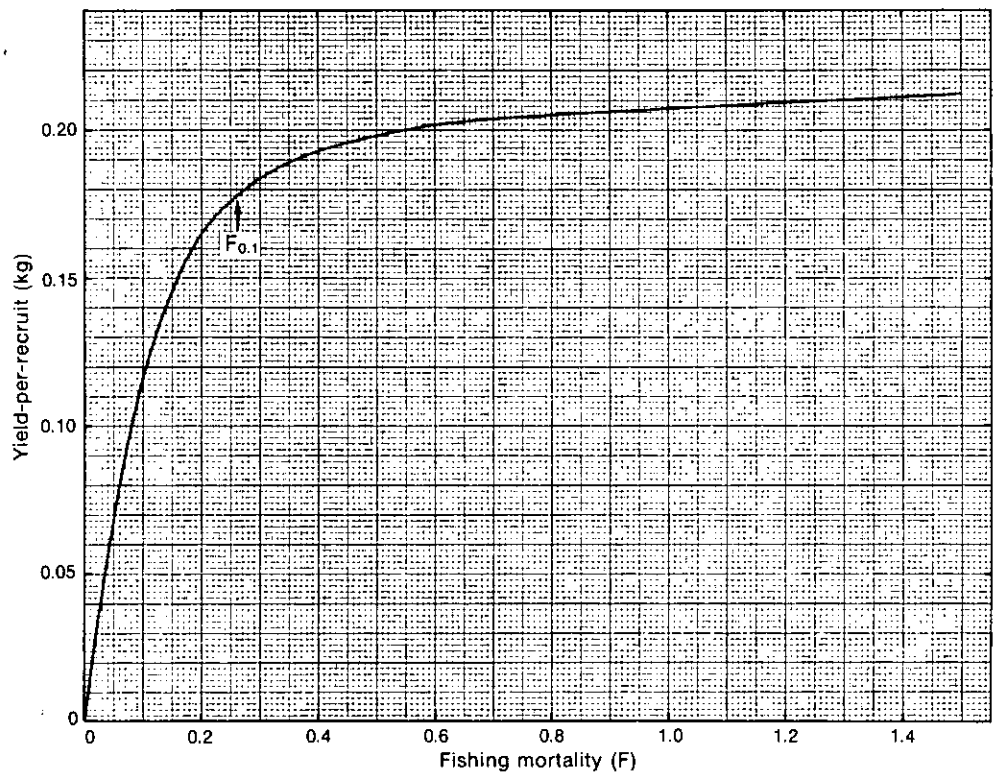


Fig. 13. American plaice in Div. 3LNO: yield-per-recruit curve.

Table 14. American plaice in Div. 3LN: parameters used in yield-per-recruit analysis.

Age	Weight-at-age	Partial recruitment
5	0.209	0.005
6	0.261	0.025
7	0.341	0.100
8	0.428	0.220
9	0.552	0.300
10	0.625	0.470
11	0.700	0.580
12	0.880	0.730
13	1.020	1.000
14	1.250	1.000
15	1.524	1.000
16	1.803	1.000
17	2.022	1.000
18	2.233	1.000
19	2.401	1.000
20	2.428	1.000

d) Assessment results

The SPA at F_T = 0.60 indicates that F has increased in recent years (Fig. 14) and that the age 9+ population numbers over the same period have been relatively stable, but considerably below the levels observed from 1977-80 and similar to those in 1972-76. The population numbers at ages 12+ (fully recruited) have declined in recent years, and in 1986 and 1987 are around the lowest levels observed for this stock. STACFIS noted that the population estimates from surveys were greater than those from SPA in corresponding years. The discrepancies were greater for the years in the earlier time period and STACFIS speculated that this may be caused by higher quantities of unknown catches in these earlier years. A second possible cause related to the pattern of increasing F values in the older ages in the population. If this is an artifact of increasing natural mortality, then the population sizes would be underestimated in all years. STACFIS, noting that discrepancies in population estimates from surveys may be caused by different factors, recommends *that these factors leading to such discrepancies be examined further.*

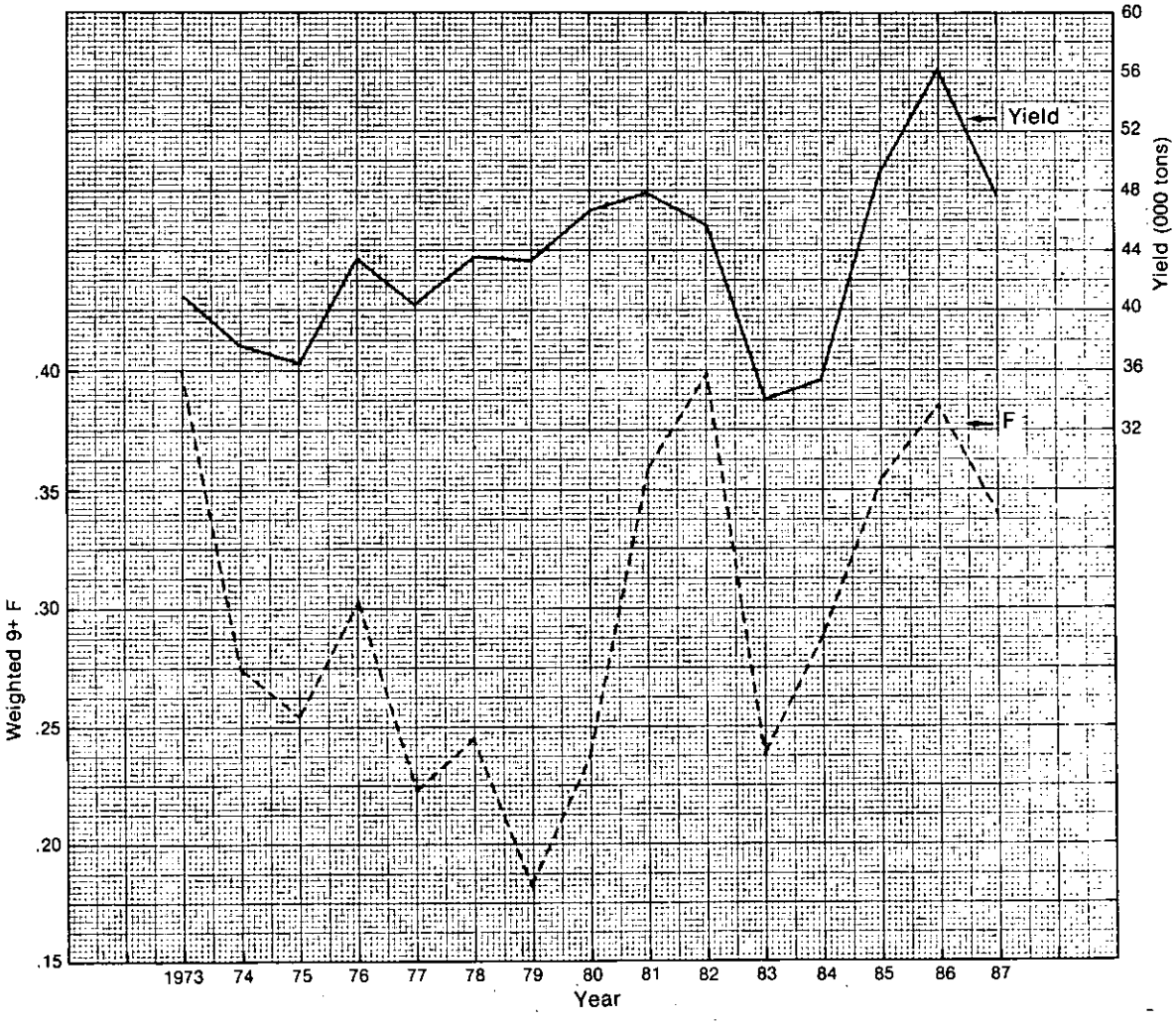


Fig. 14. American plaice in Div. 3LN: trends in total yield and fishing mortality (ages 9+) weighted by population numbers.

e) Catch projections and prognosis

The population size from the SPA with F_T in 1987 = 0.60 was used to project catches for 1988 and 1989. The population at age 5 and 6 was replaced with the geometric mean from 1974 to 1982 because these values in 1987 are very sensitive to even minor changes in the value of input PR. The average weights-at-age were averaged from 1984-87, and are similar to those used in the 1987 assessment, and the PR used to project them was the same as that used in the input for SPA (Table 15).

Table 15. American plaice in Div. 3LN: parameters used in projections of biomass and yield.

Age (yr)	1987 stock size (000)	Mean wt. (kg)	Partial recruitment
5	217,000	.192	.010
6	181,000	.277	.041
7	111,518	.362	.116
8	82,988	.428	.233
9	81,425	.515	.374
10	64,793	.615	.536
11	32,003	.754	.745
12	15,363	.993	1.0
13	6,689	1.301	1.0
14	2,673	1.659	1.0
15	1,468	2.125	1.0
16	371	2.710	1.0
17	52	3.128	1.0
18	7	3.912	1.0
19	2	4.113	1.0

It should be noted that the catch projections represent Div. 3LN only and that a catch for Div. 3O, normally equal to the recent average value (about 5,000 tons) is usually added to give a projected catch for the whole stock (Fig. 15). In Table 16, different levels of catch in 1988 are assumed and the catch is projected at $F_{0.1}$ and at F_{87} in 1989. STACFIS noted that these catch levels supported the assessment of the stock conducted in 1987. At that time, STACFIS had expressed concern that the 1988 assessment may not confirm the results of the 1987 assessment, and that the magnitude of the decline in population size from that estimated in 1986 to that calculated in 1987 may reflect changes in availability rather than abundance. However, the results from three Canadian surveys conducted in Div. 3L in 1987-88; a Canadian survey in Div. 3NO in 1988; a USSR survey in Div. 3LNO in 1987 and an additional year (1987) of commercial CPUE data from the Canadian fleet are now available since the last

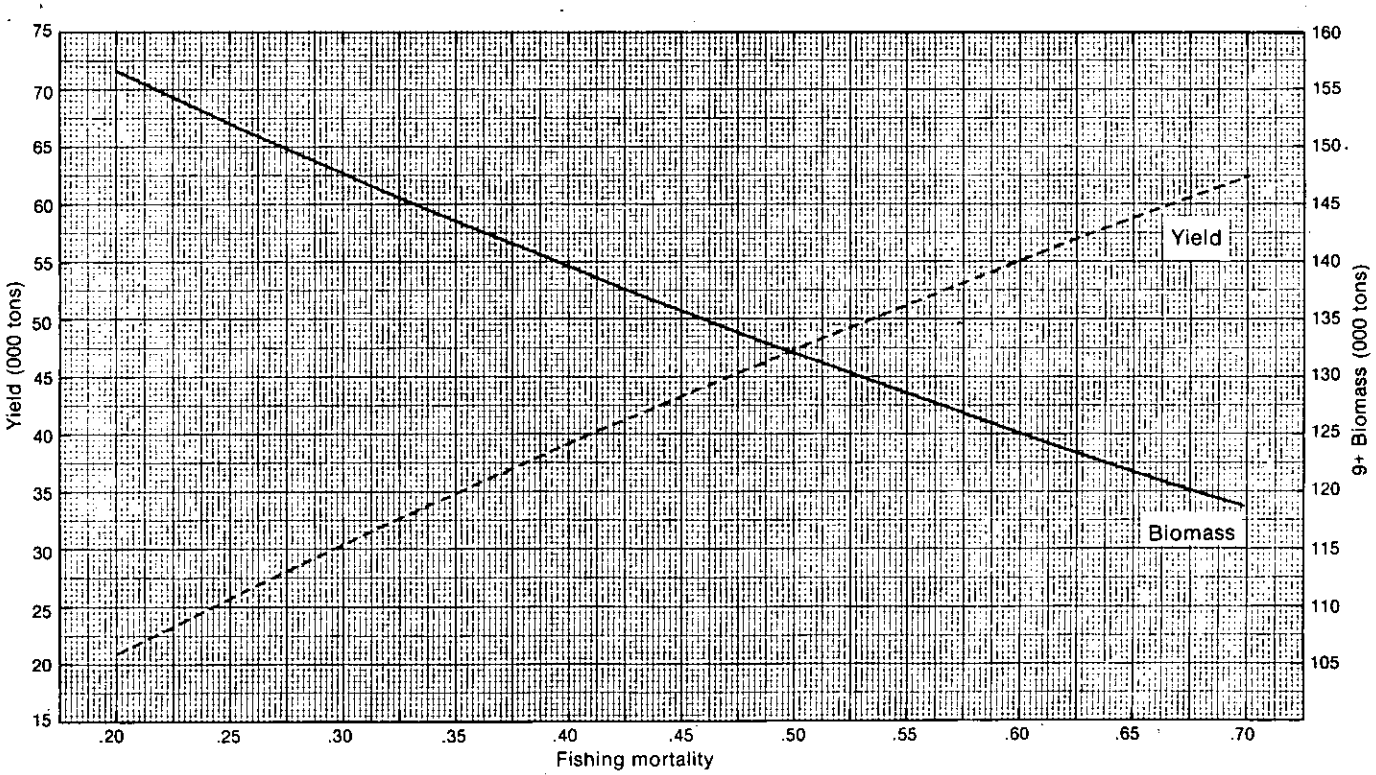


Fig. 15. American plaice in Div. 3LN: projected yield in 1989 and age 9+ biomass at January 1, 1990, for a range of fishing mortality. F in 1988 = 0.26 ($F_{0.1}$).

Table 16. American plaice in Div. 3LN: results of catch projections for different levels of F in 1987 and 1988.

Catch in 1988[2] (000 t)	Fishing mortality in 1988	Catch of $F_{0.1}$ in 1989 (000 t)	Age 9+ biomass at Jan 1, 1990 (000 t)	Catch at F_{87}[2] in 1989 (000 t)	Age 9+ biomass at Jan 1, 1990 (000 t)
22.4[3]	.26	26.6	151.3	55.2	125.1
28.0[4]	.33	25.5	146.7	53.1	121.6
35.0[5]	.43	24.3	141.0	50.5	117.2
46.8[6]	.60	22.2	131.3	46.2	109.7

[1] F_{max} not considered realistic for this stock at >3.0.
[2] To obtain catch levels for the stock, add 5,000 tons to represent the catch in Div. 3O.
[3] $F_{0.1}$ catch from 1988 assessment.
[4] $F_{0.1}$ catch projected for 1988 from 1987 assessment.
[5] Interim catch level adopted for 1988.
[6] F_{87}.

assessment. All have indicated the abundance to be similar to that estimated from previous results, and support the view of the stock size proposed in 1987, i.e. that it is considerably smaller than it was several years ago (Fig. 16).

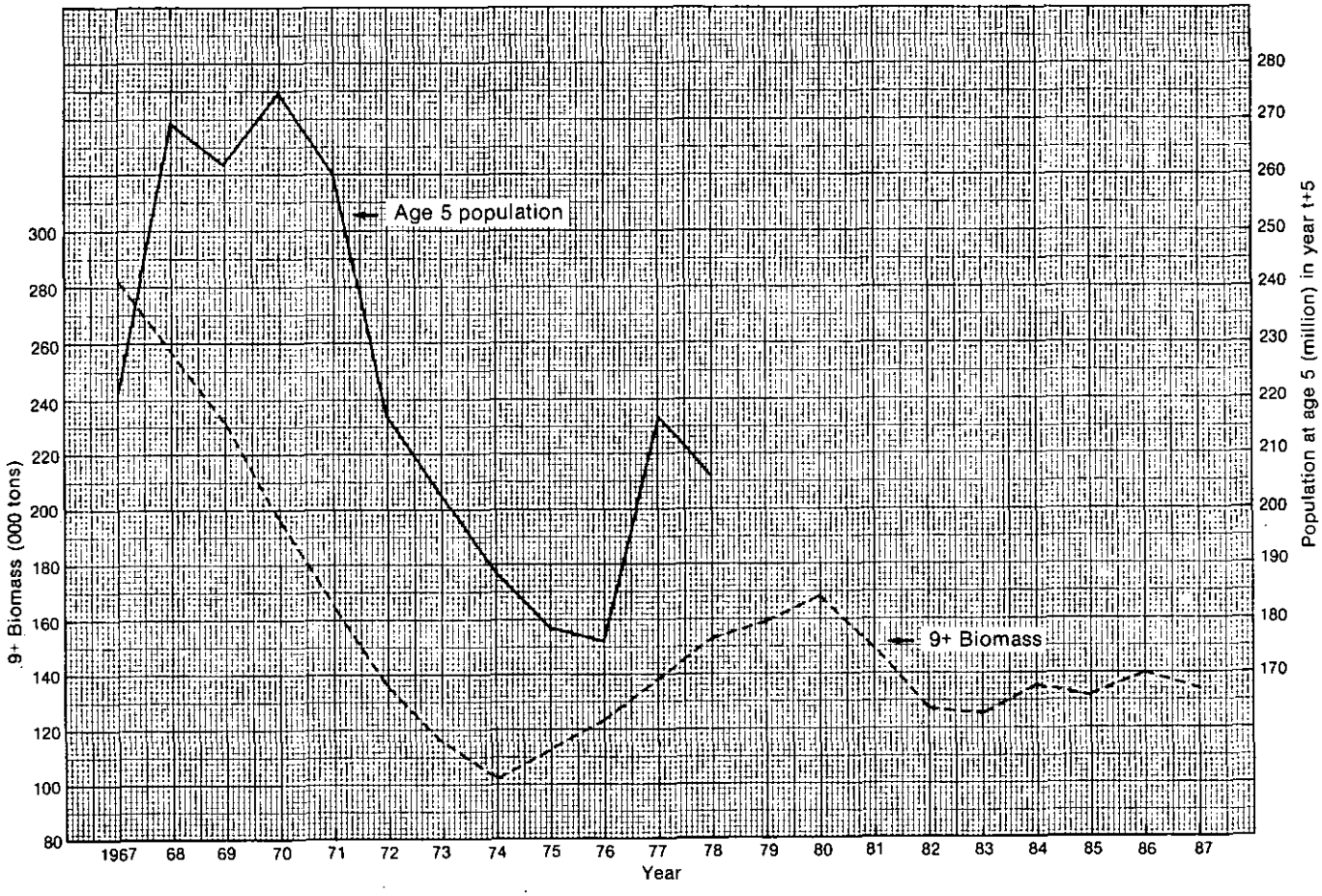


Fig. 16. American plaice in Div. 3LN: trends in age 9+ biomass (at the beginning of year) in year t and recruits at age 5 (year t+5).

STACFIS again noted that Canadian research-vessel surveys in Div. 3LNO indicated relatively stable population sizes in 1985-88, which were about 50% below 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 and in the 1987 assessment indicated a level of fishing mortality similar to that indicated by the commercial catch rates.

STACFIS therefore concluded that the present assessment does confirm the results of the 1987 assessment, and advises that the $F_{0.1}$ catches for Div. 3LNO in 1988 and 1989 are 28,000 and

32,000 tons respectively. STACFIS also emphasized that the advised total catch applies to the entire stock. With no control over the catch by non-member countries and countries fishing without allocations in the Regulatory Area, this fishery will continue to be difficult to manage. This is of particular concern, given the observation that a very high proportion of young American plaice is found in the Regulatory Area. These younger fish are thus particularly susceptible to such uncontrolled fisheries.

f) Research recommendations

STACFIS recommends *that appropriate data for American plaice in Div. 30 be examined with the goal of incorporating this portion of the stock into the assessment, along with the portion in Div. 3LN on which the assessments are currently based.*

11. Witch Flounder in Divisions 3N and 30 (SCR Doc. 88/68)

a) Introduction

Reported catches of witch flounder in the last 15 years, prior to 1985, ranged from about 2,400 tons in 1980 and 1981 to 9,200 tons in 1972. With increased effort mainly by EEC countries in 1985 and 1986, particularly Spain and Portugal, catches rose rapidly to 8,800 and 8,500 tons respectively. This increased effort was concentrated mainly in the Regulatory Area of Div. 3N. Other non-member countries such as the USA, Korea, the Cayman Islands, and Panama also contributed to increased catches. In 1987, the catch was 7,600 tons and was taken mainly by Canada, EEC and the USSR. Most of the USSR catch in 1987 was taken in Div. 30 unlike most years when catches from Div. 3N were greater. With reduced catch rates for flatfish generally outside the Canadian 200-mile limit, some countries have diverted effort towards other species such as redfish, and this may explain some of the reduction in catch in 1987 compared to 1985 and 1986. Recent catches and TACs (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	10	7	7	5	5	5	5	5	5	5	5
Catch	3	3	2	2	4	4	3	9	9[1]	8[1]	-

[1] Provisional

b) Input data

i) Commercial fishery data

Catch and effort statistics for Canada (N) from 1972-87 were available from the fishery conducted in Div. 30. Canadian catch rates declined from a high of 0.72 tons/hr in 1972 to a low of 0.19 tons/hr in 1979; it is recognized that for some years the proportion of main species catch on which the figures are based is very low and the precision of such data as indices of stock size are questionable. The catch rates have declined somewhat over the 1985-87 period, however, they are still considerably above those levels experienced during the late 1970's. These catch rates are most likely reflective of only the component of the resource which occupies the southwest slope of the Grand Bank in Div. 30.

Catch-at-age data from the Canadian fishery in Div. 30 continued to indicate 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 although the witch flounder stock component in Div. 30 may have declined slightly from 1985 to 1987, it remains higher than the levels observed from 1977 to 1984. However, due to 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 1989 from the 5,000-ton level presently in effect.

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

d) Future research

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

12. Yellowtail Flounder in Divisions 3L, 3N and 3O (SCR Doc. 88/38; SCS Doc. 88/14, 15)

a) Introduction

Nominal catches increased rapidly from a few hundred tons in 1963-64 to a high of about 39,000 tons in 1972. Vessels from Canada and the USSR took almost all of the catch up to and including 1975, with only Canada taking significant catches in 1976-81. After 1981 several other countries entered the fishery, notably South Korea, Spain, Portugal, Panama, USA and the Cayman Islands. In 1986 an estimated 16,581 tons were caught by non-Canadian vessels (54% of total catch of 30,736 tons). In 1987 catches by Canada dropped by 741 tons (5%) to 13,414 tons while catches by other countries fishing outside the Canadian 200-mile limit dropped by 13,614 tons (82%) to 2,967 tons from 1986. In 1987, no catch was reported by or estimated for Portugal, Panama, and Cayman Islands, countries which took over 11,000 tons in 1986. This change was attributed to a switch in fishing effort to species in deeper water, such as redfish. Overall the preliminary estimate for 1987 of 16,381 tons was 9% over the TAC and represented a reduction of 47% from the1986 catch.

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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	15	18	18	21	23	19	17	15	15	15	15
Catch	15	18	12	15	13	10	17[1]	29[1]	31[2]	16[2]	

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

b) Input data

i) Commercial fishery

Catch rates of yellowtail flounder by Canada (N) otter trawlers (tonnage classes 4 and 5) declined from about 0.6 tons/hr in the early 1970's to 0.33 tons/hr in 1976, increased steadily to 0.64 tons/hr in 1980, then remained at a level between 0.52 and 0.62 tons/hr from 1981-85. The values for 1986 and 1987 are 0.46 tons/hr, down by about 17% from the average catch rate in 1983-86. It should be noted that no catch rate data are available for vessels from nations fishing in the Regulatory Area in Div. 3N, and in recent years Canadian vessels have rarely entered this area to fish for yellowtail flounder. Therefore, the Canadian CPUE series does not reflect the true magnitude of changes in total stock abundance, and is likely to be an overestimate of total CPUE in 1987, given the anecdotal information that many nations ceased fishing yellowtail flounder in 1987 because of poor catch rates. This information would appear to be substantiated by the magnitude of the decline in catch from 1986 to 1987.

Age compositions and average weight-at-age data were available from the Canadian and USA fisheries in 1987. Age-length keys from the Canadian survey in 1987 in Div. 3N were used to calculate the age composition of the USA catch (1,534 tons) as no otoliths were available from this fishery and there were some fish in the length frequencies smaller than those found in the Canadian commercial age-length keys. Length compositions from the Spanish catch in 1987 (1,183 tons) were similar to those of the Canadian and USA catches so the numbers-at-age from the catch by Canada and USA (14,948 tons) were adjusted to the total catch in 1987 (16,381 tons). The numbers-at-age for Spain in 1987 will be calculated and incorporated into the total catch-at-age for the next assessment

of this stock. In the 1987 age composition, ages 7 and 8 comprised about 70% of the catch, both in numbers and weight. The strong 1979 year-class comprised about 30% of the catch numbers, which is the second highest percentage at age 8 in the 20-year series of catch-at-age. However, this percentage could also reflect the relative weakness of the 1981 and 1982 year-classes, which at 25% of the catch numbers in 1987, represented the lowest percentage of ages 5 and 6 in the time series, and compares to an average of 48% for ages 5-6 from this 20-year series.

Following the recommendation of STACFIS in 1987, available sampling from countries other than Canada was used to recalculate catch-at-age and average weights-at-age for 1985 and 1986. For 1985, length frequency data were available from both the Spanish and USA catches. For both years, age-length keys from Canadian research vessel surveys conducted in the spring were used to calculate age compositions. Also in both years the calculated age composition for the sampled part of the non-Canadian portion of the catch was adjusted up to the total non-Canadian catch. The resulting changes were not substantial for 1985, but resulted in a shift of the 1986 age composition toward younger fish, e.g. in the recalculated 1986 numbers-at-age, 31% of the catch comprised of ages 5 and 6, compared to 18% in the original values.

Following the recalculation of average weights-at-age for 1985 and 1986 to include the additional sampling information, the average weights-at-age for 1982-87 were recalculated to correct for a minor error in the average lengths used to derive these values. The resulting changes were not substantial and had little effect on the sum of products used as a comparison with the annual catches.

ii) Research vessel surveys

Stratified-random groundfish surveys - Canada. Surveys have been carried out by Canadian research vessels in Div. 3LNO each year from 1971-82 and 1984-88. The surveys from 1985-88 are comparable in terms of coverage and vessel/gear used. Estimates of biomass of yellowtail flounder from these surveys have decreased in recent years, from about 94,000 tons in 1985-86 to 82,000 tons in 1987 and 53,000 tons in 1988. Most of this decline occurred in Div. 3N, where the biomass estimate in 1985-86 was about 60,000 tons, compared to 50,000 tons in 1987 and 34,000 tons in 1988. In strata 360 and 376 (Fig. 17), which encompass virtually all the yellowtail flounder habitat in the Regulatory Area, the biomass has declined steadily from about 32,000 tons in 1984 to 1,000 tons in 1988, a decrease of 97%. In the remaining strata in Div. 3N, the biomass declined by 54% over the same period. In 1984-85, the biomass in strata 360 and 376 comprised about 33% of the total in Div. 3N, declining to about 20% in 1986-87, and in 1988, was estimated to be only 3% of the total in Div. 3N.

To allow comparison of survey results from years with different areal coverage, a multiplicative model was used to provide estimates of abundance for strata not surveyed in some years. The regression used in the model explained 78% of the variation in abundance estimates using year and stratum effects. The total abundance has decreased substantially in recent years after a period of relative stability from 1975-84, with the values from 1985-88 being the lowest in the series. The overall trends in this new series are essentially the same as those found in the survey abundance index (from selected strata) used previously for this stock. The abundance in 1988 is 41% lower than in 1987 and is less than one-half of the previous low estimate from 1971-85. To calculate abundance-at-age, the total abundance estimates from the multiplicative model were broken down using the age compositions from catches in selected strata in Div. 3LN. These strata were the ones used previously to give an index of abundance for this stock, and the age compositions from these strata were in agreement with those from all strata in comparisons using 2 recent years. The relatively strong 1978 and 1979 year-classes have virtually passed through the population and the three subsequent year-classes appear to be weak. In fact, the 1981-83 year-classes, which should contribute significantly to the fishery in 1988-90, are among the worst in the time series, based primarily on the 1988 and 1987 surveys and to a lesser extent on the 1986 survey. In 1987 and 1988, age 8 was predominant in the survey catches, compared to age 6 or 7 in all preceeding years except 1981. These results are not surprising for 1987, as the 1979 year-class was quite large, however for 1988, the results suggest the relative weakness of the 1981-83 year-classes, rather than indicating that the 1980 year-class is strong, which it does not appear to be. The following table, which shows the ranks of the estimates of the 1981-83 year-classes at ages 5, 6 and 7 (1986-88 surveys), indicates that the 1988 estimates for all three year-classes are the worst in the 17-year series:

Year-class	Age 5	Age 6	Age 7
1981	14	16	17
1982	16	17	-
1983	17	-	-

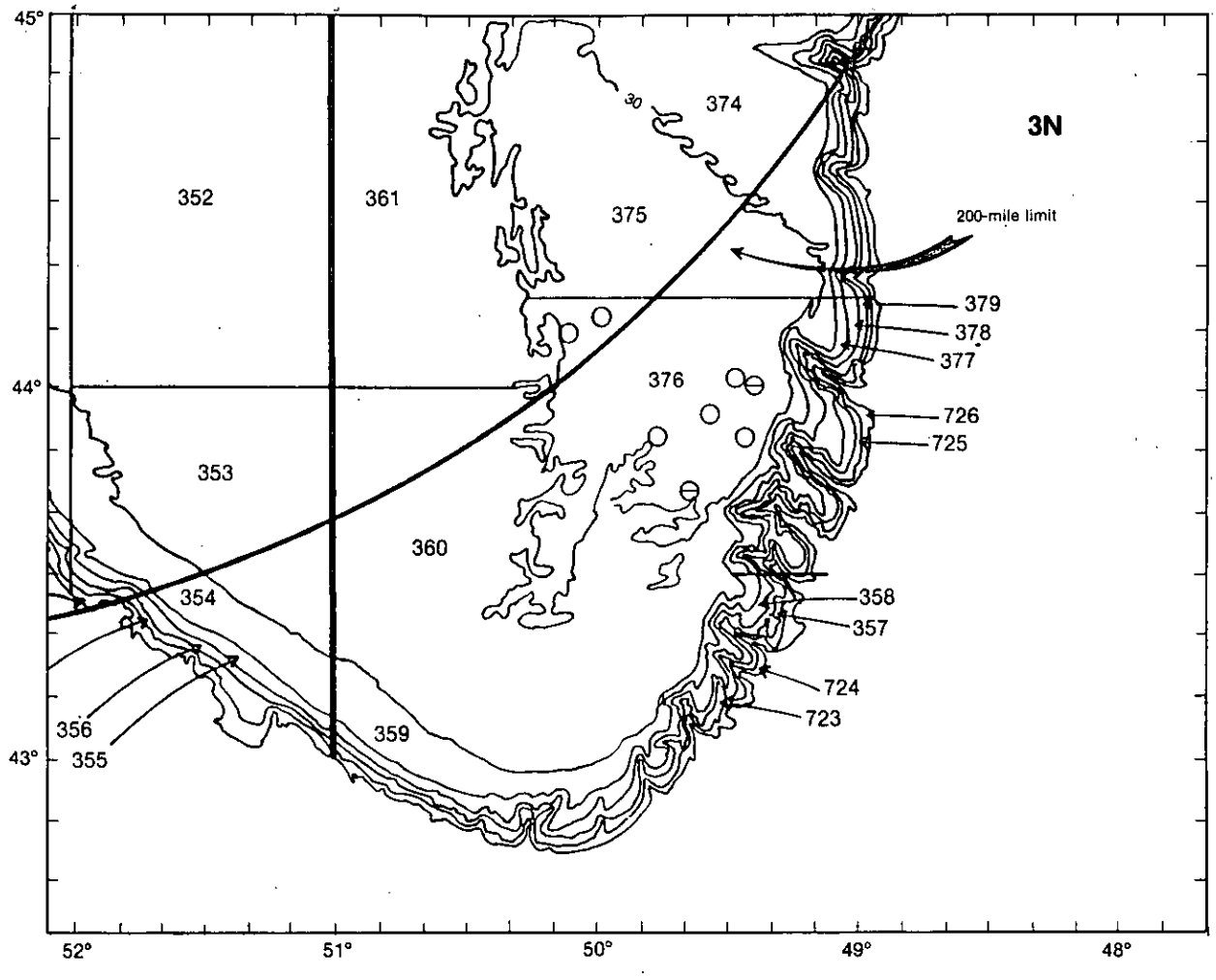


Fig. 17. Yellowtail flounder in Div. 3LNO: strata in the Regulatory Area.

The estimate of age 7+ abundance in 1988 is about 62% of the average from 1985-87, and is higher than only the value calculated for 1974.

To estimate the effects of diel variability on survey results for yellowtail flounder, a preliminary analysis with a multiplicative model was conducted, using year, stratum, and day/night effects. Despite some difficulties interpreting residual patterns, the model indicated a significant diel effect, agreeing with previous analyses which have shown that significantly higher catches of yellowtail flounder are taken in the night. The years' trends in abundance calculated from this analysis were also in agreement with those from the model described previously. However, further analysis will be required before these results can be used as an index of abundance for this stock.

Stratified-random groundfish surveys - USSR. Results from the USSR surveys conducted in Div. 3NO are in general agreement with those from the Canadian surveys, showing a sharp decline in the biomass and abundance of yellowtail flounder from 1984-87. The 1987 value for abundance was 28% lower than 1986, and 67% lower than 1985. As was the case in the Canadian surveys, the catches comprised mainly of larger fish.

Juvenile yellowtail flounder surveys. From 1985-87, annual stratified-random surveys of NAFO Div. 3LNO have been conducted using a Yankee 41 (80/104) shrimp trawl to determine indices of abundance of yellowtail flounder, particularly those aged 1-4 years. STACFIS noted that the survey design is such that independent estimates of abundance and biomass can be derived from fishing sets conducted during the day and during the night.

Independent day and night estimates of abundance of yellowtail flounder from 1987 survey revealed that yellowtail flounder catches were nine times higher for night catches than

day catches, and that biomass estimates were four times higher at night. The 1986 survey also showed similar large differences between day and night catches. Overall abundance estimates from selected strata (352, 360, 361, 375 and 376) in 1987 increased by 27% from 1986 due to increased catches of juveniles (1-4 years), but there was an overall reduction in biomass by 33% from 1986 due to a decrease in the adult population.

Age composition of yellowtail flounder showed a 32% increase from 1986 to 1987 in catches of juveniles aged 1-4 years of age. The estimates of the 1981 and 1982 year-classes (ages 5 and 6) were very low in the 1987 survey, which agreed with the 1986 survey. Also in 1987, the estimates of the 1983-85 year-classes (2-4 years) were high compared to other year-classes in that survey, however, the shortness of the time series (3 years) makes it difficult to evaluate the strength of these year-classes relative to year-classes at the same age in previous surveys. Yellowtail flounder of the 1979 and 1980 year-classes dominated the adult population but showed a noticeable decrease from the level seen in the 1986 survey.

The largest catches of juvenile yellowtail flounder were distributed on the Tail of the Bank, predominantly in stratum 360 and to the lesser extent in stratum 376. These strata are located almost entirely in the Regulatory Area. Further survey work directed at the distribution of juvenile and adult yellowtail flounder is planned for 1988 and subsequent years.

c) Assessment results

In 1984 (NAFO Sci. Coun. Rep., 1984, page 54) STACFIS "considered that the cohort analysis was not reliable because of very high fishing mortalities (1.0 to 3.0), which were evident for ages 7-10 in many years, and the lack of correlation between calculated exploitable biomass and commercial and research vessel abundance indices". In 1985 (NAFO Sci. Coun. Rep., 1985, page 70) "STACFIS again noted the continuing pattern of very high fishing mortality values (>1.00) which were evident for age groups 7-10 for many years ...STACFIS concluded that the analysis was not reliable enough to form the basis of catch projections, but the cohort analysis was useful for indicating trends in population size".

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

d) Catch projections

STACFIS noted that the strong 1978 and 1979 year-classes have essentially passed through the population and are not expected to contribute substantially to the fishery in 1988 or thereafter. The 1980 year-class is not as large and the 1981 and 1982 year-classes, as indicated by both the Canadian spring surveys and the juvenile flatfish surveys, appear to be extremely weak. The average abundance at ages 5-7, as measured by the Canadian surveys in 1987 and 1988, is about 30% of the average abundance at these ages from 1973-86. STACFIS concluded that these low estimates in 1987 and 1988 were reasonable for the following reasons:

i) The 1981 and 1982 year-classes have not shown up as anything other than very weak in all the Canadian groundfish and juvenile surveys.

ii) There were very high catches documented in 1985 and 1986 (about 30,000 tons each year), much of which came from the Regulatory Area in Div. 3N, an area where small yellowtail flounder are found in relatively high numbers. Therefore, these year-classes have been subjected to higher than normal levels of fishing mortality, which would further reduce their numbers.

iii) The USSR surveys have shown a consistent decline in abundance as the 1978 and 1979 year-classes moved through the population, indicating continued poor recruitment.

This stock has shown clear reaction to changes in fishing pressure, having been depressed in the 1970's and recovering subsequent to 1976. The stock is now declining again, commensurate with the documented high catches by both NAFO member and non-member countries.

STACFIS reiterates its 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 catches from this stock were negligible. Given the recent trends in all the abundance indices and the population size estimated from the Canadian surveys in 1987 and 1988, STACFIS notes that the prospects for the 1989 and 1990 fisheries, which should be comprised mainly of the 1981-83 year-classes, are very poor. Considering the magnitude of the decline in the stock size and the very low levels of incoming recruitment, STACFIS advises that the total catch in 1989 should not exceed 5,000 tons.

STACFIS noted that this represents a substantial change in advice from the 1987 assessment, but pointed out that several new pieces of information were very influential in formulating this advice. Among these were age-by-age abundance estimates from Canadian spring surveys in 1987 and 1988, data on abundance and distribution of yellowtail flounder from a juvenile flatfish survey in 1987, abundance and biomass estimates from a USSR groundfish survey in 1987 and CPUE information from the Canadian offshore fleet in 1987.

STACFIS also emphasized that the advised total catch of 5,000 tons applies to the entire stock. In some recent years, documented catches inside the Canadian 200-mile limit and catches in the Regulatory Area have each approached the recommended TAC. With no control over the catch by non-member countries, this fishery will continue to be virtually impossible to manage. This is of particular concern, given the observation that a high proportion of young yellowtail flounder is found in the Regulatory Area. These younger fish are thus particularly susceptible to such uncontrolled fisheries.

13. Greenland Halibut in Subareas 0 and 1 (SCR Doc. 87/81; 88/12, 13, 14, 31, 32, 34, 41; SCS Doc. 88/13, 15, 16)

a) Introduction

Catch has been rather stable in the period 1980-87 with an average catch of 9,000 tons. Most of the catch has been taken by Greenland (90% in 1987). The Greenland fishery is carried out mainly as an inshore gillnet and long-line fishery, with 88% of total catch in 1988 taken in Div. 1A. A joint-venture offshore fishery between Greenland and Japan carried out by Japanese vessels amounted to 900 tons of total catch in 1987. Recent TACs and catches (000 tons) are as follows:

	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	25	25	25	25	25	25	25	25	25
Catch	8	10	9	9	7	10	9	9[1]	-

[1] Provisional data.

b) Input data

i) Commercial fishery data (SCR Doc. 87/81; 88/14)

Information on the commercial fishery in Div. 1D and 1A shows that only fish above 50 cm are exploited. Long-line catches generally consist of somewhat longer fish than those in gillnet catches. Data from the commercial fishery in Div. 1A and 1D show that condition factor is highest in Div. 1A.

ii) Research data (SCR Doc. 87/81; 88/12, 13, 14, 31, 32, 34, 41)

Trawl surveys. A stratified-random bottom trawl survey was carried out jointly by Japan and Greenland in Subarea 1 during July and August 1987, covering depths down to 1,000 m. On the basis of a stratification scheme, the biomass was estimated to be 58,400 tons for the offshore part of Subarea 1 south of 70°N. The abundance was highest in Div. 1BCD in depths exceeding 600 m. The committee considered the biomass estimate as conservative as it is known that a considerable amount of the stock is found in water depths exceeding 1,000 m. Biological samples from the survey indicate that females begin to mature at 60 cm and males at 40 cm.

A stratified-random bottom trawl survey was conducted by USSR in Div. 0B and Div. 1BCD in autumn of 1987, covering the depth range 300-1,250 m. The 1987 survey was carried out using the stratification charts already in use by Canada. In Div. 1BCD the biomass was estimated to be 55,644 tons, of which 37,000 tons were estimated at depths less than 1,000 m. This is of the same magnitude as what was found in the Japanese survey (58,400 tons). These estimates are considerably below the estimates given from the 1986 Canadian survey in Subareas 0+1. The biomass estimated for 1987 for Div. 0B at 36,750 tons (17% of the 1986 estimate) is the lowest for the entire survey period. In view of the limited offshore fishery for Greenland halibut in Subareas 0 and 1, its seems unlikely that the decline of the biomass estimates reflects a stock decline caused by the fishery. It is suggested that changes in hydrographic conditions may have caused changes in the distribution of Greenland halibut.

The Committee noted that the extremity of the biomass estimate might be due to the relatively low coverage of the deeper strata in comparison to previous years.

Other research results. Length-weight relationship is given on the basis of samples from inshore areas of Div. 1F in 1988, Div. 1D in 1987 and Div. 1A in 1985-87.

Recordings of maturity stages in inshore areas of Div. 1A in March 1987-88 showed a considerable part of the larger females in spent condition, while females in ripe or running condition were rarely observed. Concurrent observations of running males may indicate that some spawning takes place in nearby areas.

Research shrimp trawlings conducted since 1968, showed considerable by-catches, especially in Div. 1AB.

Relationships between the fjord stock component and the total stock complex in Subareas 0 and 1. In its request for advice this year, Denmark (on behalf of Greenland) requested that the implications on local fisheries (in Subarea 1) on the local stock components as well as on the total stock complex (Subareas 0+1) should be given. SCR Doc. 87/81 summarizes studies on Greenland halibut in Subarea 1.

It is well known that abundance of young Greenland halibut is very high on the banks north of Div. 1C, which are considered as nursery grounds.

Length distributions from West Greenland fjords, banks and from the continental slope, indicates a stepwise migration towards the fjords and down the continental slope. Tagging studies carried out in the West Greenland fjords suggest little movement of Greenland halibut. As data on maturity indicate that some proportion of the larger fish participate in spawning in the area, it is possible that the local stocks in the West Greenland fjords is partly separated from the stock complex in the Davis Strait. However, good data on maturity and spawning behaviour are scarce and, therefore, the Committee recommends *that further investigations on maturity of Greenland halibut should be carried out.*

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.

14. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 88/40, 41, 69; SCS Doc. 88/15)

a) Introduction

Greenland halibut catches in the Labrador-eastern Newfoundland area have averaged between 25,000-30,000 tons annually from 1970-76 with the 1978 catch of 39,000 tons being the highest since the beginning of the fishery in the early 1960's. Catches had been declining since 1983 reaching a low of about 16,000 tons in 1986, the lowest annual catch since the mid-1960's. The 1987 catch of nearly 28,000 tons, on the other hand, was near the upper limit of the long-term average catch. In recent years most of the catch has been taken by Canada, particularly by nearshore gillnet fishermen along the coasts of southern Labrador and eastern Newfoundland. Other countries such as Poland, USSR, German Democratic Republic and Japan also participate in this fishery on a regular basis. More recently the EEC (particularly Portugal) has become active in this fishery while fishing in the portion of Div. 3L in the Regulatory Area. Recent TACs and catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC[1]	30	30	35	55	55	55	55	75	100	100	100
Catch	39	34	33	31	26	28	25	19	16[2]	28[2]	-

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

b) Input data

i) Commercial fishery data

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

The age composition of the commercial fishery is mainly comprised of age groups 6-8 inclusive, and these age groups accounted for approximately 80% of the commercial catch during 1985-87. In 1987, 41% of the catch numbers was comprised of the 1980 year-class while the 1979 year-class accounted for 33% of the catch numbers.

Considering that the highest proportion of the commercial catch is taken by gillnet fishermen in the southern range of the stock, the exploitation of these few very young age groups will likely be maintained. Furthermore, it can be expected that this fishery, which exploits such few age-groups, will be highly sensitive to fluctuations in individual year-class strengths.

ii) Research vessel surveys

Data from groundfish surveys. Trends in biomass from post-stratified USSR surveys in Div. 2GH indicated an increasing trend from 1979 to the 1982-83 period with a systematic decreasing trend since that time. A stratified-random survey by the USSR in these divisions in 1987 gave estimates of biomass of 17,000 tons and 4,000 tons in Div. 2G and 2H respectively although there was less than 20% coverage in Div. 2H. Estimates of biomass from post-stratified Canadian surveys in Div. 2GH during 1978, 1979 and 1981 were between 76,000-122,000 tons despite the fact that much of the deep water (>500 m) was not surveyed. A stratified-random survey by Canada in 1987 provided an estimate of 39,000 tons although strata <200 m were not surveyed in Div. 2G. Nevertheless, for strata common across years, a declining trend was still observed. Estimates of biomass from stratified-random surveys by Canada in Div. 2J showed a declining trend since about 1982 with the 1987 biomass estimate of 51,000 tons being the lowest in the time series which extends back to 1977. In Div. 3K there was a clear increasing trend in biomass from 1979 to 1984. Biomass has declined since that time, however, the trend is less clear. It is interesting to note that since 1984, abundance has increased. This may be the result of recruitment to the stock, emigration of larger fish out of the survey area or some combination of the two. The 1987 biomass estimate for Div. 3K was 76,000 tons. Similar trends in biomass occurred in USSR surveys in Div. 3K, although the actual estimates differed from those of the Canadian surveys. There was no apparent trend in biomass estimates in Div. 3L with estimates of about 10,000 tons over the last three years. The overall estimate of biomass in Subarea 2 and Div. 3KL in 1987 was 176,000 tons. This is 20,000 tons less than the 1986 estimate for Div. 2J+3KL only.

Catch-at-age data from the 1987 Canadian survey in Div. 2GH indicated that the 1985 year-class may be relatively strong particularly as indicated in the Div. 2H data. This conclusion was based on the fact that age 2 comprised the mode of the age structure although it is poorly selected by the fishing gear. The dominant age class in the 1987 survey in Div. 2J, 3K and 3L on the other hand, is age 3 which represents the 1984 year-class and is more abundant than any other year-class at age 3 in the time series. These differences may be the result of age-class distribution patterns in a north to south direction.

Data from shrimp surveys. Indices of year-class strengths at age 1 from shrimp surveys in Div. 2H and 2J were calculated from 1979-87. Data from both divisions agree in predicting the 1985 year-class to be the strongest in the series. There is also good agreement between divisions on the strength of the 1984 year-class (which also appears stronger than average), the 1978 year-class (which is about average) and the 1982 and 1983 year-classes (which appear relatively weak). Division 2H data did not predict the 1979 and 1980 year-classes to be stronger than average whereas the surveys in Div. 2J did predict them to be stronger than average. It was noted that with respect to the 1979 year-class and to some degree the 1980 year-class, the predictions of the Div. 2J data were more supportive of what eventually occurred in the commercial fishery. It was further reported that the 1985 year-class at age 2 was also dominant in the 1987 survey and is in agreement with the findings of the groundfish survey in Div. 2H.

c) Estimation of parameters and assessment results

Due to the lack of suitable calibration procedures for VPA, estimation of fully-recruited fishing mortality could not be determined. Considering recent catch levels and minimum survey biomass estimates, however, STACFIS felt that overall fishing mortality is likely to be low.

d) Catch projections

STACFIS expressed concern regarding the declining trends in biomass for most divisions. However, it was difficult to evaluate the cause of the apparent declines particularly for areas where little fishing occurs. STACFIS, therefore, was not convinced that such declines were true reflections of changes in stock biomass. Considering the available data, particularly the imminent strong recruitment, STACFIS advises the TAC of 100,000 tons in effect for 1988 be continued for 1989. STACFIS reiterated that with the present fishing

pattern mainly in shallower depths (<500 m) and in the more southerly divisions (particularly in Div. 2J, 3K and 3L), a catch of 100,000 tons is unlikely to be achieved. Because 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.

15. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 88/26, 31; SCS Doc. 88/15, 16)

a) Introduction

A total catch of 64 tons has been reported to date for 1987, compared with 81 tons reported for 1987. Catches since 1978 continue to be restricted to by-catches in the Greenland halibut fishery. Recent catches and TACs (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	8	8	8	8	8	8	8	8	8	8	8
Catch	3	6	7	2	+	+	+	+	+	+	

b) Input data

i) Commercial fishery data

There has been no directed fishery for roundnose grenadier in these subareas 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

The results of a research survey to Subarea 1 by Japan and Greenland in 1987 were presented. The total estimated trawlable biomass was determined to be about 44,000 tons, only about 50% of the estimate from the 1986 Canadian survey in Subareas 0+1. The Canadian survey found only about 9% of the total estimated biomass in Subarea 0. It was noted that, whereas the Canadian survey covered depths down to 1,250 m, the 1987 survey only covered depths to 1,000 m although the biomass estimated between 1,000 and 1,250 m from the Canadian survey does not account for the magnitude of the difference between estimates.

USSR research data for Subarea 0 (SCS Doc. 88/15) indicated that, as in 1986, fish aged 7-9 predominated in the area. No aged data were available from Subarea 1, but the mean length of roundnose grenadier from both Subareas was between 50 and 55 cm.

c) Catch projections

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

16. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 88/26; SCS Doc. 88/12, 15, 16)

a) Introduction

The 1987 catch of 8,200 tons was up about 800 tons from the reported catch in 1986 but was only about 74% of the TAC. The increase was due to increased catches by Portugal which reported landings of 1,000 tons. Nominal catches remain low compared to those prior to 1979. Catches and TACs (000 tons) for the recent period are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	35	35	30	27	27	11	11	11	11	11	11
Catch	21	8	2	7	4	4	4	5	7[1]	8[1]	

[1] Provisional data.

b) Input data

i) Commercial fishery data

Catch and effort data were available from ICNAF/NAFO for the 1967-86 period. In addition, data were available for 1978-87 from the Canadian Observer Program. The two data sets were analysed separately using a multiplicative model to derive two estimates of standardized catch rate and effort. Both series indicate relative stability in catch rates in the 1980's. The series derived using ICNAF/NAFO statistics suggests two periods of stability: 1967-76 and 1979-86 with a slight decline in the period between these two.

It has been noted previously that the level of by-catch of Greenland halibut allowed in the roundnose grenadier fishery (10%) has been restrictive and catch rates in recent years may reflect this restriction rather than stock status. In 1986 and 1987 the German Democratic Republic fleet has been allowed to fish with a 30% by-catch limitation in depths >800 m. The Canadian Observer data for these two years were examined and the catch rates of the German Democratic Republic fleet compared with those of the Soviet fleet. In 1986, catch rates by the German Democratic Republic fleet were somewhat higher than that of the Soviet fleet, but in 1987 catch rates by the USSR fleet were higher than expected when compared with those of the German Democratic Republic.

ii) Research data

The results of research surveys in Subarea 2 and Div. 3K by the USSR were presented. Fish aged 2 to 18 were taken in the catches. Smaller fish were found in Div. 3K (modal ages 6-9) than in Subarea 2 (modal ages 8-10).

Length frequencies available from commercial catches by Portugal indicate smaller fish caught in Div. 3L (modal anal fin length 17 and 23-24 cm) than in Div. 3N (modal anal fin length about 21 cm).

c) Estimation of parameters

There were insufficient data available at present to carry out any analytical assessment of this stock. Examination of the relationships between standardized CPUE and standardized effort, 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 noted above, the low catches relative to the TACs in recent years may, in part, be due to the by-catch limitations on Greenland halibut (10%). Catches have increased slightly from 1984 to 1987, although it was noted that catch rates have not increased during this period but instead remained relatively stable. Preliminary comparisons of catch rates of the Soviet and German Democratic Republic fleets in 1986 and 1987 (when the German Democratic Republic fleet fished in depths >800 with the by-catch limit increased to 30%), however, did not reveal any differences in catch rates between the two fleets that would support this theory. It was noted that this changed fishery is being continued in 1988 and STACFIS recommends *that the data be examined in more detail in order to address the issue of low catch rates in relation to the by-catch limitations in the Greenland halibut fishery.*

As the data available were insufficient to determine if catch rates in recent years are a reflection of stock status or only a result of the by-catch restrictions, STACFIS has no basis to advise a change in the TAC for 1988 from the present level of 11,000 tons, but notes however, that this may be a conservative level.

In 1987, STACFIS recommended (NAFO Sci. Coun. Rep., 1987, page 72) "that those nations prosecuting this fishery examine their databases for commercial catch data and, if possible, prepare updated VPAs for this stock". It was reported that commercial frequencies have not been collected by the USSR in recent years. Commercial frequencies are available from the Canadian Observer Program and these will be ready for presentation to STACFIS in 1989. It was noted, however, that Canadian scientists do not, at present, age roundnose grenadier and therefore age structured analyses of these data will not be possible.

17. Wolffish in Subarea 1 (SCR Doc. 88/31; SCS Doc. 88/16)

a) Introduction

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

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

[1] Provisional data.

b) Input data

Estimates of biomass of the two species were available from a Japanese survey in the area, in 1987. The estimates (2,000 tons for *A. lupus* and 3,600 tons for *A. minor*), while higher than reported catches in recent years, are in the same range as earlier catches.

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 any assessment. Therefore there is no basis for a 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.

18. Capelin in Division 3L (SCR Doc. 88/09, 11, 18, 23, 24, 39)

a) Introduction

Nominal catches of capelin in this Division were less than 4,000 tons between 1970 and 1973, then increased to 58,000 tons in 1974 and declined to 12,000 tons in 1979. No offshore fishing has occurred since 1978. Provisional statistics for 1987 indicate a total catch of 19,000 tons in the inshore fishery by purse seines, traps and beach seines during June and July. In recent years, the final TAC has been based on the market demand for roe capelin. Recent TACs and catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Advised TAC	200[1]	16	16	30	-[2]	60	38	60	130	283	90
TAC	200[1]	10	16	30	30	30	26	26	55	25	45
Catch	30	12	14	24	27	25	33	25	48[3]	19[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

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 with the exception of the final year. The catch rates increased from 1981 to 1983, declined in 1984 and increased to 1986. In 1987, the catch rates of traps increased but for purse seines there was a slight decline. As previously noted (NAFO Sci. Coun. Rep., 1986, page 74) the 1985 catch-rate estimates are probably biased upward because fishing patterns were different. In 1987, the fishery was late in starting because of a labour dispute and was shorter than in other years, because of lower market demand. The late start of the 1987 fishery may have biased upward the catch rates for traps because fishermen did not experience low catches at the start of their fishing season as they had in previous years.

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

Discarding (which includes dumping of dead capelin as well as releasing fish alive) of capelin in 1987 was similar to 1986 for purse seines but was substantially higher for traps.

In 1987, 'redfeed' was the principal reason for discarding but low percentages of females and a predominance of small females were also important reasons in some areas. The reported by-catch of cod in trapnets in 1987 was 0.4% of reported logbook landings of capelin, approximately the same as the 1986 cod bycatch.

The 1983, 1984, 1982 and 1985 year-classes accounted for 73%, 18%, 5%, and 4% of the commercial catch (by numbers) in the 1987 inshore fishery.

ii) Research data

Aerial surveys of capelin in Trinity and Conception Bay have been conducted in June and July since 1982. Total surface area of schools, estimated from aerial photographs, provided an index of abundance. The 1987 survey provided frequent coverage of the survey tracks because of favourable weather. The total school surface area for 1987 was the highest in the series. The trend of abundance indices from the aerial surveys corresponded to the trend observed for inshore catch rates and projected biomass from acoustic surveys.

The USSR conducted an experimental trawl-acoustic survey and an acoustic survey for capelin in Subarea 3 during approximately the same time period in 1987. Results of the acoustic survey in Div. 3KLO during 15 May-6 June 1987 provided a biomass estimate of 2,161,000 tons. The results of this survey could not be directly compared to the 1986 survey because an estimate for Div. 3L only was not provided. In the entire survey, the 1985, 1984 and 1983 year-classes accounted for 42%, 29% and 28% of the estimates by numbers respectively.

Using the trawl-acoustic method, the capelin biomass estimated for Div. 3KLO was 2,300,000 tons compared to the estimate of 2,161,000 tons using the traditional analysis of acoustic data.

An acoustic survey was conducted by Canada in Div. 3L during 13-31 May 1988. The total biomass was estimated to be 4,551,000 tons compared to an estimate of 2,576,000 tons from a similar survey in 1987. In the 1988 survey, the 1986 year-class accounted for 78% of the estimate by number and 44% by weight. The estimate for the 1986 year-class in this survey was approximately the same as the estimate of the strong 1983 year-class from a similar survey conducted in 1985.

A survey for 0-group capelin was conducted by USSR in Div. 3KLNO during 19 November-7 December 1987. The results of this survey indicated that the 1987 year-class was stronger than both the 1984 and 1986 year-classes (an estimate of the 1985 year-class is not available) but was still weaker (37%) than the strong 1983 year-class. It was noted that the results of these surveys indicated that the 1986 year-class was about one-fifth the strength of the 1983 year-class. This is in contrast to the results from the Canadian acoustic surveys which indicate that the 1986 and 1983 year-classes were about equal in abundance as two-year-olds. Concern was expressed about the method of aggregating the 0-group estimates to provide an index of abundance. It was noted that the present method of analysis used a gross aggregation of the data and that other analytical techniques might provide more precise indices of abundance.

c) Estimation of parameters

The strength of the 1985 year-class at age 2 was estimated to have been about 20% and 24% of the strong 1983 year-class from USSR and Canadian acoustic surveys respectively. The 1986 year-class at age 2 was estimated to be about the same strength as the strong 1983 year-class, as measured during Canadian acoustic surveys. The major contributor to the mature population in Div. 3L during 1989 will be the 1985 and 1986 year-classes. While the 1985 year-class will be reduced in abundance due to natural mortality, spawning mortality and fishing mortality, the bulk of the 1986 year-class has not spawned nor has it been fished. Because this year-class is strong, the spawning biomass in 1989 is expected to increase.

Spawning mortality and weight-at-age vectors and proportions mature were the same as used in previous assessments (Table 17). No estimates of spawning mortality at age 2 are available, and for catch projections, the estimate of spawning mortality at age 2 is assumed to be the same as age 3. Estimates of year-class strength for immature and mature capelin were derived from the 1988 Canadian survey.

Table 17. Capelin in Div. 3L: parameters used in projections of stock size.

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

[1] Used to calculate mature biomass in 1989.

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 18.

Table 18. Capelin in Div. 3L. Projections of stock size for 1989.

Age (yr)	Number of fish (millions) June 1988 Mature	Immature	June 1989
2	7,400	373,000	-
3	50,100	15,600	277,500
4	9,600	1,000	20,800
5	15,200	1,000	800
6	1,500	-	1,300
	Biomass (tons) of mature fish		3,345,000

STACFIS continues to consider an exploitation rate of 10% of the mature biomass to be appropriate for capelin, and accordingly advises a TAC of 335,000 tons for Div. 3L in 1989, which corresponds to a 10% exploitation rate. The projected biomass for 1989 is approximately three times that projected for 1986 even though the estimates of abundance for the year-classes contributing most to those biomasses (the 1986 and 1983 year-classes) are approximately the same. This difference is due in part to the differences in the data available to STACFIS and used in projections during the 1985 and 1988 meetings. During the 1985 meeting, survey data were available only from 1984 surveys when the 1983 year-class was detected as one year-olds. The estimates of this year-class used in the projections were obviously too low because this year-class was later reported to be in greater abundance as two year-olds during 1985 surveys. On the other hand, during the 1988 meeting, estimates of the 1986 year-class were available from a Canadian acoustic survey completed just prior to the meeting. The acoustic and trawling gear is probably more effective in sampling two year-olds than one year-olds. Thus, the data now available to STACFIS should be more accurate. In addition, projecting ahead one year using estimates of two year-olds (as has been done during 1986-88) is likely to be more accurate than projecting ahead two years using estimates of one year-olds.

The higher projection for 1989 is also partly the result of detecting higher abundance of age 3+ fish in the 1988 survey than in surveys during the early 1980's.

The estimates of abundance of the 1985 and 1986 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 result in higher estimates of year-class abundance than the target strength values used by USSR scientists.

19. Capelin in Div. 3N and 3O (SCR Doc. 88/18, 23, 24, 39)

a) Introduction

Nominal catches in these divisions increased from about 750 tons in 1971 to 132,000 tons in 1975 and declined to 5,000 tons in 1978. During this period most of the catch was taken by USSR midwater trawlers and Norwegian purse seiners. The fishery was closed during 1979-86. The provisional catch in 1987 was 793 tons reported by Japan and 14 tons reported by USSR. Recent TACs and catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Advised TAC	200[1]	0	0	0	0	0	0	0	0	10	10
TAC	200[1]	0	0	0	0	0	0	0	0	10	15
Catch	5	0	0	0	0	0	0	+	0[3]	1[3]	

[1] TAC was for Div. 3L and 3NO combined.
[2] Management measures adopted by Fisheries Commission without STACFIS advice (NAFO Sci. Coun. Rep., 1981, page 83)
[3] Provisional data.

b) Input data

Research data

An acoustic survey by Canada in Div. 3NO during 25 June to 6 July 1987 provided a biomass estimate of 229,000 tons of which 227,000 tons were estimated to be mature capelin. This estimate represents a decline from the 1986 estimate of 495,000 tons which was the highest in the 1981-87 Canadian survey series (range of 85,000-495,000 tons). The 1983 and 1984 year-classes dominated in the 1987 survey accounting for 45% and 24% of the catch by numbers and 61% and 28% of the biomass respectively.

A USSR acoustic survey in Div. 3NO during 13-20 June 1987 resulted in a biomass estimate of 315,000 tons. The 1983 and 1984 year-classes accounted for 66% and 27% of the estimate by number and 70% and 23% of the biomass respectively.

The trawl-acoustic technique was also used to analyse the data from the traditional Div. 3NO acoustic survey. This technique resulted in a biomass estimate of 540,000 tons compared to 315,000 tons using the traditional analysis. The difference in the Div. 3NO estimates was attributed to non-optimum survey design and the patterns of capelin density distribution. It was noted that this technique is promising but experimental and until it has been proven superior, estimates using the traditional acoustic analytical techniques should be favoured.

c) Catch projections

No stock projections were made for capelin in Div. 3NO because estimates of the 1985 and 1986 year-classes were not available. During its deliberations in 1986 and 1987, 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 catches of 10,000 tons in both 1987 and 1988 would not be detrimental to the stock and such precautionary TACs would represent approximately 5% of the average biomass observed since 1981.

STACFIS considers that, similar to the Div. 3L capelin stock, an exploitation rate of 10% of the mature biomass to be appropriate for the Div. 3NO capelin stock. Since 1981, there have been a total of 11 acoustic estimates (4 USSR, 7 Canadian) of this spawning stock, with average biomass being 280,000 tons. If the 1986 year-class is strong in this stock, then the biomass in 1989 would probably be higher than average but STACFIS cannot estimate by how much. Based on these considerations, STACFIS advises that the 10% target removals be based on the average biomass indicating a catch of 28,000 tons in 1989.

20. 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 less than 100 tons in 1986. The reported catch in 1987 was 1,714 tons. Recent TACs and catches (000 tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TAC	100	120	150	150	150	150	150	150	150	150	150
Catch	94	162	70	33	13	+	1	1	+[1]	2[1]	

[1] Provisional data.

b) Catch projections

No new data were available at this meeting. STACFIS was unable to provide catch projections on squid in Subareas 3 and 4 for 1989.

21. Shrimp in Subareas 0 and 1 (SCR Doc. 88/12, 50, 52, 53, 55, 56, 58, 59, 67)

a) Fishery trends

The nominal catch of shrimp in the offshore areas of Subareas 0 and 1 increased from less than 1,000 tons before 1972 to almost 43,000 tons in 1976, decreased to 27,000 tons in 1978 and 1979, and increased to about 38,000 tons annually in 1981-84. The offshore fishery has been regulated by TAC since 1977. Preliminary statistics for 1986 and 1987 for the offshore areas

south of 71°N indicate total catches of 45,000 and 59,000 tons respectively. In addition, a new fishery north of 71°N yielded about 4,300 tons in 1985, and about 11,000 tons annually in 1986 and 1987. This northern area is presently considered to be outside the fishing areas in Subareas 0 and 1, for which TACs have been advised in the past. The West Greenland inshore fishery has been relatively stable with estimated catches of 7,000-8,000 tons annually since 1972 (except 10,000 tons in 1974). Recent TACs and catches (tons) are as follows:

	1978	1979	1980	1981	1982	1983	1984	1985	1986[1]	1987[1]
Catch Subarea 0	122	1,129	874	5,284	1,812	5,413	2,142	2,640	2,995	6,140
Subarea 1	34,347	33,458	43,278	39,516	42,515	41,354	41,241	51,396	60,134	70,871
Offshore (S of 71°N)	26,747	25,958	35,778	32,016	35,015	33,854	33,741	39,547	41,589	52,671
SA 0+1 Offshore Catch (S of 71°N)	26,869	27,087	36,652	37,300	36,827	39,267	35,883	42,187	44,584	58,811
SA 0+1 Advised Offshore TAC	40,000	29,500	29,500	29,500	29,500	29,500	29,500	36,000	36,000	36,000
SA 0+1 Effective Offshore TAC	40,000	29,500	29,500	35,000[2]	34,800[2]	34,625[2]	34,925[2]	42,120[3]	42,120[3]	40,120[3]

[1] Provisional data.
[2] Includes TAC of 5,000 in Subarea 0.
[3] Includes TAC of 6,120 in Subarea 0.

Early in the year in 1982-84, ice conditions hindered the access to the main fishing ground in Division 1A and 1B, while in 1985, 1986 and 1987 the fishing grounds in the southern part of Division 1B were open to the fishery from the beginning of the year, as was the case before 1982. The 1987 fishery in Subarea 0+1 occurred from January to October whereas the Greenland fishery in Div. 1A north of 71°N began in June and continued through December. A total of 73 vessels (>80 GRT) participated in the fishery in Subarea 0+1 in 1987 compared to 64 in 1986. Thirty-three Greenland vessels participated in the fishery north of 71°N compared to 27 in 1986.

b) Input data

i) Commercial fishery

Catch rates. Catch and effort data for the shrimp fishery in 1987 were available from Canadian observer reports and vessel logs for Subarea 0 and from French, Greenland and Norwegian logbooks for Subarea 1. The Canadian data showed an increase in catch rates for the July-September period 1986-1987 by 95% from observer reports and 30% from vessel logs. Norwegian logbook data showed a slight decrease in mean catch rate for Div. 1D from 299 kg/hr for May-July 1986 to 276 kg/hr for June-July, 1987. Logbooks from French trawlers for Subarea 1 showed an increasing trend in catch rates for the period 1979-87. Data from the logbooks of seven Greenland trawlers (630-857 GRT) showed highest catch rates in April but, similar to 1986, these rates were not followed by the typical decline throughout the year as had been observed previously.

Mean catch-rate indices for the July-September period from 1976-87 for the national fisheries in Div. 1B (standardized to 1976) and for the Canadian fishery in Div. 0A (standardized to the average of the other indices in 1980) are given below.

	Div.	76	77	78	79	80	81	82	83	84	85	86	87
Greenland	1B	1.00	0.74	0.67	0.51	0.63	0.59	0.74	0.66	0.67	0.76	0.84	1.05
Norway	1B	1.00	0.84	0.60	0.47	0.60	0.43	0.57[1]	0.56	0.61[1]	-	-	-
France[2]	1B	1.00	1.13	0.61	0.48	0.58	0.80	0.60	-	-	0.62	1.01	0.67
Canada[3]	0A	-	-	-	-	0.60	0.66	0.78	0.63	0.64	0.61	0.67	1.31

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

From 1984 to 1987, the Greenland index increased by 57% while the Canadian index remained stable from 1984-86 and then increased sharply in 1987. The French index increased in 1986 by more than 60% over the 1985 value, likely due to the use of a larger trawler, and decreased in 1987 to just over the 1985 value.

Figure 18 shows a comparison between total offshore catches in Subareas 0 and 1 (excluding catches in the northern trial fishery) and the catch rate index for the Greenland trawlers in Div. 1B. As pointed out several times before, the introduction of more efficient gears around 1980 may have resulted in an upward bias of catch rates since then, but the effects cannot be quantified. In 1985 and 1986, this bias may be even more pronounced as new, more efficient trawls were introduced, together with trawl-positioning systems which allow better checks on the performance of the gear. The unquantifiable changes which have occurred in the past number of years have made it difficult to interpret the catch rate series in terms of stock abundance. However, it appears that in 1987, the technology used, at least for Canadian and Greenland trawlers, was similar to the previous years and that the increase in catch rates possibly reflects an increase in abundance between the two years. It is also possible that the increase might reflect increased familiarization with the new technological advances mentioned above.

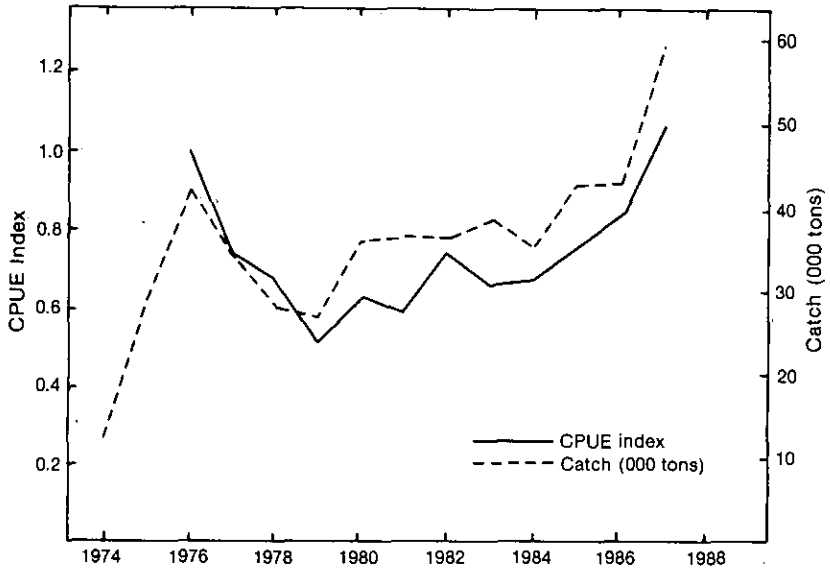


Fig. 18. Shrimp in Subarea 0 and 1: shrimp CPUE index for the July-September period of 1976-87 in Division 1B compared with total offshore catches in Subareas 0 and 1 excluding catches in the Greenland trial fishery. (Mean CPUE values are based on logbook records of seven trawlers of the Greenland Home Rule, catches from 1986 to 1987 are provisional).

In reviewing the CPUE data series, it was felt that a multiplicative model for the standardization of effort might be useful to explain some of the variability in the data.

STACFIS therefore recommends *that a study be undertaken to investiage the usefulness of a multiplicative model for the Davis Strait fishery.*

Biological data. Length frequencies for the sampled catches of Division 0A by month and depth intervals showed a prominent mode about 25 mm CL which consisted primarily of female shrimp. The largest male size group appeared at 22-23 mm with indications of other components at 20-21 mm and 18-19 mm. As in 1986, male shrimp contributed substantially to the catches but unlike 1986, several size groups of males were present.

Commercial samples from Division 1B showed a higher incidence of small males under 20 mm CL. Two components identified at 13-15 and 16-18 mm were not apparent in 1986 and might indicate a good recruitment to the fishery. Female shrimp were present at 25-27 mm.

Shrimp discards. The percentages of shrimp discards in Division 0A estimated by observers showed that levels were similar to those observed in the previous year, averaging just over 2%. Length frequencies of those samples provided evidence of selective discarding of the smaller sizes in that the smaller male size groups are more prominent.

By-catches. Observer data on catch composition of the Division 0A fishery showed that percentage by-catch by weight increased from about 11% in June to about 20% in October. Redfish was the most abundant finfish species in the catches. Catch rates from 1980 to

1987 showed a substantial increase for redfish from 1983 to the highest level observed in 1987 and a gradually increasing trend from 1985 for the Greenland halibut.

By-catch data from the logbooks of Greenland trawlers are not considered reliable but research data show that by-catch levels in Subarea 1 appear to be similar to those observed in the Canadian fishery in Div. 0A.

STACFIS noted that the data indicate a potential for substantial discarding of some finfish species and therefore recommends *that a detailed study of the by-catch in the shrimp fishery in SA 0+1 be conducted, including a complete analysis of existing data and the collection of more representative data from the commercial fleet.*

ii) Research vessel surveys

Biological data. A comparison of the growth of northern shrimp from four regions of the northwest Atlantic (St. Anthony Basin, Cartwright and Hopedale Channels and Davis Strait) using modal analysis was presented. Although four or five modes were evident in most years, severe overlap in many cases made it difficult to estimate the parameters of some components. Only the means estimated with some confidence were used in the study and the comparison of growth between areas presented was descriptive. The results indicated variation in the rates of both growth and maturity for shrimp stocks. First spawning as females occurred at age 6 (assumed) in the St. Anthony Basin and at age 7 in the areas farther north. The results showed with some extent, a trend of slower growth and increased longevity with increasing latitude.

Some experts met to analyze data from selected samples from Greenland research surveys in 1983 to 1986 for age composition. Modal analyses were performed on male length distributions by two scientists independently. Results showed that there was good agreement between the two and when differences occurred, they were related to problems in the interpretation of the tails of the distributions or where overlapping was severe. Seven components were identified within the male group with means at roughly 7, 10-12, 13-14, 15-17, 18-19.5, 20-22 and greater than 22 mm CL. The method of modal analysis is very sensitive to the number of components selected at the outset. Despite this, the good agreement achieved suggests that the method is very useful and similar results can be obtained when the method is correctly used. However, at this point, it is uncertain whether or not the modes represent year-classes. Most of the difficulties in shrimp ageing involve the interpretation of modes as year-classes. In an attempt to resolve these difficulties, it would be appropriate to investigate the parameters associated with the estimates and analyze further samples from areas where individual size-groups were prominent.

c) Prognosis

Catch rates from the Canadian fishery for the July-September period in 1987 were substantially higher than in the previous year. Norwegian and French data showed decreases between 1986 and 1987 but constituted only a small proportion of the total catch. Also, the standardized CPUE for France indicated an increasing trend from 1979-1987. The Greenland data showed an increase in catch rates for the July-September period of 25% between 1986 and 1987 and 57% from 1984 to 1987. The trend in the Greenland data was an overall increase from 1979 to 1987. It has been noted in the past that this trend may have resulted from the influence of improved trawl design since 1980.

In 1985, STACFIS recognized that, despite concerns about possible poor recruitment, catch rates in recent years had not declined (NAFO Sci. Coun. Rep., 1985, page 20). At the January 1986 Meeting, data from the commercial fishery and the photographic surveys indicated continued stability in abundance since 1982. Therefore, it was advised that the overall TAC in 1986 should not exceed 36,000 tons as advised in 1985 on the basis of average catches from 1979-84. Because similar data were not available at the January 1987 Meeting from the Greenland survey in 1986, and because it could not be established whether the increasing trend in catch rates was due to technological effects or represented a real increase in the stock, there was no basis on which to advise a change in TAC, for the offshore grounds in Subarea 1 south of 71°N and the adjacent parts of Subarea 0, from previously-advised level of 36,000 tons.

At the present meeting it was concluded that the recent increasing trend in the CPUE index for Greenland trawlers could not be interpreted in terms of changes in stock abundance. It was also recognized that, despite increasing catches in the last three years, catch rates had not declined and data on size distribution showed no changes which could be related to fishing pressure, although because the life-span of shrimp in this area might be longer than first believed, the effects of increasing catch might not yet be apparent. It was generally agreed however, that under these circumstances, some increase in TAC would be appropriate. Two approaches were discussed: (1) given that 3 or 4 years might be required before the effects of fishing on recruitment can be detected, catches for a number of years might be limited at levels observed in 1985 and 1986 (i.e. about 44,000 tons); (2) to investigate whether or not the present high catches can be maintained, the TAC could be increased to 50,000 tons, which

represents approximately the average catch for 1985-87 period which should be maintained for a number of years to detect the effects. It is noted that this second option is experimental and should higher catch levels prove deleterious to the stock, rapid reductions in catch might be required. Under either scenario, it is cautioned that unforeseen environmental effects might result in rapid stock decline which, coupled with fishing mortality, could result in a collapse of the fishery as has been observed in Alaska and the Gulf of Maine.

d) The Greenland Shrimp Fishery North of 71°N

A Greenland trial shrimp fishery was initiated north of 70°51'5"N in 1985 in an area not considered by STACFIS when advising on the shrimp fishery in Subareas 0 and 1 in previous years, and therefore not included in the quota regulation of the Greenland shrimp fishery.

Nominal catches have been 4,349 tons in 1985 and 11,045 tons in 1986. In 1987 the southern limit of the area was changed to 71°N and the area was divided in two parts: a southern area from 71°N to 72°52'5"N, for which Greenland authorities did set a TAC of 11,500 tons, and a northern area in which the fishery was still considered a trial fishery. Nominal catches in 1987 were 10,626 tons in the southern area and 74 tons in the northern area. For 1988 a TAC of 11,500 tons has been set for the southern area, and the trial fishery is continuing in the northern area.

Logbook data from the southern area showed a significant decline of mean CPUE from 1986 to 1987, especially on the two southernmost fishing grounds, indicating that the fishery in 1986 removed a surplus of shrimp, being a fishery on a virgin stock (or stock component). In 1986 there was a marked decrease in mean CPUE from south to north over the fishing grounds; in 1987 this pattern was not as evident.

Analysis of commercial shrimp samples from August 1986 has shown that the reproductive potential of females is less in the Northwest Greenland area than in the traditional fishing grounds around Store Hellefiske Bank, only 50% of females showing head roe or carrying eggs compared to more than 90% in the traditional fishing grounds. Also, frequent incidences of egg-loss have been found in the northwestern area. This may be caused by low water temperatures, and points to the possibility of the northern stock being dependent on immigration of shrimp or shrimp larvae from more southern areas. Data on current patterns and velocities during the larval period do not seem to favour major annual flows of shrimp larvae from more southern grounds to the Northwest Greenland area.

It was recognized that the data series from this new fishing area is short and that the relationships with the traditional areas around Store Hellefiske Bank and in Disko Bay are uncertain at this time. Given this situation, it is suggested that the area be treated separately from the traditional fishing grounds until the relationships are more fully understood.

Although there is no basis for advising a TAC for the north of 71°N, a cautious approach to exploitation is suggested and the fishery should be monitored closely to detect responses to increased fishing pressure. Attention is drawn to the fact that, if there is interchange between the two areas, the northern fishery would represent additional fishing pressure on the total stock.

e) The implications for the Subareas 0 and 1 shrimp stock of the maintenance of special regulatory areas off the Disko Bay

The first assessment of the Subareas 0 and 1 shrimp stock was conducted in 1976 by STACRES (ICNAF) advising a TAC for the fishery in 1977 of 40,000 tons. Because of the possible interrelationships between shrimp resources in the Disko Bay and the adjacent offshore areas, a cautious approach was advised for the area between 68°N and 69°30'N from the Greenland base line to the boundary between ICNAF Subarea 0 and 1. Accordingly the effective TAC for this area was set to 3,200 tons. In the following years, the borders of the regulatory area were changed by the authorities so that the total area decreased, but the relative size of the effective TAC set for the area has not been changed accordingly. These changes have not been biologically based, but mainly on the splitting of quotas between the different components of the fishing fleet, vessels with sea-cooking facilities being excluded from the area.

As the relationship between the shrimp stock in the Disko Bay and the offshore areas in terms of possible supply of shrimp larvae and migrations of older shrimp is not known, and as an impact of the offshore shrimp fishery on the Disko Bay stock has not been evidenced, STACFIS is not able to evaluate the significance of the maintenance of the present regulatory area off the Disko Bay.

f) Future research requirements

Some recommendations made in January 1987 will be addressed in 1988. A research trawl survey will be conducted in Davis Strait in order to estimate the biomass of shrimp and evaluate the location and importance of the nursery areas. New logbooks introduced in Greenland in 1986

should improve the effort data by having the type and size of gear recorded for each set. However, it will take a number of years to build the data base and quantify the effects of new gear technology in the fishery. The previous recommendations which were not addressed during 1987 should be reiterated. These are as follows:

i) Because there was no evident expansion of the observer programs in 1987, STACFIS recommends *that observer programs be continued and extended to cover a greater portion of the fleet with the main objectives to obtain sampling data on shrimp catches, by-catches and objective estimate of discard rates.*

ii) Since no selectivity studies were carried out during 1987, STACFIS recommends *that selectivity studies be conducted for shrimp in Davis Strait to determine optimal mesh size.*

In addition to the above recommendations:

iii) Because data are insufficient to answer questions about the existence of separate, self-sustaining stocks, STACFIS recommends *that quantitative information on both abiotic factors and stock features such as temperature, egg mortality, frequency of berried females and survival rate of embryos be obtained in order to evaluate the reproductive potential of shrimp in the different areas.*

iv) In an attempt to increase the usefulness of CPUE data, generally, STACFIS recommends *that all countries include gear type and size (number of meshes) in vessel logs as initiated for the Greenland fishery in 1986.*

22. Assessment of Shrimp Stock in Denmark Strait (SCR Doc. 88/47, 48, 50, 55, 57, 64)

a) Introduction

The shrimp fishery in Denmark Strait was begun in 1978 by an Iceland vessel on the eastern side of the midline between Greenland and Iceland. Nominal catches increased to 1,300 tons in 1979, when Norwegian trawlers participated in the fishery on the western side of the midline, and exceeded 8,200 tons in 1980 with the additional involvement of Danish, Faroese, French and Greenland vessels. Catches decreased to around 4,000-5,000 tons from 1981 to 1984 and since then have increased to above 12,000 tons in 1987. A summary of catches and TACs is given in the following table.

	1979	1980	1981	1982	1983	1984	1985	1986[1]	1987[1]
Total	1,285	8,260	4,792	4,902	4,175	6,731	8,100	11,074	11,944
Advised TAC	-	-	-	4,200	4,200	4,200	5,000	-	-
Effective TAC[2]	-	-	8,000	4,500	5,725	5,245	6,090	7,225	7,225

[1] Provisional data.
[2] On western side of midline only.

In general, the shrimp fishery in Denmark Strait takes place in the area of Strede Bank and Dohrn Bank as well as on the slopes of Storfjord Dyb; the extent of which depends upon the ice condition. Thus, the main fishing area extends from approximately 65°30'N to 67°N and between 29°W and 31°W. In 1986, there were 59 vessels actively engaged in the fishery, with occasional fishing by Icelandic vessels. In 1987, a total of 60 vessels participated in the fishery on the western side of the midline, whereas 28 Icelandic shrimpers were fishing occasionally on the eastern side.

b) Input data

i) Commercial fishery

Catch rates. Greenland data indicate general stability from year to year with catch rates declining during the early months of the season in most years. The catch rates for the French vessels were considerably higher in April and May of 1981 and especially 1984 than in the same months of 1982, 1983, 1985 and 1986. In general the catch rate increased from 1986-87, although the catch rates of Norwegian vessels for April and May, have declined steadily since 1982 and Icelandic catch rates for October and November have shown a declining trend since 1983. Ice conditions differed considerably from month to month throughout the years and thereby affected the distribution of the fishery, making the evaluation of CPUE data difficult. This difficulty was compounded by incomplete data on fishing effort for a substantial portion of the fleet. Having two series of catch rates that show a decrease, one suggesting stability and the other showing a substantial increase, and bearing in mind the difficulties with ice, gear improvements and lack of logbook information for many vessels, the Committee could not interpret the changes that have been observed in catch rates.

Biological data. Data on the biology of shrimp in Denmark Strait were available from Iceland and Norwegian trawlers in 1987. Data from Norwegian trawlers in March showed that shrimp with a modal group around 30-mm CL were dominating as in previous years. Icelandic data indicated that as in 1985 there was a great reduction in the proportion of males occurring in samples from September to December. Such changes may reflect movement of shrimp or a shift in the fishing pattern over the season. The samples showed the presence of both male and female shrimp in the catches with three components of males at 21, 25 and 28 and three components of females at 28, 31 and 33 mm.

Shrimp discards. Information from one Norwegian trawler indicated a discard rate from 1.2 to 7.2% with an average of 3.0% which is relatively higher than the 1986 value (0.9%). The discards consisted mostly of broken shrimp of sizes about 27-mm CL, indicating some selective discarding of smaller animals.

By-catches. The low levels of by-catches reported in Greenlandic vessel logbooks are not considered to be accurate estimates. Norwegian observer data from 1982 to 1987 indicate that the number of fish per kg of shrimp increased substantially in 1987 compared to previous years. Redfish was, by far, the main by-catch species.

ii) Research vessel surveys

The Norwegian research cruise to Denmark Strait in September 1987 provided additional information on the biology of this stock. The distribution of catches by sex was similar to that observed in previous years. Males were found in highest proportion in the western and northern parts of the region and in lowest numbers around Dohrn Bank. For the surveyed area as a whole, males constituted about 53% of the shrimp by number in 1987 compared to 41% in 1986 and 43% in 1985. Most of the females were ovigerous, very few had head roe, and 28% were without roe. The incidence of females without roe was highest in the north and lowest around Dohrn Bank. Shrimp sizes increased from north to south, with the smallest males being found mainly in the north and the abundance of females increasing in the south.

The largest catches during the survey were taken northeast of Dohrn Bank on both sides of the Iceland-Greenland midline. Biomass calculations, using the swept-area method, gave an estimate of 28,000 tons for the investigated area. This compares with estimates of 31,000 and 49,000 tons for 1985 and 1986 respectively. Bad weather encountered during the survey might have reduced fishing efficiency, resulting in a low biomass estimate. Also the selection of stratified-random stations in 1987 was not as successful in terms of trawlable grounds as in the previous two years resulting in a lower sample size in the western area and reducing the accuracy of the biomass estimate. STACFIS noted a general lack of detailed information associated with the biomass estimates. Also with such a short time series and doubts about the reliability of the estimates (especially 1987), their value as indicators of stock size is limited.

c) Prognosis

At the January 1986 Meeting, two different approaches were taken to the interpretation of catch rates and the continued presence of large shrimp. The inclusion of the 1986 CPUE data, together with the discussion on ice conditions, gear improvements, etc., made it impossible to draw realistic conclusions from the catch rates. Data from the Norwegian trawl surveys from 1985 to 1987 showed no change in the size compositions of catches and the relative proportions of males and females were also similar. In general, this agrees with the results from the Icelandic and French commercial vessels.

The biomass estimates of the Norwegian trawl survey which was carried out in September 1987 indicated a substantial decrease in stock size compared to that estimated in 1986. The estimate (28,000) was, however, rather similar to that of 1985.

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

d) Concerns over the management policy at East Greenland with regard to the setting of separate quotas for areas outside the main fishing area and the implications of ice coverage

It was recognized that, outside the traditional fishing area in Denmark Strait, very little is known about shrimp distribution and abundance.

Therefore, from a biological viewpoint, there are no immediate concerns over exploratory fishing for shrimp in entirely new areas except that the effects on the redfish stock should be monitored. However, because the seasonal distribution of shrimp on the traditional grounds is variable, exploratory effort should be well-separated from the known area (65°30'-67°30'N; 27°-33°W) to avoid the possibility of additional fishing pressure on the stock, especially if anomalous distribution patterns occur from time to time.

STACFIS has no response to the question regarding the possible effect on conservation of shrimp as a consequence of ice coverage over the fishing grounds.

e) Future research requirements

Data on biological characteristics of shrimp in Denmark Strait were available in reports from Iceland and Norway, but their usefulness in assessing the stock was limited by the lack of full geographical coverage on a year-round basis. STACFIS noted that Norway had again carried out a research survey in 1987 and provided a biomass estimate for the stock. However, the recommendations from the January 1987 Meeting were not dealt with and it was agreed that these be reiterated. STACFIS therefore recommends:

i) that the biological samples be obtained from all components of the fishery in Denmark Strait;

ii) that research vessel surveys in the area be continued and intensified and that for future trawl survey data analyses, details of the calculations of biomass should be included (e.g. sample size, stratification, confidence, intervals);

iii) that plankton surveys be carried out to observe the distribution of shrimp larvae;

iv) that environmental studies be undertaken in the area of Storfjord Deep.

III. RESPONSE TO FISHERIES COMMISSION REQUEST

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

Results from Canadian research-vessel surveys in Div. 3L in spring and Div. 2J, 3K and 3L in autumn during 1987 were added to previously analysed data sets. The proportion of biomass occurring in the Regulatory Area of Div. 3L relative to biomass in the whole division was 3.1% from spring surveys (1977-82, 1985-87) and 3.3% from autumn surveys (1981-87). This compares with estimates of 3.4% for both survey series as previously reported. There was no winter survey in Div. 3L during 1987 and hence the previously reported value of 25.3% is unchanged. Results of autumn surveys in Div. 2J, 3K and 3L suggest that the proportion occurring in the Regulatory Area of the entire Div. 2J+3KL cod stock biomass is unchanged from that estimated previously (0.9%).

These data support the previously reported conclusion that 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).

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The seventh meeting of the Subcommittee on Environmental Research was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, on 14 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 in 1987

A total of 17 documents referred to environmental conditions in Subareas 0-6 during 1987. A correlative study on the relationship between sea-ice distribution and concentration in the Greenland and Iceland Seas with temperatures at Fylla Bank, showed ice in December to be correlated with June temperatures indicating a 6-month travel time. Based on long-term observations of temperature and salinity data collected during November at Fylla Bank and air temperatures at Godthaab, it was found that strong year-classes of cod were often associated with warming periods. Investigations on the relationship of temperature and salinity at Station 27 off Newfoundland to large scale changes in wind and pressure field, ice cover, Hudson Bay runoff and salinity patterns from the West Greenland Shelf, indicate that almost 50% of the variation in the near-bottom temperatures were associated with the North Atlantic oscillation. A positive relationship between salinity off West Greenland and the temperature and salinity at Station 27 is believed to reflect the differential input of Arctic versus Atlantic water into the Labrador Sea.

Water temperatures on the shelf and upper slope of the Mid-Atlantic Bight followed the normal annual cycle, but bottom temperatures at mid-shelf were about 2°C cooler than normal during summer and 4°C cooler than normal during autumn.

3. Overview of Environmental Conditions in 1987 (SCR Doc. 88/60)

As a continuation of a project which began in 1983, the 1988 presentation provided an overview of (i) sea-surface temperature data from the Gulf of Maine to Labrador and southwestern Greenland, (ii) temperature and salinity stations off Newfoundland and at the entrance to the Bay of Fundy, (iii) wave heights and ice conditions in the Labrador Sea region, (iv) meteorological observations on air temperatures and sea-surface air pressure, and (v) position of the shelf-slope front, on warm-core rings and shelf-slope temperatures in the Mid-Atlantic Bight. Offshore surface temperatures from the Scotian Shelf northward were generally above normal while the southern regions were generally below normal. This is a pattern similar to that observed in the late seventies and early eighties. Annual temperatures were above normal throughout most of the Gulf of St. Lawrence and around Newfoundland. Negative anomalies were observed in southern Baffin Island and around Nova Scotia. The magnitudes were weak, seldom exceeding 1°C.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Report on the Otolith Exchanges on Silver Hake and American Place (Div. 3LNO)

a) Silver hake

An exchange of otoliths and photographs between Canada, Cuba and the USSR was not possible prior to the June 1988 Meeting of STACFIS because of difficulty in obtaining photographs. However, a sample of 100 otoliths and photographs is now available for exchange and the Committee recommends *that the exchange of silver hake otoliths and photographs between Canada, Cuba and USSR be continued in 1989.*

Examination of independent estimates of catch-at-age for 1987 by Canada (based on observer samples) and the USSR (based on USSR samples) indicated good correlation. But, given the differences in age reading experienced in the past, it could not be determined whether this agreement was only fortuitous.

b) American plaice

Report on the otolith exchange on American plaice during 1987 and 1988, 175 American plaice otoliths from the Spanish freezer trawler fishery in Div. 3N (June 1987) were examined separately by age readers from Canada, Portugal and Spain. For the Portuguese readings, 78% agreed with those of the Canadian reader. For Spain, the comparable figure was 89%.

These results show good agreement between the age readers of all 3 countries and that any corresponding age compositions calculated for the American plaice fishery in Div. 3N can be incorporated into the assessment of the American plaice stock.

The Committee recommends *that this otolith exchange be continued in order to investigate, in a coordinated manner, the difference in growth rate between American plaice of Div. 3L and 3N respectively.*

2. Status of Ageing Studies of Wolffish

No Information has been made available to STACFIS which has been unable to evaluate the studies (if any) of ageing these species.

VI. GEAR AND SELECTIVITY STUDIES

No study on gear and selectivity has been reported to STACFIS.

VII. REVIEW OF SCIENTIFIC PAPERS

1. Feeding Peculiarities of the Main Commercial Fishes (SCR Doc. 88/22)

The food composition of cod and redfish *(Sebastes mentella)* from the Flemish Cap Bank (Div. 3M), as well as cod and Greenland halibut from the northern Newfoundland Bank (Div. 3K), was studied from the material collected by the R/V Persey-III (MB-1202) in spring-summer 1987. A strong relationship between the fish size and species composition of their prey was found in the Flemish Cap Bank area. Copepods, Hyperiidae and juvenile redfish were the main food components.

2. Mean Length at Age of Atlantic Halibut (SCR Doc. 88/10)

Atlantic halibut *(Hippoglossus hippoglossus)* is found in the West Greenland area from Cape Farewell to Upernavik. The commercial long-line fishery was sampled in 1935-38 and in 1988. Age groups 4 to 28 were identified in the material from 1935-38, while only age groups 5 to 13 were found in the most recent sample. This difference can be due to various reasons, amongst which may be difficulties in reading otoliths of old fishes. Atlantic halibut in the West Greenland area generally seem to grow more slowly than Atlantic halibut of other stocks in the North Atlantic.

3. Development of Ovaries in Benthosema glaciale (SCR Doc. 88/21)

Benthosema glaciale is a most common and abundant myctophid species in the North Atlantic distributed from 35° to 72°N in the West and from 30° to 80°N in the East. Length-maturation relationships have been studied in various areas. Continuous asynchronous vitellogenesis, typical of female benthosema, is a prerequisite for serial spawning. Trophoplasmatic growth of ova lasts from October-November to January in the Northwest Atlantic. Spawning occurs from January till April in the Northwest Atlantic and till June in the Northeast Atlantic.

4. Spawning Process of the Yellowtail Flounder (SCR Doc. 88/33)

The spawning of *Limanda ferruginea* (Pleuronectidae) was analysed from 1892 mature females of 35 different samples. This species is a serial spawner with continuous maturation. The number of oocytes maturing at the same time (batch fecundity) have been estimated to be 200,000±20,000. No significant relationship between batch fecundity and size, weight (ovary freed), and number of yolked oocytes within the ovary, were found.

5. Investigations of Roughhead Grenadier (SCR Doc. 88/17)

The distribution of the roughhead grenadier catches by area, depth, in relation to water temperatures, length and sex compositions, feeding and fatness characteristics was described based on material collected during 1967-83. They were caught in all depths fished (100-1,300 m) but catches generally increased with depth. Highest catches were recorded during daylight and at temperatures of -2.0° to +3.0°C. Large grenadiers were distributed in shallower waters. The feeding spectrum is large and changes drastically with age. Intermittent spawning occurs in winter and early spring. Before maturation, liver weight increases relative to total body weight. Roughhead grenadier have a long life span and numerous age groups are present in the population. Although females are larger at age than males, there is little difference in their length-weight relationships.

VIII. OTHER MATTERS

1. Proposal for a Workshop on Age Determination of Shrimp

At its meeting of January 1987 (NAFO Sci. Coun. Rep., 1987, page 19), STACFIS concluded that some experts should meet at some time in 1987 to analyse data from the West Greenland samples and that the results of this analysis and other contributions should be presented to a working group of STACFIS during the June 1988 Meeting. During 1987-88, shrimp samples from West Greenland were analyzed for age composition but the necessary arrangements to organize a working group on age determination at the June 1988 Meeting were not carried out as proposed in January 1987.

It was subsequently proposed that shrimp experts meet during the Scientific Council Meeting in June 1988 in order to discuss the status of the methodology of age determination of shrimp and to make precise and comprehensive proposals for a possible formal workshop on age determination of shrimp including terms of reference and suggested convener (NAFO Circular Letter 88/8). At this meeting, it was concluded that a working group similar to the one proposed in January 1987 would be the most appropriate forum to discuss the advances of age determination of shrimp. Formal contributions should be solicited from members of STACFIS, participants of the 1981 workshop and others who might have relevant information to present. To provide sufficient time for the preparation of documents, it was proposed that the meeting should be held in October 1989 and the possibility of Iceland as the host country should be investigated. Three to five days would be needed for the presentation of papers and the synthesis of the discussions.

It was further agreed that Unnur Skuladottir should convene the meeting and communicate with other shrimp experts within NAFO on the details of its organization.

2. Special Session - September 1988

A progress report on contributions for the special session to be held in Dartmouth 7-9 September 1988 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 Banks Regions in the Early 1980's" was presented by J. Rice (Convener). It is noted that 19 papers have been submitted to date with an approximate equal number of papers on

pure physcial oceanography, methodological consideration and fisheries-environment relationships. The convener encourages further submissions to this special session.

3. Special Session - September 1989

STACFIS noted that it had not been possible to confirm the suitability of a potential convener. The Chairman of the Scientific Council offerred to approach two possible candidates before the September 1988 Meeting and if one of them would accept the duty, that proposals for scope and format be solicited.

4. Proposed Theme for Special Session in September 1990

Three possible themes were identified:

- Atlantic Cod: Synthesis of the Understanding on Physiology, Dynamics, Ecology and Environmental Relationships.
- Impact of Marine Mammals on Commercial Fisheries in the North Atlantic.
- Management Under Uncertainties Related to Biology and Assessments, With Case Studies on Some North Atlantic Fisheries.

Although this list is not necessarily complete and further possible topics can be added, selection will be made at the September 1988 Meeting of the Scientific Council.

5. Review of Current Arrangements for Conducting Stock Assessments

Discussions centered on the desirability of carrying schedules, so that the agenda could be completed in the hours scheduled while at the same time avoiding establishment of working groups as much as possible. STACFIS agreed that if working groups have to be established, the agenda items assigned to them should cover a range of topics so that each group is well attended. It was noted that the success of the peer-review process, which is the fundamental strength of STACFIS, is dependent upon regular and wide participation. The effectiveness is reduced when attendance is selective for topics of particular interest.

The availability right at the beginning of the STACFIS meeting of the preliminary assessment of the main, if not of all, stocks has been recognized of crucial importance for the organization and the effectiveness of the meeting. Therefore, STACFIS recommends *that every effort be attempted in order to make available at the beginning of its meeting(s) of the preliminary assessments.*

In order to achieve this goal, it is essential that all necessary data be made available to a designated expert (rapporteur) well in advance of the meeting (6-7 weeks) who will have the duty of asking for the missing information and to carry out the preliminary assessment, and submit it at the beginning of the meeting. Therefore, STACFIS recommends *that all data necessary to carry out preliminary assessments be made available to designated experts (rapporteurs) 6 to 7 weeks before its meeting(s).*

6. Impact of Changes of Survey Design on Assessment Results

No documentation was available for discussion.

7. Follow-up on the Flemish Cap Project

No activity was reported to STACFIS on this subject. This item will be retired from the STACFIS agenda.

8. Other Business

Summary sheets for assessment and advice as used by the Advisory Committee for Fisheries Management in ICES were presented at the first meeting of STACFIS and their purpose, in the ACFM framework explained. Despite the differences in organization and working procedures of ICES and of NAFO, the suggestion was made to look at the possibility of using a summary sheet for the benefit of the recipients of the advice (i.e. the fisheries managers).

In order to receive comments and advice from the Fisheries Commission, it was decided to complete summary sheets for not more than 3 stocks of the Convention Area and to submit them at the September 1988 Meeting. They are given as Annexes 2, 3 and 4 of the STACFIS Report.

9. 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 and the Shrimp Working Group. 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 14 June 1988, 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. 88/1, 5, 6, 7, 8, 36, 54, 59, 60, 61, 62, 63, 65, 66; SCS Doc. 88/6, 8 and 16.

1. Marine Environmental Data Service (MEDS) Report for 1987 (SCR Doc. 88/54)

a) Data collected in 1987

Approximately 10,300 oceanographic stations were occupied within the NAFO area during 1987, of which data for 5,190 were sent directly to MEDS and data for 6,083 were received through IGOSS (Integrated Global Ocean Services System). Some to the latter are duplicates of the data sent directly to MEDS. The total number of stations occupied and the numbers received both directly and through IGOSS increased over last year by 8, 14, and 25% respectively. Much of the data received in 1987 have not yet been fully processed due to a reduction of funds for computing, late arrival of the data and that much of it arrived in non computer-readable format.

b) Historical data holdings

A total of approximately 14,250 historical data stations were received by MEDS in 1987 representing a 10% increase over last year.

c) Drift-buoy data

A total of 28 drift-buoy tracks were received by MEDS during 1987 representing approximately 53 buoy-months of data. The latter is a 17% decrease over last year although the number of buoys was roughly the same during the two years.

d) Current-meter data

Current-meter data collected in 1987 within the NAFO area, and archived at the Bedford Institute of Oceanography, increased by 150% over last year to 207 meter-months. A table including the depth of meters and the mean current was presented.

e) Wave data

This year a new section was added to the report containing information on wave-data collections. The data are derived from Canadian and USA sources. In 1987, approximately 24,000 wave spectra were obtained of which 95% were non-directional and 5% directional.

f) Environmental conditions

A review of monthly sea-surface temperature anomalies for each of the the NAFO subareas during 1987 were presented, based on three sources: (i) data received by MEDS, (ii) monthly reports issued by the Bedford Institute of Oceanography but based primarily on tri-weekly US temperature maps, and (iii) monthly anomalies published by the US. It was noted that the BIO analysis showed slightly lower values than the MEDS analysis and the two organizations are attempting to resolve the differences.

The Subcommittee was informed that MEDS, due to changes in the operating system of the computer they use, have been forced to change their data-base management system in which the archived data are kept. This is expected to cause some delays and disruptions in data processing and retrieval over the next two years.

2. Review of Environmental Studies in 1987

a) Subareas 0 and 1 (SCR Doc. 88/36, 49, 59; SCS Doc. 88/16)

The Danish Research Report (SCS Doc. 88/16) noted that hydrographic observations were collected during 1987 along the standard sections off West Greenland. It was noted that both sea temperatures and salinities were below normal and are believed to be due to atmospheric influences. A correlative study of the relationship between sea-ice distribution and concentration in the Greenland and Iceland Seas with temperatures at Fylla Bank (SCR Doc. 88/49) showed ice in December to be correlated with June temperatures indicating a 6 month travel time. Using proxy data to estimate the ice concentrations during December of 1987, the authors predicted a temperature of 1.5-1.7°C on Fylla Bank. Information received at the

meeting suggested that the measured June temperatures were close to those predicted but slightly higher (1.9°C).

Long-term temperature and salinity data collected during November at Fylla Bank and air temperatures at Godthaab were used to investigate environmental influences on cod recruitment off West Greenland (SCR Doc. 88/36). A similar periodicity of 3-5 yr was noted in both the temperature, salinity data and the cod recruitment. The authors found that strong year-classes of cod were often associated with warming periods but not with the absolute temperature.

A paper on the West Greenland shrimp stock north of 71°N was presented (SCR Doc. 88/59). It discussed the available historic information on temperature and currents in the region that may be of importance in maintaining the stock and indicated that more detailed information was required to determine larval drift patterns.

b) Subareas 2, 3 and 4 (SCR Doc. 88/5, 61, 62, 65, 66; SCS Doc. 88/6)

The Canadian Research Report, 1987 for the Newfoundland Region (SCS Doc. 88/06) described physical oceanographic activities including the maintenance of several standard sections in the Grand Banks, northern Newfoundland and southern Labrador regions. Current-meter moorings were carried out together with CTD surveys in Baffin Bay, Labrador Shelf, northeast Newfoundland Shelf, the Grand Banks, and in the Newfoundland Basin. Brief descriptions of two studies of ice and ice drift were also provided. These and the current mooring programs were carried out by the Bedford Institute of Oceanography.

Data collected from the southeast shoal area of the Grand Banks including results from a current-meter array moored between April and October in 1986 and 1987 were presented (SCR Doc. 88/61). The data showed variability in temperature, salinity and currents on time scales from daily to interannual. Dramatic changes in temperature and salinity were observed during the passage of Tropical Storm Charlie in 1986 suggesting both vertical mixing and horizontal advection. The mean currents over the shoals were generally weak (<0.04 ms^{-1}) and did not support earlier suggestions of an anticyclonic gyre in the region. Surface temperatures over the shoal were warmer-than-normal in May and July of 1987 but colder-than-normal in June and August and September.

Two papers pertaining to Station 27 temperature and salinity data were given. The first (SCR Doc. 88/62) discussed the reduction of the large number of possible variables (temperature and salinity at a variety of depths) into fewer independent variables using two different ordination methods, factor analysis and detrended correspondence analysis. Significant differences were noted when they were applied to the Station 27 hydrographic data. The authors advised that care be taken in the interpretation of the results from such analysis, especially if only one data reduction method is used. The second paper (SCR Doc. 88/65) investigated the relationship of temperature and salinity at Station 27 to large-scale changes in wind and pressure fields, ice cover, Hudson Bay runoff and salinity patterns from the West Greenland Shelf. Almost 50% of the variation in the near-bottom temperatures were associated with the North Atlantic Oscillation, i.e. the variations in the sea-surface air pressure field dominated by the Icelandic Low and the Bermuda-Azores High. A positive relationship between salinity off West Greenland and the temperature and salinity at Station 27 is believed to reflect a differential input of Arctic versus Atlantic water into the Labrador Sea. Variations in the strength of the salinity minimum in late summer at Station 27 was found to be related to the extent of sea ice south of 55°N the previous winter. The peak in the discharge into Hudson Bay affects Station 27 salinities, not at the time of minimum salinity as had previously been suggested, but rather in the following February to March at the surface and in April to June near bottom.

Temperature anomalies on the Scotian Shelf during autumn in 1986 relative to 1962-72 means were reported to be predominantly negative in the surface layer and positive at mid-depths and near bottom (SCR Doc. 88/5). The data were collected with BTs during silver hake trawl surveys. A paper investigating the effects of Ekman offshore transport on fish recruitment on the Scotian and Labrador/northwest Newfoundland shelves was presented (SCR Doc. 88/66). No statistically significant relationships were found between simulated Ekman transport of eggs and larvae using geostrophic wind data for the years 1946-86 and subsequent recruitment in the 10 stocks investigated. Vertical migration was found to significantly reduce the changes of cross-shelf advection of larvae.

c) Subareas 5 and 6 (SCR Doc. 88/6, 7, 8; SCS Doc. 88/8)

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 17 separate occasions during 1987 (SCR Doc. 88/6). Water temperatures on the shelf and upper slope followed the normal annual cycle, but bottom temperatures at mid-shelf were about 2°C cooler than normal during summer and 4°C cooler than normal during the fall. Temperatures on the upper slope were warmer than normal, similar to 1985 and 1986. The position of the shelf-slope front in 1987 (SCR Doc. 88/8) generally followed the ten-year (1974-83) mean seasonal patterns but the

seasonal displacements were small compared to the shorter-period variations associated with the passage of warm-core rings. The average position of the front for the year was near the long-term mean but the variability in 1987 was less.

An analysis of warm-core Gulf Stream rings in the area west of 60°W (SCR Doc. 88/7) showed that 10 rings formed in 1987, the same number as last year and 1 more than the long-term mean (1974-86). Four rings formed in 1986 survived into 1987. Life spans of individual rings ranged from 10 to 247 d and were typical of the long-term records.

3. Overview of Environmental Conditions in 1987 (SCR Doc. 88/60)

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 are listed below:

a) Coastal sea temperature data at Halifax, St. Andrews and Boothbay Harbor were slightly below normal relative to their 1951-80 means.

b) Offshore surface temperature data from ships of opportunity showed positive annual anomalies over the Scotian Shelf, Gulf of St. Lawrence, and the Grand Banks while negative anomalies were observed in the Gulf of Maine and shelf waters further south. This is a reversal of the pattern from last year and similar to that observed in the late seventies and early eighties.

c) Subsurface temperatures at Station 27 off St. John's, Newfoundland (Div. 3L), were below the long-term mean for the sixth consecutive year and lower than observed last year.

d) At Prince 5 off St. Andrews, New Brunswick (Div. 4X), temperature anomalies were variable while salinity anomalies were predominantly positive but of low magnitude.

e) Significant wave heights in the Labrador Sea, on the Grand Banks and on the Scotian Shelf were slightly above normal throughout most of the year; however, the frequency of large waves was near normal in the Labrador Sea and on the Scotian Shelf but the third lowest in 18 years of data on the Grand Banks.

f) Sea ice appeared earlier and left later in the Gulf of St. Lawrence and off St. John's, Newfoundland. Longer-than-normal durations were also recorded along much of the inshore regions off northwest Newfoundland due primarily to early formation. In the offshore regions, ice duration was shorter than normal.

g) The number of icebergs crossing 48°N was 318, an increase of approximately 33% over 1986.

h) Annual air temperatures were above normal throughout most of the Gulf of St. Lawrence and around Newfoundland. Negative anomalies were observed in southern Baffin Island and around Nova Scotia. The magnitudes were weak, seldom exceeding 1°C.

i) The seasonal sea-surface pressure anomalies showed a strong low in winter and strong high in spring centered to the west of the Grand Banks. The pressure patterns in summer and autumn weakened to approximately half the strength of the winter and spring anomalies.

4. Marine Environment and Ecosystems Subcommittee of CAFSAC (SCR Doc. 88/63)

The Marine Environment and Ecosystems Subcommittee (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 held in 1987. The meeting comprised three sessions; one devoted to holistic ecosystem modelling, the second on environmental issues related to fisheries, and the third on standardization of oceanographic instrumentation on fisheries surveys carried out by the various regions within the Canadian Department of Fisheries and Oceans. A list of the papers in the second session was given and covered quantifying oceanographic conditions, quantitative methods to relate environmental variables to fish stocks, and projects in which oceanography was related to fisheries data.

5. Remote-sensing Activities

A brief report on remote-sensing activities at the Bedford Institute of Oceanography was presented. A contract has been let for processing of 4 years of data for the Northwest Atlantic continental shelf waters and will be ready by 1989. Collaborative work is also progressing on tracking of sea ice floes and ocean color remote sensing.

6. Environmentally-related Aspects of the Special Session in September 1987 and September 1988

The convener (R. Bowering) of the special session held in September 1987 on "Biology of Demersal Resources of the North Atlantic Continental Slope, with Emphasis on Greenland Halibut and Grenadiers" noted that the 3 papers on physical oceanography that were presented dealt with

processes in the upper portion of the water column (generally <500 m). He asked if the Environmental Subcommittee would request submission of the papers reviewing the physical oceanography of the waters between 500-1,500 m, which is the primary depth range of the species that were under consideration. The chairman noted that a paper on temperature and salinity measurements off West Greenland which cover this depth zone is in preparation and should be available for next year's meeting of the Environmental Subcommittee. It was also stated that current-meter measurement programs in Davis Strait and off the Labrador continental slope by scientists from the Bedford Institute of Oceanography also covered this depth range and they will be encouraged to present their findings at future NAFO meetings.

The convener (J. Rice) of the special session in September 1988 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 Banks Regions in the Early 1980's" noted that 19 papers have been submitted to date with an approximate equal number of papers on pure physical oceanography, methodological considerations and fisheries-environment relationships.

7. Revision of List of NAFO Standard Oceanographic Sections and Stations (SCR Doc. 88/1)

At last year's meeting of the Environmental Subcommittee, it was noted that the depths of the 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 always correspond with on-site measured values. The Subcommittee decided that the station positions would be maintained and the Chairman (M. Stein) agreed to update the depths with the intention of presenting a revised list of stations for review at the June 1988 Meeting. The Chairman presented a list of all stations. For those stations that were occupied between 1983 and 1987 and for which data were provided, their observed depth ranges were included. A debate ensued over whether the depth or position of the station should be fixed. The Subcommittee decided, as last year, that the position should be fixed and that the depths of the stations be revised where necessary. It was recommended *that updates on the depths for any standard stations be submitted to the NAFO Secretariat and that they will keep an updated version of the positions and depths of the standard stations.*

8. Other Matters

a) Georges Bank Experiment

A field study of the physical and biological processes in the vicinity of the tidal front on Georges Bank which is to be conducted this summer was described by K. Drinkwater. The program involves numerous scientists primarily from government laboratories in the Scotia-Fundy Region but also from Dalhousie University. The physical component of the program will investigate horizontal and vertical mixing rates, the variability of the position of the tidal front and the circulation patterns in the area through the use of current-meter moorings, ship and satellite-tracked drifters, microstructure measurements, temperature and salinity measurements, and analysis of historical data. A biological study will also be conducted to investigate the horizontal and vertical structure of zooplankton and fish larvae in order to study the role of the physical environment in determining their distribution.

b) Changes in national representatives

The Subcommittee was informed of one change in the names of national representatives who are responsible for submitting oceanographic data to MEDS. The new representative is Ch. Brockmann (Federal Republic of Germany). The other representatives are R. Keeley (Canada), R. J. Dominguez (Cuba), E. Buch (Denmark), 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).

c) R. W. Trites informed the Subcommittee that wall charts displaying the temperature and current patterns in the Northwest Atlantic and another detailing the Grand Banks have been published by the Communications Branch of the Canadian Department of Fisheries and Oceans and copies were available for those committee members who wished them.

9. Acknowledgements

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

ANNEX 2

SUMMARY SHEET - COD 3PS

Source of information: NAFO Scientific Council, June 1988

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	Max	Min	Mean
Recomm. TAC[1]	28	30	33	33	33	41[2]	[3]	[3]	[4]	41	28	33
Effect. TAC	28	39	33	33[5]	35.8[5]	44.6[5]	60.6[5]	60.6[5]	60.6[5]	60.6	28	44
Catch	38	39	34	38	37	51	57	57		57	27	40
Sp. Stock Biom.	64	68	60	60	78	96	101	101		101	32	68
Recruit. (Age 3)	118	131	133	170	206	228	212	221		78	36	58
Mean $F_{(7-11)}$	0.55	0.56	0.57	0.47	0.39	0.55	0.61	0.55		.61	.39	.53

For all footnotes see the main report (Recomm. TACs at $F_{0.1}$) Weights in 000's tons.
[6]Over 1977-87 period. Recruitment in millions.

Catches: The increased landings since 1985 are mainly associated with increased effort by the offshore fleet.

Data and assessment: Analytical assessment. Catch-at-age data by combining French and Canadian estimates from extensive sampling in both cases.

Fishing mortality: Attempted calibration of cohort analysis by catch rates (French and Canadian trawlers data combined) and surveys results (French and Canadian). Not precisely determined by the methods used.

Recruitment: Estimated from French surveys (ages 2 and 3 combined), with a significant regression, but indices for the last year-classes generally outside the range of the regression (1975-80 year-classes).

State of the stock: The stock has been at its lower level in the middle of the 70's. The sharp increase of the biomass since 1982 is attributed to successive strong year-classes, substantially greater than the long-term mean. Long-term potential mainly dependent upon the level of recruitment which has shown large fluctuations over the period considered.

Forecast for 1989: Assuming F(88) = 0.50, landings (88) = 57,000 tons.

	$F_{0.1}$	F_{max}	F_{87}
Catch (1989)	.5	35	65
SSB (1.1.1990)	156	143	116

ANNEX 3

SUMMARY SHEET - COD 3NO

Source of information: NAFO Scientific Council Reports, June 1988

Year	1981	1982	1983	1984	1985	1986	1987	1988	Max[2]	Min[2]	Mean[2]
Recomm. TAC				Same as agreed					-	-	-
Agreed TAC	26	17[3]	17[3]	26	33	33	33	40	33	15	26
Act. landings	24	32	29	27	37	51	39	-	51	15	32
Sp. stock biomass	88	113	124	135	141	157	167	157[1]	167	19	96
Recruit. (Age 3)	36	23	37	59	46	10	23	33[1]	59	10	34
Mean F (7-10)	0.23	.21	.15	.16	.22	.22	.20	-	.58	.15	.24

[1] Predicted or assumed. [2] Over 1977-87 period. Weights in '000 tons.
[3] Excludes expected catches by Spain Recruitment in millions.

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

Data and assessment: Analytical assessment of catch-at-age data using a combined Canadian otter-trawl and Spanish pair-trawl catch-rate index and a combined Canadian/USSR research-vessel abundance index. Interpretation of data difficult.

Fishing mortality: Appears to be quite stable for the past 10 years, could not be precisely determined for 1987.

Recruitment: Independent estimates of recruitment obtained from research-vessel survey results. The 1983 and 1984 year-classes appear to be very weak from this index as well as from the commercial catch in 1987.

State of Stock: The mean 3+ biomass for this stock has increased from 47,000 tons to 242,000 tons over the 1976-86 period. The estimated biomass for 1987 is about 15% lower than that of 1986.

Forecast for 1988: Assuming F(88) = 0.24, Catch(88) = 40,000 tons

Option Basis	Predicted catch (1989)	Predicted SSB (1.1.1990)
$F_{0.1}$ = 0.15	25	151
F(87) = 0.20	33	144
F_{max} = 0.25	40	138

Recommendation:

Special comments:

ANNEX 4

SUMMARY SHEET - AMERICAN PLAICE 3LNO

Source of information:

Year	1981	1982	1983	1984	1985	1986	1987	1988	Max	Min	Mean
Recomm. TAC	55	55	55	55	49	55	48	33[1]	55	33	51
Agreed TAC	55	55	55	55	49	55	48	40[2]	55	40	52
Act.landings[5]	50	51	39	39	54	61	53		61	39	50
Sp.st.biomass[3]	149	128	125	137	132	139	134		149	125	135
Recruitment (age 5)	175	216	206	170	178	217[4]	217[4]		217	170	197
Weighted Mean F (9-19)	.36	.40	.24	.29	.35	.39	.34		.40	.24	.34

[1] $F_{0.1}$ catch determined from 1987 assessment. Weights in '000 t.
[2] Interim TAC adopted for 1988.
[3] Age 9+ population biomass
[4] Geometric mean 1974-82.
[5] See footnotes in report.

Catches: Increased catches since 1983 due to increased effort in Regulatory Area. Still below historic highs in late 1960's.

Data and assessment: Analytical assessment. Catch at age incorporates Canadian and Spanish sampling. Only Div. 3LN are assessed, catch added for Div. 30 to produce TAC.

Fishing mortality: SPA calibrated using data from Canadian offshore fishery (CPUE) and Canadian r/v surveys (population at age).

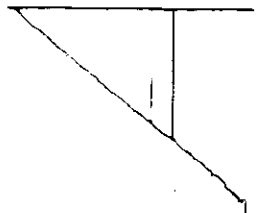
Recruitment: No relationship between SPA and r/v surveys. Recruitment relatively stable over long term.

State of stock: Currently at low level, similar to that observed in mid-1970's. Long term potential yield probably in range of 45-50,000 t.

Forecast for 1988: Assuming F (88) = .26, Catch (t) = 22,400 t.

Option	Basis	F(89)	Predicted Catch (89)	Predicted SSB (90)
A	$F_{0.1}$	.26	26,600	151.3
B	F_{87}	.60	55,200	125.1
C				
D				

Special comments: Add 5,000 t for catches in forecast table to account for Div. 30.



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

Chairman: A. Vazquez Rapporteur: W. B. Brodie

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 17 June 1988. Representatives attended from Canada, Cuba, Denmark (Greenland), EEC, Japan and USSR.

1. Adoption of Agenda

The provisional agenda was enlarged with an item to consider the request of the Fisheries Commission concerning an Annual Scientific Program in the Regulatory Area. Item 1 was also included. The adopted agenda is shown in Appendix V.

2. Fishery Statistics

a) Progress report on Secretariat activities in 1987/88

i) Acquisition of STATLANT 21A and 21B reports for recent year

STACREC was pleased to note that all STATLANT 21A forms for 1986 had been received by the Secretariat, but that 4 countries (or components) had not submitted STATLANT 21B forms. STACREC stated that the effort (hours) field on the 21B forms was of particular importance for use in stock assessments, and that every effort should be made to encourage this data to be provided whenever possible.

ii) Publication of statistical information

The Committee was informed that Statistical Bulletin Vol. 35 (321 pages) was published with a December 1987 date. As well, historical catches from 1976-86 were made available for this meeting in NAFO SCS Doc. 88/1. The 1986 Statistical Bulletin will be published when the outstanding STATLANT 21B forms have been received, with a likely date of late 1988. STACREC noted that the Secretariat had recently acquired a new computer system, which will be of great value in the long term but may cause some delays in the short term.

iii) Updating of fishery statistics database

STACREC was informed that updates to the existing database back to 1963 were ongoing and that this process would be greatly enhanced by using the new computer system.

b) Review of reporting requirements

There were no changes suggested and no discussion of the present situation.

c) 14th Session of CWP, February 1990 and inter-agency meeting before ICES Statutory Meeting in October 1988

Mr. D. Cross, Deputy Secretary of the CWP, informed STACREC that a major item on the agenda of the inter-agency meeting in October was to establish an agenda and location for the next CWP meeting scheduled for 1990. There were also a number of other items on the agenda of interest to STACREC and therefore the Committee recommends *that the Assistant Executive Secretary of NAFO attend the October meeting.*

A decision on attendance at the CWP meeting in 1990 was deferred until next year.

3. Biological Sampling

a) Progress report on activities in 1987/88

STACREC noted that a provisional list of biological sampling for 1986 was being prepared as NAFO SCS Doc. 88/2. As well, the list of biological sampling for 1979-84 has been compiled, and will be published as soon as a listing of data for Canada (Quebec) has been made available. STACREC observed that this additional sampling information from Canada (Quebec) would be valuable to NAFO and that every effort should be made to obtain this and any other outstanding data from the 1979-84 period.

b) Forms and deadlines for submission of data

There was no discussion on this item.

4. Biological Surveys

a) Review of survey activity in 1987

An inventory of biological surveys in 1987 was presented by the Secretariat (Table 1) and included information from 10 countries (or components).

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1987.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
			STRATIFIED-RANDOM SURVEYS		
E. Greenl.		E/DEU	9-10	Groundfish	155
0	B	SUN	10	Trawl:G.halibut, grenadier	59
1	ABCDEF	JPN	7,8	Groundfish	117
	B-F	E/DEU	10-11	Groundfish	150
	BCD	SUN	10	Trawl:G.halibut, grenadier	43
2	G	SUN	9-11	Trawl:G.halibut, grenadier	75
	H	SUN	11	Trawl:G.halibut, grenadier	18
	GH	CAN-N	8,9	Groundfish	130
	HJ	CAN-N	7	Shrimp	120
	J	CAN-N	10-11	Groundfish	91
2+3	JK	CAN-N	2	Groundfish	67
		CAN-N	11	Groundfish	109
		CAN-N	11-12	Groundfish	103
3	K	SUN	5-6	Groundfish(trawl,acoustic)	108
	L	CAN-N	5,6,7,8,10	Groundfish	415
		SUN	4-5	Groundfish(trawl,acoustic)	127
	LN	CAN-N	5	Groundfish	137
	LNO	CAN-N	11	Juvenile flatfish	60
	M	SUN	6-7	Groundfish(trawl,acoustic)	131
	N	SUN	3-4	Groundfish(trawl,acoustic)	84
	NO	CAN-N	3,4,5	Groundfish	181
	O	SUN	3-4	Groundfish(trawl,acoustic)	80
	Ps	CAN-N	2,3	Groundfish	149
		CAN-N	5	Scallop	285
		E/FRA	2-3	Groundfish	93
3+4	Pn+RST	CAN-Q	1	Groundfish	154
		CAN-Q	8	Groundfish	190
4	R,S,T	CAN-Q	9-10	Shrimp	112
	T	CAN-SF	1	Groundfish abundance	73
	V	CAN-SF	5	Shrimp	31
		CAN-SF	10	Shrimp	31
	Vs,W	CAN-SF	3-4	Groundfish	92
	VWX	CAN-SF	6-7	Groundfish	182
		CAN-SF	10	Redfish	94
		SUN	10-11	Juvenile Silver hake	109
	X	USA	4,10-11	Bottom trawl	67
4+5	X,Ze	CAN-SF	3	Groundfish inventory	70
5	YZ	USA	4,10-11	Bottom trawl	326
	Z	CAN-SF	9-10	Larval scallop	130
		USA	7-8	Scallop	315
	Ze	CAN-SF	7	Cod/haddock distribution	61
6	ABC	USA	2-4,9-10	Bottom trawl	316
		USA	7	Scallop	326
			OTHER SURVEYS		
1	A	GRL	8	Heavy metal	26
		"	8,9	Environmental research	54
	ABCD	"	6	Hydrogr.,Plankton,shrimp	171
		"	11-12	Hydrography	47
	ABCDEF	"	7,8	Areal surveys, whales	-
	B	"	10	Scallop	39
	BDE	"	10,11	Cod inshore	126
	BDF	"	6,7	Young cod	223
	D	"	1	Greenland halibut	28
		"	2	Hydrography	3
		"	3	Scallop	130
	DE	"	10	Young fish, hydrography	19
	DEF	"	3	Hydrography	24
	E	"	6	Heavy metal	21
1,2,3	EFJKL	CAN-N	9,10	Salmon tagging	-
2	GH	SUN	9	Acoustic:myctophidae	8
	J	CAN-N	7,8	Cod sampling	-
2+3	J+K	SUN	11	Acoustic:capelin	9
	JK	CAN-N	10	Capelin (acoustic)	-
	JKL	CAN-N	8	Oceanography	-
3	K	CAN-N	10,11	Hydrography	-
		"	10,11	Pelagic (acoustic)	-
	KL	"	5,6	Capelin (acoustic)	-
		"	6	Cod (acoustic)	-
		"	10,11,12	Pelagic (acoustic)	-
	KLNO	SUN	5-6	Acoustic:capelin	39
		"	11-12	Capelin larvae, temperature, salinity	59
	L	CAN-N	5,7,8	Crab	98
		"	5	Oceanography	-
		"	5,6	Capelin (acoustic)	-
		"	6,7	Cod tagging (acoustic)	-
		"	8,9	Fish larvae	-
		"	9	Squid	-
		"	9,10	Oceanography	-
		"	8,9,10,11	Hydrography	-
	LNO	"	4	Gear trials	158
	M	SUN	4	Eggs, larvae, temperature, salinity, zooplankton	46
	NO	CAN-N	6,7	Capelin (acoustic)	-
		"	11	Capelin	117
	OP	"	6	Squid	114
	Ps	"	7	Redfish (acoustic)	-
		"	2,3	Scallop	24
3+4	KLR	CAN-N	12	Oceanography	-
4	RS	CAN-Q	5-6	Ichthyoplankton	149
	S	"	6	Crab tagging	30
	T	CAN-SF	5-6	Juvenile gadids	183
		CAN-Q	7	Ichthyoplankton	40
		"	7	Blue mussel feeding	307
		"	7	Mackerel larvae	...
		"	7	Scallops video	13
		"	8	Scallops (survey)	100
		USA	6,7	Fish eggs,larvae,temp.	155
	T,Vn	CAN-Q	6	Mackerel larvae	132
	Vn	CAN-SF	1	Herring acoustics	13
	Vn,W	CAN-SF	5	Sealworm	26
	Vs	CAN-N	2,3	Squid	79
	VW	CAN-SF	4	Haddock tagging	-
	VWX	CAN-SF	2	Observer training	-
		"	3	Groundfish acoustics	9
		"	4-5	Gear studies	-
		"	5	Scallops	135
		"	6-7	Halibut survival	48
		"	9-10	Deep trawling	8
		"	6	Gear trials/live fish	7
		"	9	Gear studies	-
		"	10	Live fish	5
		"	9	Clam tag recovery	-
		"	4	Seal worm index survey	81
		"	4	Parasites	1
		"	6	Pollock	37
		"	6	ECOLOG test	-
		"	7	Plankton collection	5
		"	10	IOP training	-
		CAN-N	4,5,6	Hydrography	-
4+5	W,X,Ze	CAN-SF	7-8	Juvenile gadids	38
	XZ	"	8-9	Lobster	-
		"	10-11	Offshore herring	44
	XZe	"	3-4	Larval gadid	37
		"	7	Lobster larval	171
		"	10-11	Herring larvae	154
5	Y,Ze	USA	7	Fish eggs,larvae,temp.	155
	Y,Ze,Zw	"	6,7	Fish eggs,larvae,temp.	155
	Ze	CAN-SF	4	Larval fish	44
		"	8	Scallops	150
	Z	USA	2,5	Fishing power	55
		"	9,11	Fishing power	172
5+6	YZA	USA	5,6	Fish eggs,larvae,temp.	155
	YZABC	"	3,4	Fish eggs,larvae,temp.	155
		"	5,6	Fish eggs, larvae, temp., salinity, chlorophyll	134
		"	8,9	Fish eggs, larvae, temp., salinity, chlorophyll	134
		"	9,10	Fish eggs,larvae,temp.	155
	ZABC	"	1,2	Fish eggs, larvae, temp., salinity, chlorophyll	134
		"	11,12	Fish eggs, larvae, temp., salinity, chlorophyll	134
		"	4	Fish eggs,larvae,temp.	155
		"	7,8	Fish eggs,larvae,temp.	155
6	A	USA	1-12	Environmental quality (inc. hydrologic, sediment benthic and trawl catch analyses)	996

b) Survey plans for 1988 and early 1989

STACREC was presented with an inventory of surveys planned for 1988 and early 1989 (Table 2) covering 10 countries (or components). STACREC also noted that Canada (Gulf) was not to be found in this list or the one for 1987 survey activity, and that this information should be obtained. The Secretariat should contact a Scientific Council representative for Canada so that contacts can be identified to facilitate the collection of this information.

Table 2. Biological surveys planned for the NAFO Area in 1988 and early 1989.

Country	Area	Type of survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1988	
CAN-N	2GH	Groundfish	Aug 16-Sep 09
	2HJ	Shrimp	Jul 06-26
	2J+3K	Groundfish	Oct 25-Dec 03
	3L	Groundfish	Nov 09-28
	3LNO	Groundfish	Apr 05-May 25
		Juvenile flatfish	Sep 09-28
	3Ps	Scallop	Apr 28-May 10
		Scallop	Aug 04-09
CAN-Q	3Pn+4RST	Groundfish	Jan 11-29
		Groundfish	Jul 26-Aug 19
	4RST	Shrimp	Aug
CAN-SF	4VsW	Groundfish abundance	Mar 22-30
		Shrimp	May 02-13
		Shrimp	Sep 19-30
		Cod	Mar 13-23
	4VWX	Scallop	May 16-27
		Groundfish	Jul 04-28
		Redfish	Oct 03-13
	5Ze	Groundfish survey	Feb 29-Mar 14
		Scallops	Jul 26-Aug 12
	5Z	Groundfish	Feb 21-Mar 06
E/DEU	E.Greenl.	Groundfish, mainly cod	Sep 05-Oct 12
	1B-F	Groundfish, mainly cod	Oct 15-Dec 02
E/FRA	3Ps	Groundfish survey	Feb-Mar
GRL	0+1ABCD	Shrimp trawl survey	Jul-Aug
JPN	E.Greenl.	Pelagic, groundfish	Jun-Jul
	SA 1	Groundfish	Sep-Oct
E/ESP	3M	Bottom trawl	Jul 01-Aug 05
SUN	OB	Trawl: G. halibut, grenadier	Sep 16-Nov 15
	2GHJ	Trawl: G. halibut, grenadier	Sep 16-Nov 15
	3KLMNO	Trawl and acoustic:groundfish	Mar 14-Jul 03
	4VWX	Juvenile Silver hake	Oct-Nov
USA	4X	Bottom trawl	Apr 04-29
		Bottom trawl	Oct 17-Nov 11
	5YZ	Bottom trawl	Mar 21-Apr 15
		Bottom trawl	Oct 03-Nov 11
	5+6	Scallops	Jul 06-Aug 12
	6	Bottom trawl	Mar 03-Apr 01
		Bottom trawl	Sep 12-Oct 14
		OTHER SURVEYS - 1988	
CAN-N	1-3	Salmon	Sep 30-Oct 21
	2J	Cod sampling	Jul 20-Aug 16
	2J+3K	Cod (acoustic)	Jun 01-19
		Capelin (acoustic)	Oct 04-23
	2J+3KLPs	Hydrography	May 02-Nov 04
	2J+SA3	Oceanography	Jul 11-Aug 02
	3KL	Herring	Sep 23-Nov 25
		Herring	Oct 18-Nov 25
	3KLPs	Capelin	May 16-Jun 24
	3L	Crab	Apr 19-May 03
		Capelin tagging	May 05-23
		Oceanography	Apr 04-15
		Capelin (acoustic)	May 13-30
		Crab	Jun 01-17
		Cod tagging	Jun 20-Jul 15
		Oceanography	Jul 29-Aug 05
		Crab	Aug 08-24
		Squid	Aug 27-Sep 02
		Cod tagging	Sep 06-20
		Oceanography	Sep 23-29
		Crab	Oct 03-14
		Gear trials	Oct 24-Nov 07
	3LPs	Herring	Jan 09-Feb 24
		Herring	Jan 09-Feb 24
	3NO	Capelin (acoustic)	Jun 21-Jul 04
	3OP	Squid	May 25-Jun 08
	3P	Redfish (acoustic)	Jul 28-Aug 14
	3Ps	Cod tagging	Aug 22-Sep 20
	4R	Crab	Apr 18-29
	4VW	Squid	Feb 22-Mar 14
CAN-Q	4R	Herring hydroacoustics	Oct,Jul
	4RS	Shrimp larvae and ichthyoplankton	May 16-26
	4S	Crab tagging	May 29-Jun 16
		Crab behaviour (photography)	Sep 03-15
		Shrimp hydroacoustic	Sep
		Protogongaulax t.	Aug
	4T	Mackerel larvae	Jun 18-Jul 07
		Mackerel mortality	Aug-Sep
		Gear trial (video,acoustic)	May
CAN-SF	4V	Herring acoustics	Jan 07-27
	4Vn	Herring acoustics	Jan 1989
	4VW	Haddock tagging	May 03-13
	4VWX	IOP training	Feb 01-12
		Gear trials	Feb 10
		Mesopelagic fauna slope Coastal	Feb 15-26
		Square/diamond mesh	Apr 18-29
		Square/diamond	May 25-Jun 03
		Mesopelagic	Jun 06-17
		Square/diamond	Aug 16-26
		Mesopelagic	Oct 17-28
		Mesopelagic	Nov 28-Dec 09
		IOP training	Feb 02-08
	4W	Live fish	Jun 21-30
	4WX	Acoustics	Mar 21-31
	4X	Acoustic trawl groundfish	Mar 14-24
		Plankton collection	Apr 06-08
	4VWX+5Z	Pollock	May 30-Jun 10
	4X+5Ze	Live fish	Apr 05-15
		Larval herring	Oct 24-Nov 10
	5Ze	Juvenile gadids	Jun 13-30
		Lobster trawling	Jul 11-22
		Lobster/trawl	Sep 06-16
		Herring	Oct 26-Nov 09
	5Z	Ichthyoplankton	Jul 04-22
		Ichthyoplankton	Aug 22-Sep 02
		Plankton	Oct 02-09
		Plankton	Oct 11-24
GRL	E.Greenl.	Whales aerial surveys	Jul-Aug
		Capelin acoustic	Sep
	1A	Greenland halibut	Aug
		Heavy metal	Aug-Sep
	1ABCD	Young shrimp survey	Sep
	1ABCDEF	Hydrografi, plankton	Jun-Jul
		Hydrography	Oct-Nov
		Whales aerial surveys	Jul-Aug
	1BCD	Scallop	Sep
	1BD	Scallop	May-Jun
	1BDF	Young cod	Jun-Jul
	1CDE	Whale photo I.D. survey	Jul-Aug
	1CDEF	Cod survey	Oct-Nov
	1D	Hydrography	Jan
		Hydrography	Jun
		Hydrography	Oct
		Hydrography	Dec
	1DEF	Young fish survey	Aug-Sep
	1E	Heavy metal	Jun
	1F	Greenland halibut	Jan-Feb
		Heavy metal	Jul-Aug
SUN	2+3K	Acoustic:myctophidae	Sep 06-15
	2J+3K	Acoustic:capelin	Oct 28-Nov 15
	3K	Trawl:grenadier	Aug 28-Sep 06
	3LNO	Acoustic:capelin	May 24-Jun 05
		Capelin larvae, temperature	Nov 20-Dec 10
	3M	Eggs, larvae, temperature, salinity	Apr 13-22
	4VWX	Adult Silver hake, hydrography, plankton	Jun-Aug
USA	5Z	Fishing power	Sep-Oct
	5+6ABC	Fish eggs, larvae, temperature	Mar-Apr
		Fish eggs, larvae, temperature	Sep-Oct
	6A	Environmental quality	Jan-Dec
		SURVEYS PLANNED FOR EARLY 1989	
CAN-N	2J+3K	Groundfish	Feb
	3LNO	Redfish	Jan
	3Ps	Groundfish	Feb
E/ESP	3M	Bottom trawl	Jul-Aug

c) Review of stratification schemes

STACREC noted that no information was available on this item including further review of the stratification schemes which had been proposed for Div. 2G and 2H in 1987 (SCR Doc. 87/23). This information should be presented to STACREC when ready.

d) Coordination of surveys in 1988 and 1989 (if required)

There were no proposals to discuss under this item.

e) Survey design procedures (Working Group Report)

The recent activities of this working group was tabled by the convener, along with the recommendations made to the group by STACREC at the September 1987 Meeting. The main task remaining for the group, a review of the comparability of USSR surveys from 1967 onwards, will be started by the convener and presented to the working group for review at this September 1988 Annual Meeting, if possible.

5. Request of the Fisheries Commission Concerning an Annual Scientific Program in the Regulatory Area

a) Review of the scientific knowledge on the status of the fish stocks

STACREC noted that the Regulatory Area extends over NAFO Statistical Divisions 3LMNO and compiled a list of fish stocks involved. Among these stocks, those in Division 3M are entirely in the Regulatory Area while others are only partially in this area. Although it was agreed that the STACFIS report from this meeting would be valuable in addressing this issue in general, STACREC felt that the current status of information on stocks in the Regulatory Area was well known. This information is summarized in Table 3.

Table 3. Summary of scientific information on stocks occurring in the Regulatory Area.

	Statistical Information on		Directed Fishing Effort	Biological Sampling of:		R/V abundance surveys for:		Biological Studies	
	Nominal Catch	Discarded Catch		Catches	Discards	Stock	Recruits	Stock ID	Other
Cod 3L (2J+3KL)									
Cod 3M								NA	
Cod 3NO									
Redfish 3M									
Redfish 3LN									
Redfish 3O									
A. plaice 3M								NA	
A. plaice 3LNO									
Yellowtail 3LNO									
Witch 3L (2J+3KL)		NA	NA		NA				
Witch 3NO		NA			NA				
*G. halibut 3L (2+3KL)		NA			NA				
R. Gren. 2+3									
Capelin 3LNO									
Squid 3+4									

NA — Not applicable

No data

Deficiencies in data

Data satisfactory

* No relevant catches in the Regulatory Area.

b) Available scientific information

i) Data available and shortcomings

STACREC analysed the level of scientific information and examined the statistical

databases for stocks in the Regulatory Area. SCR Doc. 88/19 contains both the summarized information on sampling provided by the Secretariat as well as a stock-by-stock description, each on a country-by-country basis, of the available information, including a summary of the deficiencies in the databases.

STACREC noted that an important issue with regards to data deficiencies was the lack of information from some non-member countries fishing in the Regulatory Area. It was pointed out that the main problems which persist in the statistical information are inadequate reporting of discards and submission of incomplete statistical reporting forms. However, STACREC also noted that this was a general problem for many stocks in the NAFO area.

ii) Collecting method used

STACREC noted that there are essentially 3 methods which could be employed to collect new data: research vessel surveys, sampling of catches at sea on board commercial vessels and sampling of landings. A summary of the level of these sampling methods can be seen in Table 3 of SCS Doc. 88/19. It was felt that the present sampling of some fisheries in the Regulatory Area, although very important, does not cover all the fishing season. With some co-operation between sampling-at-sea programs of different countries, it may be possible to obtain more complete coverage of fisheries in some areas and/or seasons. Further information may also be available from examination or reanalysis of logbook data.

Information on Canadian commercial sampling and research vessel survey activity in Div. 3LNO was reviewed by the committee. It was noted that only Canada and the USSR had conducted surveys extending in to the Regulatory Area in recent years.

iii) Review of means available for collecting data

STACREC noted that the methods for collecting data which were described previously are essentially those which are most adequate for assessment purposes. It was felt that additional efforts must be directed towards improving sampling coverage and intensity, towards resolving deficiencies in the data bases, and towards improving our overall knowledge of the stocks listed in Table 1 of SCS Doc. 88/19.

c) Requirements for additional scientific information

STACREC noted that there are many relevant matters for those stocks in the Regulatory Area which could be proposed as specific scientific objectives, such as the Flemish Cap Project. Nevertheless, it was agreed that such studies, other than those presently in progress, refer to species without present commercial interest.

All relevant data for stock assessments are currently provided by existing programs of sampling and research vessel surveys. However, STACREC noted that all such programs were not complete. Steps should be taken to improve these programs so that existing deficiencies in the databases (Table 3) can be resolved.

d) Recommendations for the first Annual Scientific Program 1989

The most valuable scientific information that could be collected at this moment is that oriented toward covering deficiencies already pointed out. This implies improving the accuracy of statistical data reporting, collecting more information on discards and extending sampling coverage.

STACREC noted that research vessel surveys are an additional source of valuable information for many stocks, providing most of the biological data available for these stocks. STACREC therefore recommends *that existing surveys be continued, and that any new research efforts be addressed towards completing scientific objectives currently in place.*

6. Other Matters

a) Review of Scientific Observer Program

STACREC noted that the number of observer days in the Regulatory Area declined steadily from 145 in 1983 to 25 in 1987. Based on the assumption that the Fisheries Commission's request for an Annual Scientific Program in the Regulatory Area implies coordination of sampling at sea, STACREC felt that the NAFO Scientific Observer Scheme may become superfluous. STACREC therefore recommends *that the usefullness of the NAFO Scientific Observer Scheme be reevaluated.*

b) List of fishing vessels for 1986 (progress work)

NAFO SCS Doc. 88/11 pointed out that the outstanding data from two countries (GDR and Portugal) were forwarded to the Secretariat during the June 1988 Meeting. The Secretariat can now proceed with the final listing of fishing vessels for 1986. STACREC noted that this delay was due to a communications problem between the Secretariat, Portugal and the EEC. Future requests for information of this type should be directed to the EEC rather than to individual member countries of the EEC. Efforts should be made to provide these data on or before the deadline dates.

c) Tagging activities for 1987

A review of tagging information was presented in SCS Doc. 88/7. It was noted that data for Denmark (Greenland) will be submitted after this meeting[1], and that any other outstanding information should be made available to the Secretariat. STACREC also pointed out that it would be useful for the Secretariat to obtain information on salmon tagging reported to ICES to complete the NAFO information on this subject.

d) Review of relevant SCR and SCS documents (not considered in items 2 to 5 above)

NAFO SCS Doc. 88/1, which contained nominal catches of selected species for 1976-86, was considered valuable by STACREC, and the annual production of similar documents was encouraged.

NAFO SCR Doc. 88/15 presented a technique using spline methodology for analysis of USSR research vessel surveys on Flemish Cap. This approach is currently used for shrimp surveys in the Barents Sea. STACREC noted that the method of spline approximation would be more useful if a separate survey was conducted with this technique in mind, but that the only available data for analysis were results from previous stratified-random surveys.

e) Other business

The Secretariat pointed out that a fishery now exists for Stimpson's surf clam (Spisula polynyma) in Div. 4VWX and that this species requires a code for the NAFO statistical database. STACREC recommends *that this be done and that FAO be notified so appropriate changes can be made to statistical forms.*

There being no other business, the Chairman thanked the rapporteur and the participants and extended special thanks to the NAFO Secretariat for their assistance in the preparation of information for this meeting. The meeting was then adjourned.

---

[1] These data were submitted to the Secretariat on 22 June 1988.

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

Chairman: Sv. Aa. Horsted Rapporteur: R. G. Halliday

The Committee met at NAFO Headquarters in the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 13 and 21 June 1988. In attendence were Sv. Aa. Horsted (Chairman), W. R. Bowering and R. G. Halliday (Canada), S. Kawahara (Japan), J. Messtorff (EEC), and V. A. Rikhter (USSR), as STACPUB members. The Assistant Executive Secretary (T. Amaratunga) also attended and the Executive Secretary (J. C. E. Cardoso) attended on the morning of 13 June and on 21 June. G. P. Ennis and M. D. Grosslein attended on 13 June in their capacity as Associate Editors.

1. Review of STACPUB Membership

W. R. Bowering was welcomed to the Committee replacing M. G. Larraneta who had resigned.

2. Review of Scientific Publications Since June 1987

a) Journal of Northwest Atlantic Fishery Science

Volume 7(2) containing 9 papers and 3 notices (85 pages), was published in early 1988 with a publication date of December, 1987. Three papers have been processed for publication in Vol. 8. Two more papers requiring technical editing were returned to the NAFO Secretariat by the Associate Editors. Indications are that Volume 8 will be ready for publication in late summer or autumn 1988.

b) NAFO Scientific Council Studies

Number 12 containing 8 papers and 3 notices (92 pages) was published in March 1988. Two papers are currently under review for Studies No. 13.

c) NAFO Statistical Bulletin

Volume 35 for 1985 (321 pages) was published in December 1987.

d) NAFO Scientific Council Reports

The volume (138 pages) containing reports of 1987 meetings of the Scientific Council in January, June and September, was distributed in December 1987.

e) List of Fishing Vessels

Late submission of data for 2 countries has delayed publication of the 1986 list of fishing vessels. (see also Item 6(b) of STACREC report, Appendix II.)

f) Index and List of Titles

The provisional index and lists of titles of 98 research documents (SCR Doc. series) and 27 summary documents (SCS Doc. series), which were presented at the Scientific Council Meetings during 1987 were compiled and presented in SCS Doc. 88/9 (24 pages).

3. Editorial Matters Regarding Scientific Publications

a) Editorial Board activities

Journal submissions increased again in 1987 to 26 papers, compared to 18 in 1986. Although this is encouraging, there is an insufficient number of accepted papers in hand to allow two issues to be published this year. Thus, Volume 8 will consist of a single issue published in the latter half of the year.

b) Interim and future editorial arrangements

i) Position of editor

It was confirmed by the Executive Secretary that the new Assistant Executive Secretary has among his duties responsibility as editor of the Studies series and technical editor for the Journal.

ii) Review of Editorial Board

The Committee was informed of the resignation of W. G. Doubleday as Associate Editor for Biomathematics, and of the prospective resignation of G. P. Ennis as Associate Editor

for Invertebrates contingent on decisions at this meeting on duties and functions of associate editors.

The three Associate Editors present identified a number of issues and problems associated with the functioning of the Board. In particular, typescripts received for editing were often substandard in terms of document preparation, and it seemed unlikely that these ones had received any review within the author's laboratory before submission. It was agreed that the Technical Editor will screen papers received for the Journal and return to the authors for further revision those which do not meet basic requirements. It was also agreed that, when Research Documents are identified by STACPUB for possible publication, authors are to be advised that those submitted for the Journal are expected to have been already subjected to some review within the authors' laboratory and that the typescripts are expected to meet normal journal submission standards.

The poor initial quality of a typescript is often a reason for a long "turn-around" time in processing papers but workload of Associate Editors is another primary cause. It was believed that quick publication is an important factor determining authors' choice of journal when submitting papers, and improvements in speed of publication in the NAFO Journal were required. None of the editors present felt that they could take on any additional editorial work and it was proposed that two more editors in the field of Vertebrate Fisheries Biology be appointed.

Associate Editors also expressed uncertainty about the extent of their duties, particularly now that a new Technical Editor was in place. It was agreed that the respective duties of the Technical and Associate editors would be as described in Annex I.

The Committee expressed the hope that Dr. Ennis would find it possible to continue as Associate Editor for Invertebrate Fisheries Biology and agreed to offer Dr. R. Mohn, Halifax Laboratory, Canada, and Mr. R. Bowering, Northwest Atlantic Fisheries Centre, St. John's, Canada, the positions of Associate Editor for Biomathematics and Vertebrate Fisheries Biology respectively. It was decided to defer appointment of the remaining editor for Vertebrate Fisheries Biology until the September meeting. Members were requested to bring forward names of potential candidates at that time. The desirability of finding an editor in Europe, if at all possible, was expressed.

4. Promotion and Distribution of Scientific Publications

a) Publicity and response regarding the Journal

Journal subscriptions have not increased in the last four years indicating that recent advertising efforts have not been successful. The meeting was informed that there are agencies which advise on promotion of scientific journals and the Executive Secretary was requested to investigate these and to enlist their services on behalf of the NAFO Journal if it appears to be in the best interests of the Council.

b) Invitational papers for the Journal

The past chairman had been unable to make progress on this matter. The present Chairman undertook, with the assistance of the Assistant Executive Secretary, to pursue earlier proposals.

c) Scope of the Journal

Associate Editors expressed concern that, particularly if additional editors are appointed, there may be problems maintaining consistent criteria for judging the suitability of papers. It was confirmed that, while the Journal aspires to be a primary journal in that it publishes refereed papers of high quality, it has a regional scope and should provide an outlet for material of regional interest which might not be within the scope of the major international journals, i.e. it should play a role complementary to, rather then compete with, the major international journals. It was also emphasized that the Journal was under fewer space restraints than most commercial journals and can offer to accommodate longer papers than do other publications. Thus, the length of papers need not, in itself, be a criterion for rejection.

The distinction between the Council's Studies and the Journal with regard to editorial standards was also reviewed and members attention was directed to the editorial standard for Studies established at the September 1985 Meeting (Sci. Coun. Rep., 1985, page 121). Institution of periodic meetings of the Editorial Board was suggested as one way to promote consistent standards but the Executive Secretary indicated that there was no provision for payment of editors' travelling expenses by NAFO. It was agreed that other ways of maintaining editorial consistency need to be explored.

The question was raised whether inclusion of "notes" in the Journal would encourage more numerous contributions. It was agreed that the present scope of the Journal did not exclude notes. Brief communications have tended to find their way into Studies, however, and the criteria for distinguishing between notes suitable for each series need to be developed. It was pointed out that this was another example of the continuing difficulties which had been experienced in defining the respective roles of the two series. One solution would be to combine the series into a single journal with a broadened scope. It was agreed to explore these issues in depth at a subsequent meeting.

d) Production costs and revenues for Scientific Council publications

Production costs and revenues for the various publications related to the activities of the Scientific Council were reviewed and it was noted that no significant changes had occurred from previous years.

5. Papers for Possible Publication

a) Review of proposals from 1987 meetings

Of the 26 papers nominated from 1987 meetings, 62% have been received to date. This is close to the long-term average and an improvement over the 1985 and 1986 situation, when only about 50% were received.

b) Review of contributions to 1988 meetings

Documents which were presented to this meeting, including SCR Doc. 87/98, were reviewed and the Committee requested the Assistant Executive Secretary to invite the authors of the following documents to submit these as papers for possible publication in one of the NAFO Scientific Council series: SCR Doc. 87/98 and SCR Doc. 88/15, 17, 21, 33, 36, 44, 53, 60, 65, and 66.

When the invitation to authors is made, the Assistant Executive Secretary was requested not only to convey the submission quality standards for Journal papers described under Item 3.b(ii) of this report but to indicate also that papers for Studies should be of reasonable technical quality. Most SCR Documents selected require some revisions before they can be considered ready for publication in Studies. It is not possible to publish papers unless there is a clear and unambiguous presentation of results, and this is the authors' responsibility.

6. Microfiche projects

a) Review of requests for microfiche of ICNAF documents

Ten sets of ICNAF documents have now been purchased and half the initial expenses have been recouped. There are a variety of libraries and laboratories which previously expressed an interest in purchasing sets but which have not yet done so. Scientific Council representatives are urged to encourage these agencies to proceed with a purchase.

b) Question of microfiching NAFO research documents

It was agreed in principle that to put NAFO documents on microfiche would be a worthwhile thing to do. Furthermore, with each year's delay, initial outlay required to do this is mounting as the backlog increases. STACPUB members continued to be of the view that a specific sum should not be requested in the publications budget for this item, at least until the ICNAF microfiche project breaks even. However, the Executive Secretary was requested to make whatever progress is possible with microfiching NAFO documents should opportunities present themselves within annual budgets.

7. Other Matters

The Chairman thanked the Executive Secretary, the Assistant Executive Secretary and the Associate Editors who were in attendance for their contributions to the meeting.

ANNEX I. The Respective Roles of the Technical Editor

and of Associate Editors of the NAFO Journal

The Technical Editor

The Assistant Executive Secretary will serve as Technical Editor for the Journal. Responsibilities include:

- Initial screening of typescript on receipt to ensure that the paper lies within the general scope of the Journal and that the format and presentation quality is adequate to allow efficient editorial review. Papers not meeting submission standards are to be returned to the author with suggestions for improvements which might make the paper suitable for consideration either for the Journal or another outlet.

- Distribution of papers to Associate Editors with due consideration of editor's field of expertise and editorial workload.

- Maintenance of records on the progress of editorial review and cooperation with Associate Editors to ensure its expeditious completion.

- Technical editing of papers accepted for Journal publication by Associate Editors. This includes correction of spelling or punctuation, standardization of symbols and abbreviations, cross-checking of table and figure references, checking that literature citations are properly referenced in the text, that such citations are complete and journal abbreviations are standardized, improving presentation of tables and figures, and other items of this nature. Any issues of a scientific nature which arise during technical editing are referred back to the Associate Editor responsible for that paper.

Associate Editors

Responsibilities include:

- Obtaining reviews of papers by experts on the topic dealt with in the paper. As many referees as necessary may be consulted in forming a view on the paper's merit for publication, but at least two expert views will normally be obtained.

- Advising the author(s) of changes, if any, required in the analysis to make it acceptable for the Journal or, alternatively, informing the author(s) of the paper's rejection for the Journal.

- Forwarding to the Technical Editor a typescript suitable for publication with regard to scientific content and expression, requiring only standard technical editing. Figures and tables will be evaluated for content only.

- Advising the Technical Editor of those papers rejected for the Journal which might be suitable for the Studies series.

APPENDIX IV. RULES OF PROCEDURE

Formulation of Rules Common to the Three Main Components of NAFO (SCS Doc. 88/10)

At the 1987 June Meeting, the Executive Secretary advised the Scientific Council that the General Council had initiated in 1986 discussions on new Rules of Procedure which dealt with voting by mail or telex stating that as soon as they would be approved by the General Council they should be presented to the Scientific Council for consideration. These rules were finally approved in September 1987 by the General Council but were not presented to the Scientific Council, as it had been expected.

The Executive Secretary also advised that even though the Fisheries Commission received the new rules in 1987, consideration by that body will take place at the 1988 September Meeting.

The question was reviewed along with SCS Doc. 86/28 (Serial No. N1266) which provided the current status of the Rules of Procedure for the Scientific Council.

It was agreed that Rule 2 of the Scientific Council be expanded by addition of the following amended text of the provisions concerning mail and telex voting as adopted by the General Council:

2.5 When a vote is taken by mail or by other means of teledocumentation, the Executive Secretary shall address the request for the vote from each Contracting Party to the authority representing that Contracting Party at his or her official address with copies addressed to each representative on the Scientific Council of that Contracting Party at his or her corresponding official address.

2.6 The result of a vote taken by mail or by other means of teledocumentation shall be ascertained by the Executive Secretary at the end of a period of at least thirty (30) days after the date of the initial request for the vote and such period shall be made clear in the text of that request.

2.7 a) If no reply from a Contracting Party, in the case of a vote taken by mail or by other means of teledocumentation, reaches the Secretariat within the period established under 2.6, that Contracting Party would be recorded as having abstained and it shall be considered part of the relevant quorum for voting purposes.

b) Contracting Parties shall promptly acknowledge receipt of any request for vote by mail or other means of teledocumentation. If no acknowledgement is received from any particular Contracting Party within one week of the date of transmittal, the Executive Secretary will retransmit the request, and will use all additional necessary means available to ensure that the request has been received. Confirmation by the Executive Secretary that the request has been received shall be deemed conclusive regarding the inclusion of the Contracting Party in the quorum for the purpose of the relevant vote by mail or other means of teledocumentation.

APPENDIX V. AGENDA FOR SCIENTIFIC COUNCIL MEETING - JUNE 1988

I. Opening (Chairman: J. S. Beckett)

1. Appointment of rapporteur
2. Adoption of agenda
3. Plan of work
4. Report on proxy votes (Executive Secretary)

II. Fishery Science (STACFIS Chairman: A. Maucorps)

1. General review of catches and fishing activity in 1987

2. Review of relevant recommendations from 1987 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. 3NO; Div. 3M)
- Redfish (Div. 3LN; Div. 3M)
- American plaice (Div. 3LNO; Div. 3M)
- Witch flounder (Div. 3NO)
- Yellowtail flounder (Div. 3LNO)
- Capelin (Div. 3NO)
- Squid (Subareas 3 and 4)
- [Note also Item 3 of Annex 1 concerning cod in Div. 2J+3KL and Item 4 of Annex 1 concerning American plaice in Div. 3LNO)

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

- Cod (Div. 3Ps) (also see Annexes 4 and 5)
- 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, north of 71°N)
- Northern shrimp (East Greenland)
- Other finfish and invertebrates (Subarea 1)

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 1)

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

a) Marine Environmental Data Service report for 1987
b) Review of environmental studies in 1987
c) Overview of environmental conditions in 1987
d) Update of remote-sensing activities
e) Marine Environmental Ecosystems Subcommittee of CAFSAC (report)
f) Environmentally-related aspects of Special Session in September 1988
g) Revision of List of NAFO Standard Oceanographic Sections and Stations
h) Other matters

5. Ageing techniques and validation studies

a) Reports on the otolith exchanges on Silver hake and American plaice (Div. 3LNO).
b) Status of ageing studies of wolffish

6. Gear and selectivity studies

   a) Results of selectivity experiment (if any) on shrimp in Davis Strait
   b) Trawl escapement and selectivity problems (NAFO Sci. Coun. Rep., 1986, p. 110)
   c) Other relevant studies

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

8. Other matters

   a) Proposal for a workshop on ageing shrimp (Circular Letter 88/08)
   b) Progress report on contributions for the Special Session in September 1988 (J. C. Rice, Convener)
   c) Preparation for Special Session in September 1989 on "Changes in Biomass Production and Species Composition of the Fish Populations in the Northwest Atlantic Over the Last 30 Years, and Their Possible Causes".
   d) Proposed theme for Special Session in September 1990
   e) Review of current arrangements for conducting stock assessments
   f) Impact of changes of survey design on assessment results
   g) Follow up on the Flemish Cap project
   h) Other business

III. Research Coordination (STACREC Chairman: A. Vazquez)

1. Adoption of Agenda

2. Fishery statistics

   a) Progress report on Secretariat activities in 1987/88

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

   b) Review of reporting requirements

      i) Forms and deadlines for submission of STATLANT 21A and 21B statistics

   c) Fourteenth Session of CWP, February 1990, and inter-agency meeting before ICES Statutory Meeting, October 1988.

3. Biological sampling

   a) Progress report on activities in 1987/88
   b) Forms and deadlines for submission of data

4. Biological surveys

   a) Review of survey activity in 1987
   b) Survey plans for 1988 and early 1989
   c) Review of stratification schemes
   d) Coordination of surveys in 1988 and 1989 (if required)
   e) Survey design procedures (Working Group report - W. Brodie)

5. Request of the Fisheries Commission concerning an Annual Scientific Program in the Regulatory Area.

   a) Review of the scientific knowledge on the status of the fish stocks

   b) Available scientific information

      i) Data available and shortcoming
      ii) Collecting methods used
      iii) Review of means available for collecting data

   c) Requirements for additional scientific information

   d) Recommendations for the first Annual Scientific Program (1989)

6. Other Matters

   a) Review of scientific observer program
   b) List of fishing vessels for 1986 (progress work)

c) Tagging activities reported for 1987
d) Review of relevant SCR and SCS documents (not considered in Items 1 to 3 above)
e) Other business

IV. Publications (STACPUB Chairman: Sv. Aa. Horsted)

1. Review of STACPUB Membership

2. Review of scientific publications since June 1987

3. Editorial matters regarding scientific publications

a) Editorial board activities
b) Interim and future editorial arrangements

i) position of editor
ii) review of editorial board

4. Promotion and distribution of scientific publications

a) Publicity and response regarding the journal (brochure and advertising)
b) Invitational papers for the journal
c) Scope of the journal
d) Production costs and revenues for Scientific Council publications

5. Papers for possible publication

a) Review of proposals for 1987 meetings
b) Review of contributions to 1988 meetings

6. Microfiche projects

a) Review of requests for microfiche of ICNAF documents
b) Question of microfiching NAFO research documents

7. Other matters

V. Rules of Procedure

1. Formulation of Rules common to the three main bodies of NAFO

VI. Collaboration with other Organizations

1. Reconsideration of establishment of joint ICES/NAFO working group on seals

2. Fourteenth Session of CWP, February 1990, and inter-agency meeting before ICES Statutory Meeting, October 1988

VII. Adoption of Reports

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

VIII. Arrangements for Special Sessions

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

IX. Future Scientific Council meetings, 1988 and 1989

X. Other Matters

XI. Adjournment

ANNEX 1. FISHERIES COMMISSION REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT

IN 1989 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 1988 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 1989:

Cod (Div. 3NO; Div. 3M)
Redfish (Div. 3LN; Div. 3M)
American plaice (Div. 3LNO; Div. 3M)
Witch flounder (Div. 3NO)
Yellowtail flounder (Div. 3LNO)
Capelin (Div. 3NO)
Squid (Subareas 3 and 4)

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

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As general reference points the implications of fishing at $F_{0.1}$, F_{1987} and F_{max} in 1989 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options. Opinions of the Scientific Council should be expressed in regard to stock size, spawning stock sizes, recruitment prospects, catch rates, and TACs implied by these management strategies for 1989 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 of which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence of stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds of the virgin stock.

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

e) Presentation of the result should include the following:

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

- a graph of yield and fishing mortality for at least the past 10 years.
- a graph of spawning stock biomass and recruitment levels for at least the past 10 years.
- a graph of catch options for the year 1989 over a range of fishing mortality rates (F) at least from $F_{0.1}$ to F_{max}.
- a graph showing spawning stock biomasses at 1.1.1990 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.

4. With respect to American plaice in Divisions 3LNO, the Council should provide a review of its 1987 advice on the management of this stock in 1988. In particular comment should be provided as to whether the calculations of 1988 catches at given fishing mortalities are still considered to be valid, and if not the revised projections should be included.

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1989 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1988 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1989:

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

It is also suggested that, subject to the concurrence of Denmark (Greenland), the Scientific Council, prior to the 1988 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1989 of the following stocks:

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

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

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As a general reference point, the implications of continuing to fish at $F_{0.1}$ in 1989 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 1989 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.

P. Meyboom
Deputy Minister
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 3. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT OF CERTAIN STOCKS IN 1989

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1988 Meeting to provide advice on the status of the stocks and on the biological basis for management in 1989 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 (A. minor and A. lupus), if possible)
      iv) Any other stock (of commercial interest) of invertebrates and finfish in Subarea 1 for which data allow a status report

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

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

2. In the analyses on which management advice will be based, the following should be included:

   a) For cod in Subarea 1, the current stock size and its age composition and distribution should be analyzed and form the basis for management options in which catch and catch composition (by age-groups) and the resultant stock size and spawning stock size are to be given, with the following examples of options:

      i) F = (0.1) from 1989 onward
      ii) F = F(max) from 1989 onward
      iii) F = F(1987) from 1989 onward
      iv) A steady catch level from 1989 onward with the annual catch equal to the catch for 1989 by options I, II and III, respectively.

      The above mentioned analyses should be based upon a catch in 1988 equal to the set TAC of 40,000 tons. Special attention should be paid to the sizes of the 1984 and 1985 year-classes. The size of these year-classes should be quantified, if necessary by upper and lower limits, and their expected spatial distribution in 1988, 1989 and 1990 described. Likewise, the expected length distribution of the fishable stock in 1988, 1989 and 1990 should be described, especially in relation to distribution below 40 cm, between 40 and 55 cm (total length), if possible by gear type.

   b) For redfish, the implications upon stocks of a continued catch equal to the TAC for 1988 (19,200 tons) should be analyzed. By-catches of redfish (including discards) in fisheries for species other than redfish, especially the fisheries for shrimp and cod, should be taken into account.

   c) For Greenland halibut, the analyses should incorporate description of the spatial distribution of the fisheries and the implications of local fisheries (in Subarea 1) on the local stock components as well as on the total stock complex (Subareas 0+1). (Canada may wish to give further guidelines).

   d) For northern shrimp, the implications for the stock of the maintenance of special regulatory areas off the Disko Bay should be analyzed. Furthermore, STACFIS is requested to evaluate the possible dependance of the stock component north of 71°N on recruitment from more southern areas and its implications for the total allowable catch in this area.

3. As in the past, advice on status of stock and management options for shrimp at East Greenland should also be provided in cooperation with ICES. The advice should also concern the recent Greenland management policy at East Greenland with regard to the setting of separate quotas for areas outside the main fishing area. The possible effect on conservation of shrimp as a consequence of the ice coverage of the water should be evaluated.

4. The Scientific Council should feel free to report on such other invertebrates and finfish stocks in Subarea 1 and on such other scientifically-based management options for the above mentioned Subarea 1 stocks as its feels applicable.

Greenland Home Rule Authorities
Nuuk, Greenland

ANNEX 4

DE : C.C.E. BRUXELLES - PEC48 - DG 14
A : DRT - NOVA SCOTIA
REF: 14:26 5-05-88 000155506 - 000156749

TELEX NO 96752 - XIV/A/2 L.120 8/209A

019-31475 NORTHWEST ATLANTIC FISHERIES ORGANISATION
NOVA SCOTIA, CANADA

ATTN. CAPT. J.C. ESTEVES CARDOSO, EXECUTIVE SECRETARY

SUBJECT : PROVISIONAL AGENDA OF NAFO SCIENTIFIC COUNCIL, MEETING OF 8-23 JUNE 1988
- REQUEST FOR SCIENTIFIC ADVICE ON COD DIVISION 3PS
REFERENCE : NAFO CIRCULAR LETTER 88/21 DATED 8 APRIL 1988
APPENDIX I, SECTION II, POINT 3B

THE COMMUNITY WISHES TO REFER TO THE PROVISIONAL AGENDA OF THE SCIENTIFIC COUNCIL CIRCULATED TO CONTRACTING PARTIES AS APPENDIX I TO NAFO CIRCULAR LETTER 88/21 OF 8 APRIL 1988 RECEIVED 18 APRIL AND IN PARTICULAR TO THE REQUEST FOR SCIENTIFIC ADVICE ON THE COD 3PS STOCK BY A COASTAL STATE (CANADA) INCLUDED IN ANNEX 2 TO THAT APPENDIX.

ARTICLE VII OF THE CONVENTION FORESEES THAT.

> THE SCIENTIFIC COUNCIL SHALL, AT THE REQUEST OF A COASTAL STATE, CONSIDER AND REPORT ON ANY QUESTION PERTAINING TO THE SCIENTIFIC BASIS FOR THE MANAGEMENT AND CONSERVATION OF FISHERY RESOURCES IN WATERS UNDER THE FISHERIES JURISDICTION OF THAT COASTAL STATE WITHIN THE CONVENTION AREA.

THE COMMUNITY, HOWEVER, WOULD DRAW THE ATTENTION OF CONTRACTING PARTIES TO THE FACT THAT THE COD 3PS STOCK IS A JOINT OR SHARED STOCK WHICH OCCURS IN THE WATERS OF TWO COASTAL STATES, NAMELY CANADA AND FRANCE.

SINCE THE CANADIAN AREA OF FISHERIES JURISDICTION IN WHICH THIS STOCK OCCURS HAS NOT BEEN DEFINED THE SCIENTIFIC COUNCIL CONSEQUENTLY WOULD BE UNABLE TO GIVE SCIENTIFIC ADVICE ON THE STOCK RESTRICTED TO THAT AREA AS REQUIRED BY ARTICLE VII.

THE COMMUNITY THEREFORE REQUESTS THE DELETION OF AGENDA ITEM COD 3PS FROM SECTION II POINT 3B OF THE PROVISIONAL AGENDA OF THE SCIENTIFIC COUNCIL FOR ITS MEETING OF 8-23 JUNE NEXT.

THE COMMUNITY TAKES THIS OPPORTUNITY TO REITERATE ITS VIEW THAT THE LIMITING OF A REQUEST FOR SCIENTIFIC ADVICE FROM THE SCIENTIFIC COUNCIL TO A SINGLE OPTION, F0.1, DOES NOT CONSTITUTE AN ADEQUATE SCIENTIFIC BASIS FOR THE MANAGEMENT AND CONSERVATION OF FISHERY RESOURCES.

IT IS REQUESTED THAT THIS COMMUNICATION BE TRANSMITTED TO ALL CONTRACTING PARTIES AND TO THE CHAIRMAN OF THE SCIENTIFIC COUNCIL AND STACFIS.

E. GALLAGHER
DIRECTOR GENERAL
COMEUR
NNNN

MAY - 5 1988

*
NAFO DRT

21877 COMEU B
FOR LATEST NEWS

ANNEX 5

Fisheries and Oceans / Pêches et Océans
Deputy Minister / Sous-ministre

JUN - 7 1988

J.C. Esteves Cardoso (Capt.)
Executive Secretary
Northwest Atlantic Fisheries Organization
P.O. Box 638
Dartmouth, Nova Scotia
B2Y 3Y9

Dear Sir:

Re: Provisional Agenda of NAFO Scientific Council Meeting of June 8-23, 1988 - Canada's Request for Scientific Advice on Cod Division 3Ps

I refer to NAFO Circular Letter GF/8-107 of May 6, 1988 in which the European Community requests the deletion of Agenda Item "Cod in Division 3PS" from Section II point 3(b) of the Provisional Agenda of the Scientific Council for its meeting of June 8-23, 1988.

Canada, pursuant to Article VII of the NAFO Convention, has requested advice from the Scientific Council for NAFO Division 3Ps. Under Article VII it is mandatory for the Scientific Council to provide advice in response to the request of a coastal state with respect to fishery resources in waters under the jurisdiction of that state. It is not of course open to the Scientific Council to raise questions concerning the legitimacy, or otherwise, of the extent of the jurisdiction claimed by a NAFO member. The non prejudice provision of Article I, paragraph 5 of the NAFO Convention is relevant to this point.

There is no basis in the Convention for any intervention by any NAFO member to prevent the implementation of Article VII, which creates a simple duty on the part of the Scientific Council to respond to the request of a coastal state which is a member of NAFO. As you know, there have been occasions when advice was sought under under Article VII, and because the stock in question extended to the jurisdiction of another NAFO member as well, the "second" NAFO member was asked by the "first" NAFO member to join into the request. This was done to allow the area under the "second" NAFO member's jurisdiction to be included in the Scientific Council's review so that the Scientific Council could advise on the management of the stock as a whole. This practice is not, however, required under the terms of the Convention. Further, if, for any reason, a "second" NAFO member declined such an invitation, the "first" NAFO member would remain entitled to receive the advice it requested on the resources within its own jurisdiction. Putting the point

in other terms, this is one of the benefits it pays for through its annual financial contribution to the organization.

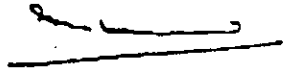
As an additional element, I would note that, as a result of a European Council Decision of 30 June 1986 on the association of the overseas countries and territories with the European Economic Community (86/283/EEC), the European Community no longer has legal status as a coastal state with respect to Division 3Ps. It would appear, therefore, that the Community, as a member of NAFO, has no legal standing on the subject different from any other NAFO member. Any NAFO member is free, of course, to point out, in response to an Article VII request, any conflicting jurisdictional claim of which it may be aware, but any such notice would not affect the responsibilities of the Scientific Council under Article VII.

It must be noted that the Community's position, if given effect, would result in the inability of the Scientific Council to provide advice on a fish stock in a NAFO Division, creating a significant and incurable gap in the provision of scientific advice for the NAFO Convention Area. This would plainly be contrary to the terms and intentions of the Convention.

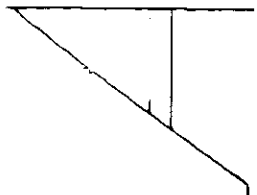
My conclusion is that there is no legal basis in the NAFO Convention for the European Community's position that 3Ps cod should be removed from the agenda of the forthcoming meeting of the Scientific Council. Accordingly, I must insist that it remain and that the Scientific Council's responsibilities under Article VII of the Convention be carried out. I would add that this is simply a request for scientific information and there is no legal prejudice involved to the position of any country in the provision of this scientific advice.

I would be grateful if copies of this letter could be distributed to all Contracting Parties and to the Chairmen of the Scientific Council and STACFIS.

Yours sincerely,



Peter Meyboom



APPENDIX VI. LIST OF PARTICIPANTS

CANADA

Akenhead, S. A.	Northwest Atlantic Fisheries Centre, P. O. Box 5667, St. John's, Newfoundland
Atkinson, D. B.	" " " " " " "
Baird, J. W.	" " " " " " "
Bishop, C. A.	" " " " " " "
Bowering, W. R.	" " " " " " "
Brodie, W. B.	" " " " " " "
Carscadden, J. E.	" " " " " " "
Miller, D.	" " " " " " "
Myers, R. A.	" " " " " " "
Nakashima, B.	" " " " " " "
Parsons, D. G.	" " " " " " "
Power, D.	" " " " " " "
Rice, J. C.	" " " " " " "
Walsh, S. J.	" " " " " " "
Wells, R.	" " " " " " "
Winters, G. H.	" " " " " " "
Beckett, J. S.	CAFSAC, Bedford Institute of Oceanography, Dartmouth, Nova Scotia
Frank, K. T.	Marine Fish Division, Bedford Institute of Oceanography, Dartmouth, Nova Scotia
Halliday, R. G.	" " " " " " "
Waldron, D. E.	" " " " " " "
Zwanenburg, K.C.T.	" " " " " " "
Loder, J. W.	Physical & Chemical Sciences, DFO, Bedford Institute of Oceanography, Dartmouth, N.S.
Drinkwater, K. F.	Coastal Oceanography, Bedford Institute of Oceanography, Dartmouth, Nova Scotia
Trites, R. W.	" " " " " "
Hunt, J. J.	Marine Fish Division, Biological Station, St. Andrews, New Brunswick
Perry, R. I.	" " " " " "
Frechet, A.	Fisheries and Oceans, Quebec Region, 850 Route de la Mer, Mont.-Joli., Quebec
Savard, L.	Fisheries and Oceans, Institut Maurice LaMontegne, C.P. 1000, Mont.-Joli., Quebec
Rivard, D.	Fisheries Research Branch, DFO, 200 Kent Street, Ottawa, Ontario
Keeley, J. R.	Marine Environmental Data Service, 200 Kent St., Ottawa, Ontario

CUBA

Garcia, M. B. R.	International Relations Div., Ministry of the Fishery Industry, Barlovento, Santa Fe., Playa, La Habana

DENMARK (GREENLAND)

Boje, J.	Greenland Fisheries Research Institute, Tagensvej 135, DK-2200 Copenhagen N, Denmark
Carlsson, D. M.	" " " " " " " "
Horsted, Sv. Aa.	" " " " " " " "
Hovgård, H.	" " " " " " " "
	" " " " " " " "

EUROPEAN ECONOMIC COMMUNITY (EEC)

Bertrand, J.	IFREMER, B. P. 4240, F-975000 Saint-Pierre et Miquelon
Borges, M. F.	Instituto Nacional de Investigacao das Pescas, Av. Brasilia, 1400 Lisbon, Portugal
Cross, D.	EUROSTAT, B. P. 1907, Batiment J. Monnet, Luxembourg (Grand Duchy)
Godinho, M. L.	Instituto Nacional de Investigacao das Pescas, Av. Brasilia, 1400 Lisbon, Portugal
Maucorps, A. M.	IFREMER, B. P. 1049, F-44037 Nantes-Cedex, France
Messtorff, J.	Sea Fisheries Institute, D-2850 Bremerhaven 29, Federal Republic of Germany
Noé, R.	Commission of European Communties, Joseph II 6/223, 200 Rue de la Loi B1049 Brussels, Belgium
Schumacher, A.	Sea Fisheries Institute, Palmaille 9, D-2000 Hamburg, Federal Republic of Germany
Stein, M.	" " " " " " "
Vazquez, A.	Instituto de Investigaciones Marinas, Muelle de Bouzas, Vigo, Spain
Zamarro, J.	" " " " " " "

List of Participants (continued)

ICELAND

Halligrimsson, I.	Marine Research Institute, P. O. Box 1390, 121-Reykjavik
Skuladottir, U.	" " " " " "

JAPAN

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

UNION OF SOCIALIST REPUBLICS (USSR)

Gastev, A. I.	Welsford Place, 2074 Robie St., Apt. 2202, Halifax, Nova Scotia, Canada
Kovalev, S. M.	PINRO, 6 Knipovich Street, Murmansk, 183763
Tretiak, V. L.	" " " "
Rikhter, V. A.	AtlantNIRO, 5 Dmitry Donskoy Street, Kaliningrad, 236000

APPENDIX VII. LIST OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS (SCR)

Doc. #	Ser. #	
88/01	N1432	STEIN, M. Revision of list of NAFO standard oceanographic sections and stations. (9 pages)
88/02	N1434	TIZOL, R., and C. GARCIA. Age and growth of silver hake (Merluccius bilinearis) on the Scotian Shelf. (2 pages)
88/03	N1438	W I T H D R A W N
88/04	N1439	RIKHTER, V. A. On possible assessment of relative TAC value after the example of the Scotian silver hake (Div. 4VWX). (5 pages)
88/05	N1440	SIGAEV, I. K. Distribution of autumn water temperature anomalies on the Scotian Shelf in 1986 and their relative changes in recent decade, 1977-1986. (7 pages)
88/06	N1441	BENWAY, R. L. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1987. (7 pages)
88/07	N1442	BARTON, K. W., and M. H. SANO. Anticyclonic warm core Gulf Stream rings off the northeastern United States during 1987. (20 pages)
88/08	N1443	STROUT, G. A. Variation in the shelf water front position in 1987 from Georges Bank to Cape Hatteras. (8 pages)
88/09	N1445	NAKASHIMA, B. S., and R. W. HARNUM. The inshore capelin fishery in NAFO Div. 3L in 1987. (16 pages)
88/10	N1446	RIGET, F., and J. BOJE. Mean length-at-age of Atlantic halibut (Hippoglossus hippoglossus) in West Greenland. (4 pages)
88/11	N1447	NAKASHIMA, B. S. Capelin school surface area index for NAFO Div. 3L, 1982-87. (11 pages)
88/12	N1448	RIGET, F., J. BOJE, and K. LEHMANN. By-catches of Greenland halibut and redfish in the shrimp fishery at West Greenland. (15 pages)
88/13	N1449	BOJE, J., and F. RIGET. Maturity stages in March and August of Greenland halibut in Div. 1A, West Greenland. (7 pages)
88/14	N1450	RIGET, F., and J. BOJE. Length-weight relationship and condition factor of Greenland halibut in West Greenland waters. (12 Pages)
88/15	N1451	STOLYARENKO, D. A., A. K. CHUMAKOV, and A. G. GALUZO. An application of the spline approximation method for design and data analysis of trawl surveys of commercial fish stocks in the Northwest Atlantic. (16 pages)
88/16	N1452	BULATOVA, A. Yu., A. G. GALUZO, and S. A. KUZMIN. Cod stock estimation and yield-per-recruit analysis for Div. 3NO. (16 pages)
88/17	N1453	SAVVATIMSKY, P. I. Investigations of roughhead grenadier (Macrourus berglax L.) in the Northwest Atlantic in 1967-83. (41 pages)
88/18	N1454	BAKANEV, V. S., and I. A. OGANIN. Ichthyoplankton investigations for the capelin 1987 year-class strength in NAFO Div. 3KLNO. (11 pages)
88/19	N1455	BAIRD, J. W., and C. A. BISHOP. Assessment of the cod stock in NAFO Div. 3NO. (24 pages)
88/20	N1456	BISHOP, C. A., J. W. BAIRD, and R. WELLS. Yield-per-recruit analyses for cod in Div. 3NO. (5 pages)
88/21	N1457	MAZHIRINA, G. P. Some information on the development of ovaries in Benthosema glaciale from different areas of the North Atlantic. (11 pages)

SCR Documents (continued)

88/22 N1458 ALBIKOVSKAYA, L. K., O. V. GERASIMOVA, and S. M. KOTLYAROV. Feeding peculiarities of the main commercial fishes on the Flemish Cap and northern Newfoundland Banks in spring-summer 1987. (12 pages)

88/23 N1459 BAKANEV, V. S., and V. S. MAMYLOV. Hydroacoustic surveys of the capelin stocks in NAFO Div. 2J+3KLNO in 1987. (11 pages)

88/24 N1460 MAMYLOV, V. S. Experimental trawl-acoustic survey in NAFO Subarea 3 from March to July 1987. (27 pages)

88/25 N1461 POWER, D., and D. B. ATKINSON. The redfish resource in NAFO Div. 3M. (9 pages)

88/26 N1462 ATKINSON, D. B., and D. POWER. Roundnose grenadier in NAFO SA 0+1 and 2+3. (11 pages)

88/27 N1463 ATKINSON, D. B., and D. POWER. An assessment of the redfish in NAFO Div. 3LN. (15 pages)

88/28 N1464 WALSH, S. J., and W. B. BRODIE. American plaice distribution on the nose and tail of the Grand Bank. (12 pages)

88/29 N1465 RIKHTER, V. A. Assessment of stock size and TAC of the Scotian (Div. 4VWX) silver hake for 1989. (17 pages)

88/30 N1466 RIKHTER, V. A. More on estimating the instantaneous natural mortality rate for the Div. 4VWX silver hake. (7 pages)

88/31 N1469 YAMADA, H., K. OKADA, and O. JØRGENSEN. West Greenland groundfish biomasses estimated from a stratified-random trawl survey in 1987. (6 pages)

88/32 N1470 YATSU, A., H. YAMADA, and O. JØRGENSEN. Length-weight relationship, condition factor, gonad index and stomach contents of Greenland halibut, Reinhardtius hippoglossoides, around Greenland in 1987. (12 pages)

88/33 N1471 ZAMARRO, J. Spawning process of the yellowtail flounder (Limanda ferruginea). (11 pages)

88/34 N1473 YAMADA, H., K. OKADA, and O. JØRGENSEN. Distribution, abundance and size composition of Greenland halibut estimated from a stratified-random trawl survey off West Greenland in 1987. (6 pages)

88/35 N1474 YAMADA, H., K. OKADA, and O. JØRGENSEN. Distribution, abundance and size composition of redfish (Sebastes marinus and S. mentella) estimated from a stratified-random trawl survey off West Greenland in 1987. (9 pages)

88/36 N1475 STEIN, M., and J. MESSTORFF. Are fluctuations in cod recruitment off West Greenland related to long-term variations of the physical environment. (14 pages)

88/37 N1477 BRODIE, W. B. An assessment of the American plaice stock in Division 3LNO. (39 pages)

88/38 N1478 BRODIE, W. B., and S. J. WALSH. An update on the status of the yellowtail flounder stock in Divisions 3LNO. (42 pages)

88/39 N1479 MILLER, D. S., and J. E. CARSCADDEN. Biomass estimates from two hydroacoustic surveys for capelin (Mallotus villosus) in NAFO Divisions 3L and 3N. (7 pages)

88/40 N1480 BOWERING, W. R. Biomass estimates of Greenland halibut in NAFO Div. 2GH from post-stratified and stratified Canadian groundfish surveys. (12 pages)

88/41 N1481 CHUMAKOV, A. K., and W. R. BOWERING. Post-stratified biomass and abundance estimates of Greenland halibut from USSR surveys in Subareas 0+2 and Division 3K. (20 pages)

88/42 N1482 HOVGÅRD, H., and K. H. NYGÅRD. Young cod distribution and abundance in West Greenland inshore areas, 1987. (11 pages)

88/43 N1483 HOVGÅRD, H., K. H. NYGÅRD, and K. M. LEHMANN. Inshore and offshore distribution and abundance of the West Greenland cod stock, autumn 1987. (13 pages)

SCR Documents (continued)

88/44 N1484 HOVGARD, H. Migration patterns of cod (Gadus morhua) in West Greenland waters. (18 pages)

88/45 N1485 SCHUMACHER, A. Status of Subarea 1 cod and the fisheries. An extract of the report of the ICES Working Group on cod stocks off East Greenland, Copenhagen, 11-23 February 1988. (39 pages)

88/46 N1486 HOVGARD, H. Expected length distribution of cod in West Greenland waters, 1988-90. (7 pages)

88/47 N1487 SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (Pandalus borealis) in East Greenland waters in 1987. (11 pages)

88/48 N1488 SMEDSTAD, O. M. Preliminary report of a cruise with M/T Masi to East Greenland waters in September 1987. (10 pages)

88/49 N1489 SLOTH, P., and E. BUCH. Correlation between winter ice coverage in the Greenland Sea and the summer temperatures at Fylla Bank, West Greenland? (7 pages)

88/50 N1490 BERTRAND, J., J. C. POULARD, A. BATTAGLIA, and P. DERIBLE. Catch, effort and biological data of shrimp (Pandalus borealis) in the French fisheries off Greenland in 1986 and 1987. (17 pages)

88/51 N1491 WALDRON, D. E., L. P. FANNING, M. C. BOURBONNAIS, and M. A. SHOWELL. Size of the Scotian Shelf silver hake population in 1987. (32 pages)

88/52 N1492 PARSONS, D. G., and P. J. VEITCH. The Canadian fishery for northern shrimp (Pandalus borealis) in Division 0A, 1987. (10 pages)

88/53 N1493 PARSONS, D. G., V. L. MERCER, and P. J. VEITCH. A comparison of the growth of northern shrimp (Pandalus borealis) from four regions of the Northwest Atlantic. (12 pages)

88/54 N1494 KEELEY, J. R. Marine Environmental Data Service report for 1987/1988. (19 pages)

88/55 N1495 BERTRAND, J., A. MAUCORPS, and J.C. POULARD. Shrimp abundance indices from the French fisheries off East and West Greenland. (4 pages)

88/56 N1496 CARLSSON, D. M. The shrimp fishery in NAFO Subarea 1 in 1987. (17 pages)

88/57 N1497 CARLSSON, D. M. The commercial shrimp fishery in the Denmark Strait in 1987. (12 pages)

88/58 N1498 LUND, H. Greenland fishery for shrimp (Pandalus borealis Kr.) in NAFO Division 1A (Greenland management areas NV1 and NV2) in 1986 and 1987. (15 pages)

88/59 N1499 LUND, H. On environment and reproduction of the West Greenland shrimp stock (Pandalus borealis Kr.) north of 71°N (NAFO Division 1A). (15 pages)

88/60 N1501 DRINKWATER, K. F., and R. W. TRITES. Overview of environmental conditions in the Northwest Atlantic in 1987. (24 pages)

88/61 N1502 LODER, J. W., and C. K. ROSS. Moored current and hydrography measurements on the southeast shoal of the Grand Bank in 1986 and 1987. (20 pages)

88/62 N1505 RICE, J. C., and S. A. AKENHEAD. Reducing dimensionality in the temperature and salinity data from Station 27: same data, different analyses. (13 pages)

88/63 N1506 RICE, J. C. Report of 1987 Meeting of Marine Environment and Ecosystems Subcommittee of CAFSAC. (2 pages)

88/64 N1507 HALLGRIMSSON, I., and U. SKULADOTTIR. The Icelandic shrimp (Pandalus borealis) fishery in the Denmark Strait in 1987. (9 pages)

88/65 N1508 MYERS, R. A., S. A. AKENHEAD, and K. F. DRINKWATER. The North Atlantic oscillation and the ocean climate of the Newfoundland shelf. (22 pages)

88/66 N1509 MYERS, R. A., and F. DRINKWATER. Wind-driven currents and larval fish survival. (17 pages)

SCR Documents (continued)

88/67 N1510 CARLSSON, D. M., D. G. PARSONS, and L. SAVARD. Modal analysis for Davis Strait shrimp samples. (5 pages)

88/68 N1511 BOWERING, W. R. Some aspects of the witch flounder fishery on the southern Newfoundland Grand Bank (NAFO Divisions 3NO). (9 pages)

88/69 N1512 BOWERING, W. R., and W. B. BRODIE. A review of the status of the Greenland halibut resources in NAFO Subarea 2 and Divisions 3K and 3L. (23 pages)

88/70 N1513 BISPHOP, C. A., W. H. LEAR, J. W. BAIRD, and R. WELLS. Comparison of cod samples from St. Pierre Bank, Burgeo Bank and Rose Blanche Bank from analysis of meristic characters, average length at age, and prevalence of parasitic nematodes. (7 pages)

88/71 N1514 LEAR, W. H. Distribution of recaptures of cod tagged on Burgeo Bank during March 1986. (8 pages)

88/72 N1515 BISHOP, C. A., and J. W. BAIRD. Assessment data for the cod stock in NAFO Subdivision 3Ps. (19 pages)

88/73 N1516 LEAR, W. H. Migrations of Atlantic cod of NAFO Division 3Ps. (8 pages)

88/74 N1517 BERTRAND, J., and A. MAUCORPS. Contribution to the assessment of the cod stock in Subdivision 3Ps. (15 pages)

88/75 N1518 ANON. Report of the Ad hoc working group for the assessment of the cod stock in Subdivision 3Ps. (20 pages)

88/76 N1519 MESSTORFF, J. Survey biomass and abundance estimates for redfish (Sebastes marinus and Sebastes mentella) in Subarea 1. (3 pages)

SUMMARY DOCUMENTS (SCS)

Doc. # Ser. #

88/01 N1422 NAFO SECRETARIAT. Historical catches of selected species by stock area and country for the period 1976-86. (38 pages)

88/02 N1427 NAFO SECRETARIAT. List of biological sampling data for 1986. (40 pages)

88/03 N1428 MEYBOOM, P. Canadian request for scientific advice on management in 1989 of certain stocks in Subareas 0 to 4. (1 page)

88/04 N1429 GREENLAND HOME RULE AUTHORITIES. Denmark (Greenland) request for scientific advice on management of certain stocks in 1988. (2 pages)

88/05 N1430 DeMIQUEL, R. EEC request for scientific advice on management of certain stocks in 1989. (1 page)

88/06 N1431 COADY, L. W. Canadian research report for 1987. (Section I - Newfoundland Region) (9 pages)

SCOTT, J. S.. Canadian research report for 1987. (Section II - Scotia-Fundy Region)

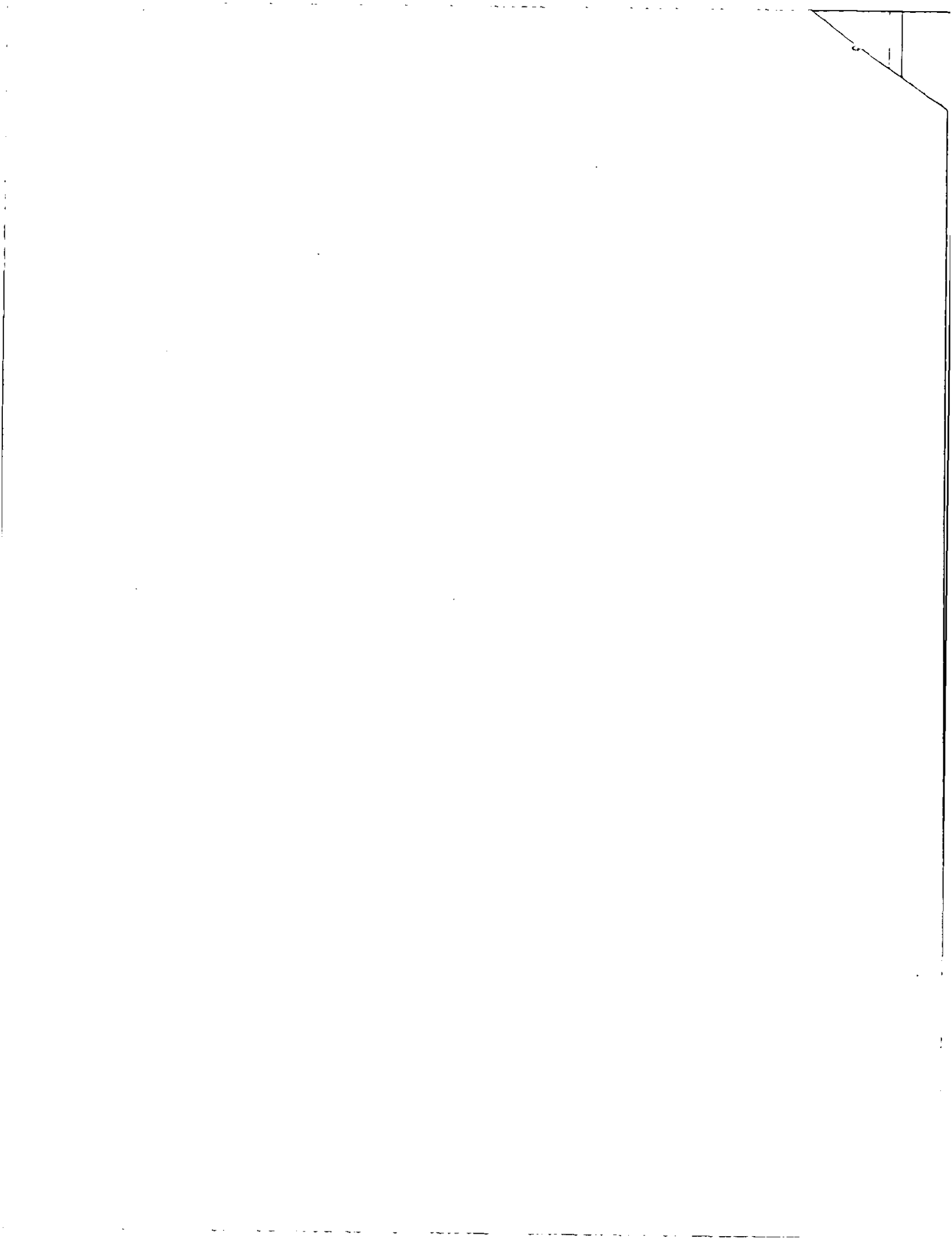
FRECHET, A. Canadian research report for 1987. (Section IV - Quebec Region) (6 pages)

CANADA. Canadian research report for 1987. (Section V - Physical oceanographic studies) (3 pages)

88/07 N1433 NAFO SECRETARIAT. Tagging activities reported for the Northwest Atlantic in 1987. (4 pages)

SCS Documents (continued)

88/08	N1435	GROSSLEIN, M. D., and F. M. SERCHUK. United States research report for 1987. (10 pages)
88/09	N1436	NAFO SECRETARIAT. Provisional index and list of titles of research and summary documents for 1987. (24 pages + addendum)
88/10	N1437	NAFO. Formulation of rules of procedure common to the three main bodies of NAFO. (1 page)
88/11	N1444	NAFO SECRETARIAT. Notes on statistical activities and publications since June 1986. (2 pages)
88/12	N1467	GODINHO, M. L. Portuguese research report for 1987. (9 pages)
88/13	N1468	KAWAHARA, S. Japanese research report for 1987. (4 pages)
88/14	N1472	VAZQUEZ, A. Spanish research report for 1987. (10 pages)
88/15	N1476	NOSKOV, A. S. USSR research report for 1987. (Section I - Subarea 4) (3 pages)
		BOROVKOV, V. A., A. K. CHUMAKOV, and S. M. KOVALEV. USSR research report for 1987. (Section II - Subareas 2 and 3 - Tables only, text not available at present) (15 pages)
88/16	N1500	LEHMANN, K. Denmark (Greenland) research report for 1987. (8 pages)
88/17	N1504	TIZOL, R., R. DOMINGUEZ, A. ALVAREZ, and B. MORENO. Cuban research report for 1987. (8 pages)
88/18	N1521	NAFO SECRETARIAT. Provisional nominal catches in the Northwest Atlantic, 1987. (59 pages)
88/19	N1522	NAFO. Summary of sampling data (1983-86), collecting data methods used, and level scientific information available on stocks in the Regulatory Aera. (31 pages + corrigendum)
88/20	N1523	NAFO. Provisional Report of Scientific Council, Dartmouth, Nova Scotia, 8-23 June 1988.



Northwest Atlantic Fisheries Organization

Serial No. N1523

NAFO SCS Doc. 88/20
(Corrigendum)

SCIENTIFIC COUNCIL MEETING - JUNE 1988

Provisional Report of Scientific Council, June 1988 Meeting

The following corrigendum and modifications were forwarded to the NAFO Secretariat after discussion on the text of the provisional report (NAFO SCS Doc. 88/20) at the September 1988 Annual Meeting of the Scientific Council:

PLEASE NOTE: An initial document described as the corrigendum and circulated at the September 1988 Meeting was revised to prepare this document.

Page 6, line 6: should read arguments not agruments.

Page 6, last line in introductory section: should read "Committee.....Council....."

Page 6, Section 1.1 (line 4): should read "catch decreased (4.5%)....."

Page 7, line 3: should read "...Subarea 4 (781,000 to ....."

Page 7 to 10, Section 1.2: Replace text under the section titled Assessment of Finfish and Invertebrate Stocks with the following text:

2. Assessment of Finfish and Invertebrate Stocks

The Council noted that STACFIS had reviewed the status of certain stocks in Subareas 0 to 4, as requested by Canada, Denmark (Greenland) and the Fisheries Commission, and had advised on catch levels corresponding to reference levels of various fishing mortality. Advice was developed in terms of $F_{0.1}$, two-thirds of the fishing effort associated with the maximum sustainable yield, F_{max} or $F_{current}$, according to the different requests (Table 1). 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 had been used which were consistent with those of recent years. No data were available to provide advice on the squid stock. Details of the stock assessments are given in the Report of STACFIS at Appendix I. General observations and comments by the Scientific Council are as follows:

a) The cod stock in Subarea 1 has declined greatly from levels seen in the 1960's, but the recruitment of the very abundant 1984 year-class is resulting in stock rebuilding. This year-class may be as big as any seen in the past, but catch projections have been provided to illustrate the impact of other year-class sizes than that assumed. The 1985 year-class is considered average but that of 1986 to be very low. Management options, yield-per-recruit calculations and answers to specific questions are available in Appendix I, Section II.1.

b) For the cod stock in Div. 3M, the biomass (age 3+) continues to be at a very low level (less than 30,000 tons) relative to the target biomass of 85,000 tons which was set by the Fisheries Commission. This target biomass will not be reached in the near future, because the year-classes of cod older than age 5 are at very low levels and the fishery has been exploiting incoming year-classes at too early an age. Continuation of the moratorium on fishing is advised.

c) Analytical assessment of the cod stock in Div. 3NO indicates a continuous increase in spawning stock biomass (8 fold since 1979). However, the new assessment, coupled with a new yield-per-recruit analysis which suggests lower fishing mortalities for the reference levels, gives a projected catch in 1989 at $F_{0.1}$ = 0.15 of 25,000 tons, and F_{max} = 0.25 of 40,000 tons. The projected catch in 1989 at the 1987 level of fishing mortality (F_{87} = 0.2) is 33,000 tons.

d) For the cod stock in Subdiv. 3Ps, the results of the assessments are reported in Appendix I, Section II. 4.

e) For American plaice in Div. 3LNO, the Council was concerned in 1987 about the actual value of the estimate of the population size, and advised caution in implementing fully the implied reduction in catch in 1988. The new assessment, however, largely confirms the 1987 assessment. In 1986, for example, the 9+ biomass was thought to have increased during the

Table 1. Summary of recent catches (1983-87) and TACs (1983-88) for stocks reviewed at the June 1988 Meeting of STACFIS, with advised TACs for 1989.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)						Advised TACs for 1989			
		1983	1984	1985	1986	1987[1]	1983	1984	1985	1986	1987	1988	$F_{0.1}$	F_{max}	F_{87}	Other
Cod	1	58	33	15	7	19	62	68	28.3	12.5	12.5	40	[2]	[2]	[2]	
	3M	10	13	14	15	8	12.4	13	13	13	13	[3]				0[3]
	3NO	29	27	37	50	41	17	26	33	33	33	40	25	40	33	
	3Ps	38	37	51	32	58	33	35.8	44.6	60.6[8]	60.6[8]	60.6[8]				
Redfish	1	8	6	4	5	1	...	...	...	...	...	...				[4]
	3M	20	20	20	29	45	20	20	20	20	20	20				20[10,11]
	3LN	20	15	21	42	55	25	25	25	25	25	25				25[10,11]
Silver hake	4VWX	36	74	75	83	62	80	100	100	100	100	167	235	[12]	[12]	
A. plaice	3M	2	1	2	4	6	2	2	2	2	2	2				2[10,11]
	3LNO	38	36	48	56	52	55	55	49	55	48	40	32	[14]	60	
Witch flounder	3NO	4	3	9	9	8	5	5	5	5	5	5				5[10,11]
Yellowtail	3LNO	9	13	21	23	16	19	17	15	15	15	15				5[13]
G. halibut	0+1	9	7	10	9	10	25	25	25	25	25	25				25[10]
	2+3KL	28	25	19	15	28	55[5]	55[5]	75	100	100	100				100
R. grenadier	0+1	+	+	+	+	+	8	8	8	8	8	8				8[10]
	2+3	4	4	5	7	8	11	11	11	11	11	11				11[10,11]
Wolffishes	1	3	2	2	2	2	...	5-6	5-6	5-6	5-6	5-6				5-6[10]
Capelin	3LNO	25	33	25	48	20	60[6]	38[6]	60[6]	130[6]	293[7]	100[7]				363[9]
Squid-Illex	3+4	+	1	1	+	2	150	150	150	150	150	150				[4]
Shrimp	0+1	47	43	54	63	73	35	35	42	36	42	40				36[2]

[1] Provisional data.
[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 incude 10,000 tons in 1987 and 15,000 tons in 1988 for Div. 3NO and remainder for Div. 3L.
[8] Effective TAC - combined Canada and EEC.
[9] Div. 3L TAC is 335,000 tons, Div. 3NO TAC is 28,000 tons.
[10] Maintenance of TAC advised as no basis for change.
[11] Not agreed by EEC representative (see paragraph L).
[12] Not requested.
[13] Not agreed by EEC representative (see paragraph G).
[14] F_{max} cannot be calculated in a meaningful manner.

early 1980's to a level in 1985 of about 240,000 tons. The subsequent (1987 and 1988) assessments have indicated a much different view of the 9+ biomass, showing it to have been relatively stable around 130,000 tons during the 1980's. If the catch in 1988 is 28,000 tons, which is the new estimate of the catch at $F_{0.1}$, the projected catch in 1989 is 32,000 tons at $F_{0.1}$ (F = 0.26) and 60,000 tons at F_{87} = 0.6. F_{max} is not a meaningful option for this stock because of the very high F implied.

f) For witch flounder in Div. 3NO, catches in the past three years have been reported as 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 and there was no basis for advising a change in the current TAC of 5,000 tons for Div. 3NO. The EEC representative did not accept this conclusion (see paragraph 1) in this section. The Council reiterates its opinion that the stock is unlikely to be able to support the recent high catch levels without declining in abundance.

g) For the stock of yellowtail flounder in Div. 3LNO, the Council has expressed concern for the past two years over the reports that catches were double the TAC but has not been able to provide firm advice. There is again no quantitative assessment this year, but given the available information from trawl surveys that show major declines in biomass and poor recruitment prospects, the Council advises that total catches, including those by non-members should not exceed 5,000 tons. The representative of the EEC noted that "the consequences of projected catches at 5,000 tons or more seem not possible and the calculations of such a precise figure do not appear in the text, therefore the advice that catch in 1989 should not exceed 5,000 tons does not adequately answer the request of the Fisheries Commission".

h) For capelin in Div. 3L, recruitment of the strong 1986 year-class will increase biomass greatly and it is estimated that the catch in 1989, that would represent about 10% of the spawning stock, would be 335,000 tons.

i) The biomass of capelin in Div. 3NO is considered to have averaged about 280,000 tons since 1981, and should the 1986 year-class also be strong for this stock, the biomass would be at least as large as the average. Removals of 28,000 tons would represent 10% of this average biomass.

j) For the silver hake stock in Div. 4VWX, it is estimated that the recruitment of the very large 1985 year-class and the large 1986 year-class will result in a major increase in the biomass. The Council noted that the input fishing mortality (F = 0.2) in 1987 for ages 3-9 is much lower than those resulting from the cohort analysis for the same ages in earlier years. No satisfactory explanation could be found for this discrepancy, and the analysis indicated that if the catch in 1988 is 110,000 tons, the estimated catch at the $F_{0.1}$ level in 1989 would be 235,000 tons.

k) For squid in Subareas 3 and 4, the Council notes that the unpredictable nature of the fluctuations in stock availability, means that no catch projection can be made. Advice in recent years has been that there is "no reason to change the existing advice". The phrasing used this year is an accurate statement of current predictive abilities for this stock, but it should be noted that this is not a recommendation for a zero TAC but a recognition that insufficient information is available to assess the impact on the population of any particular catch level. The species is a by-catch in other fisheries and, in years of high abundance, may comprise a major part of catches in small meshed fisheries such as those directed at silver hake.

l) No change in TAC was advised for redfish in Div. 3M and 3LN, American plaice in Div. 3M, witch flounder in Div. 3NO (also see Section f), Greenland halibut in Subareas 0+1 and SA 2 plus Div. 3KL, and roundnose grenadier in Subareas 0+1 and 2+3. The EEC representative stated when the STACFIS report was being adopted that "for at least five stocks on which scientific advice has been expressed by the Scientific Council (i.e. redfish in 3M, 3LN, A. plaice in 3M, witch flounder in 3NO, roundnose grenadier in Subareas 2 and 3) it used the expression "STACFIS has no basis to advise a change from the present TAC of ...". In other words, this means that it has no basis to advise on any precise level of TAC. This is a normal situation given the fact that it was only requested to make catch projections and to comment on their effects on the fishable stock size, spawning stock biomass, recruitment prospects, catch rates, for the next year and in the long term. Therefore such sentences are inappropriate and should be deleted. Advice should be rephrased to comment on any consequences of possible catch levels."

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

n) For shrimp, the Scientific Council addressed assessments at this meeting rather than in the winter as in the recent past. In Subareas 0+1, catches have increased markedly since 1984

and over 52,000 tons was reported caught offshore in 1987. There is no quantitative assessment and the Council cannot predict whether the present catches can be maintained. Catch rate and size frequency information suggest that recent catches have not depressed stock size although a time lag of several years would be expected particularly as it is now thought that shrimp in the catches may be older than thought previously. The Council therefore advises that, should it be desired to investigate more vigorously the level of catch that can be sustained, controlling offshore catches at the 1986 level (44,000 tons) might be a safe approach. A higher catch level such as 50,000 tons would demonstrate more rapidly whether a higher yield can be maintained. These experimental approaches would require catch levels to be held constant for several years in order to detect the impact on the population. The higher the catch level, the greater the risk that drastic reductions in effort might be necesary should the stock start to decline. In response to a request concerning the need for management of shrimp in grounds north of 71°N, the Council advises a separate but cautious approach, but in response to a second request it was not able to evaluate the present Regulatory Area off Disko Bay.

o) With respect to shrimp in Denmark Strait, biomass estimates from research surveys conducted by Norway over a three-year period indicate some stability in the resource despite increasing catches. Given the indications of biomass size and stability, the Council advises that the recent level of catches appears to be a safe level and that maintaining catches at this level (10,000 tons) might be adopted as a precautionary measure until the database has been improved and an assessment performed. In answering a request about exploratory fishing, it is advised that this should only be conducted in areas well separated from grounds exploited currently.

Page 11, Section 1.7: Change to read as follows: "....which were not directly related to the stock...."

Page 12, Section II.3: Change to read as follows:

"....in 1987 and of surveys planned for 1988 and early 1989. It was noted that data records were not complete for all reporting components from Canada, as no report was available from Canada (Gulf)."

Page 16, line 1: should read "...in 1987, was 5% less..."

Page 16, line 11: should read "...in other molluscs (20%) and..."

Page 16, Section 1.3(f), line 1: should read "...(6%) from 397,000 tons...."

Page 16, Section 1.3(g), line 3: Change (10%) to (3%)

Page 27, Item 3 (Cod in Divisions 3N and 3O): insert SCR Doc. 20 to the list of documents reviewed.

Page 31, Section V, 2nd last line: The reference to Table 8 changed to read Table 10.

Page 34, Table 9: The heading of the third column showing "Catch (1989)[a]" should read "Catch (1989)".

Page 34, Text below Table 9: delete the last sentence which reads "A comparison of projected catch.....at the standard reference levels (Table 10).".

Page 81, Annex 1.1(a), line 3: Change to read "Some of the latter..."

Page 81, Annex 1.1(f), line 2: Change to read "during 1987 was presented..."

Page 85, Annex 2: The text table at the bottom of the page under item Forecast for 1989 is deleted. The new Annex 2 is as attached.

SUMMARY SHEET - COD 3PS

Source of information: NAFO Scientific Council, June 1988

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	Max	Min	Mean
Recomm. TAC[1]	28	30	33	33	33	41[2]	[3]	[3]	[4]	41	28	33
Effect. TAC	28	39	33	33[5]	35.8[5]	44.6[5]	60.6[5]	60.6[5]	60.6[5]	60.6	28	44
Catch	38	39	34	38	37	51	57	57		57	27	40
Sp. Stock Biom.	64	68	60	60	78	96	101	101		101	32	68
Recruit. (Age 3)	118	131	133	170	206	228	212	221		78	36	58
Mean $F_{(7-11)}$	0.55	0.56	0.57	0.47	0.39	0.55	0.61	0.55		.61	.39	.53

For all footnotes see the main report (Recomm. TACs at $F_{0.1}$) Weights in 000's tons.
[6]Over 1977-87 period. Recruitment in millions.

Catches: The increased landings since 1985 are mainly associated with increased effort by the offshore fleet.

Data and assessment: Analytical assessment. Catch-at-age data by combining French and Canadian estimates from extensive sampling in both cases.

Fishing mortality: Attempted calibration of cohort analysis by catch rates (French and Canadian trawlers data combined) and surveys results (French and Canadian). Not precisely determined by the methods used.

Recruitment: Estimated from French surveys (ages 2 and 3 combined), with a significant regression, but indices for the last year-classes generally outside the range of the regression (1975-80 year-classes).

State of the stock: The stock has been at its lower level in the middle of the 70's. The sharp increase of the biomass since 1982 is attributed to successive strong year-classes, substantially greater than the long-term mean. Long-term potential mainly dependent upon the level of recruitment which has shown large fluctuations over the period considered.

Forecast for 1989: