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SCIENTIFIC COUNCIL MEETING - JUNE 1991

Report of Scientific Council, June 1991 Meeting

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REPORT OF SCIENTIFIC COUNCIL

June 1991 Meeting

Chairman: B. W. Jones Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada, on 5-19 June 1991, to consider the various matters listed in its provisional agenda (Appendix IV).

The Executive Committee met briefly prior to the opening session of the Council, and the provisional agenda and work plan were reviewed.

Representatives attended from Canada, Denmark (Faroe Islands/Greenland), European Economic Community (EEC), Iceland, Japan and Union of Soviet Socialist Republics (USSR). The NAFO Executive Secretary and Assistant Executive Secretary were in attendance.

The meeting was called to order at 1020 hr on 5 June 1991.

The Chairman welcomed everyone to the June 1991 Meeting of the Scientific Council and hoped that it would once again be a successful one with the Council working together in the cooperative spirit.

On behalf of the Council, the Chairman welcomed the new Executive Secretary, Dr. L. I. Chepel, to his first meeting of the Scientific Council.

The Assistant Executive Secretary was appointed rapporteur, as was the usual practice. The Chairman then addressed the adoption of the provisional agenda. He commented that the election of officers would be addressed later during this meeting. He also brought to the attention of the Council that a proposal to prepare an Executive Summary of the Council report should be reviewed later under Other Matters (Agenda, item X). The provisional agenda was then adopted without change.

The Council was informed that the Executive Secretary held four proxy votes: from Bulgaria, Cuba, Norway and Poland.

The Chairman then set out a plan of work with the objective of having the Council report adopted before closing the meeting.

The session was adjourned at 1045 hr.

The Council reconvened briefly at 1350 hr on 7 June 1991 to consider STACPUB Membership and nominations and elections of officers to the Council.

The session was adjourned at 1400 hr.

The Council again reconvened from 1330 hr to 1415 hr on 10 June 1991 and from 0910 hr to 0935 hr on 18 June 1991 to consider matters related to Agenda items V, VI, VII, VIII, IX and X.

The concluding session was convened at 0955 hr on 19 June 1991. The Council then considered and adopted the Reports of the Standing Committees and considered and adopted the Report of the Scientific Council of the June 1991 Meeting.

The meeting was adjourned at 1115 hr on 19 June 1991.

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

The adopted Agenda, the lists of Research (SCR) and Summary (SCS) documents and the list of participants are given in Appendix IV, V and VI respectively.

The Council's considerations on the Standing Committee Reports and other matters addressed by the Council follow in Sections II-XI.

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

1. General Review

a) Catch Statistics

The Council noted with concern the difficulties which had been experienced by STACFIS due to the high levels of unreported catches from some of the stocks in the Regulatory Area. In addition, no biological sampling data were available from the unreported catches. This severely hampered the Committee's ability to interpret trends in indices of stock abundance. As last year, it was necessary to use estimates of catches for non-member countries which did not report to NAFO. Furthermore, for the first time, independent estimates have indicated that some catches by some Contracting Parties have been under-reported and, where considered appropriate, estimates for unreported catches by Contracting Parties were used in the assessments.

b) Dynamic Analytical Assessments

The Scientific Council endeavours to make continuous improvements in the standard of the stock assessments and the quality of advice offered to the Fisheries Commission and Coastal States. The Council therefore notes with regret that it was not possible for STACFIS to accept completely any of the full analytical assessments attempted at the June Meeting. As a result detailed catch projections were provided for one stock only (Div. 4VWX silver hake) and these were only partially based on an analytical assessment. There were a variety of reasons for the apparent 'deterioration' in assessments and advice. These included the lack of sampling data from the unreported component of catches in the Regulatory Area, and the emergence of conflicting trends indicated by commercial catch rates and research vessel indices making calibration of the assessment impossible. Furthermore the more sophisticated analytical methods now being used enable the results of analyses to be assessed more objectively. Assessments which previously might have been accepted on more subjective criteria may now have to be rejected when stricter objective criteria are applied.

c) Timely Availability of Assessment Related Data

The Council notes that the work of STACFIS is further hampered by the late availability of assessment-related data. This results in the Designated Experts not having sufficient time to fully evaluate the data, and the preparation of assessments is rushed. The work of STACFIS can be held up at the beginning of the meeting due to the unavailability of some assessments. Furthermore the efficiency of STACFIS may be reduced because Designated Experts have to prepare assessments during the early part of the meeting and are therefore not available to participate in the review process for other assessments.

2. General Fishery Trends

The Council noted that provisional nominal catch data for 1990 were, not available for EEC-France (Metropolitan) and France (St. Pierre and Miquelon). The following general trends were noted in the absence of those data.

From provisional statistics for 1989 and 1990 the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) increased (5%) from 2.98 million tons in 1989 to 3.13 million tons in 1990 (see Appendix I, Table 1), although the "groundfish" catch decreased (8%) from 1.18 million tons in 1989 to 1.09 million tons in 1990, the "pelagic fish" catch increased significantly (16%) from 628,000 to 728,000 tons in 1990, the "other finfish" increased very substantially (41%) to 270,000 tons from 191,000 tons in 1989, and "invertebrates" catches increased (6%) from 982,000 to 1,041,000 tons in 1990. With respect to nominal catches by Subarea, increases were noted for Subarea 0 (from 13,000 tons in 1989 to 19,000 tons in 1990), Subarea 3 (from 601,000 tons in 1989 to 644,000 tons in 1990), Subarea 5 (from 398,000 tons in 1989 to 476,000 tons in 1990), Subarea 6 (from 894,000 tons in 1989 to 965,000 tons in 1990) and decreases were noted for Subarea 1 (from 173,000 tons in 1989 to 139,000 tons in 1990), Subarea 2 (from 104,000 tons in 1989 to 102,000 tons in 1990) and Subarea 4 (from 796,000 tons in 1989 to 784,000 tons in 1990).

3. Assessment of Finfish and Invertebrate Stocks

The Council noted that STACFIS 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 options according to the different requests. Management advice, based on the reference levels, could not be provided for several stocks due to insufficient data. Details of the stock assessments are given in the Report of STACFIS (Appendix I), while summaries of assessments are as follows:

SUMMARY SHEET - Cod in Subarea 1

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	Various options (see special comments)							
Agreed TAC	68.5	28.3	12.5	12.5	53	90	110	90
Reported landings	33	15	7	13	59	105[1]	60[1]	
Non-reported catches					3	3		
Actual landings								
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Following the mid-1940s catches rose to a level of between 250,000 and 450,000 tons annually, in the 1950 to 1968 period. Since then recruitment has deteriorated and catches declined significantly. In this latter period years of good catches have been associated with occasional good year-classes (viz. 1973, 1977+1979 and 1984).

Stock size indicators : Catch rates for Greenland fresh fish trawlers were high subsequent to the recruitment of the year-classes mentioned above. A drastic decline in catch rate has been observed since spring 1989.

FRG ground fish survey abundance and biomass estimates of cod reflect the recruitment of the 1984 year-class. Since 1988 survey abundance has declined dramatically to less than 35 mill. in autumn 1990. The 1984 year-class was reduced by 97% in 1990 corresponding to a total "mortality" of 3.3. A high emigration of cod is assumed.

Data and Assessment: With the emigration rate far exceeding the fishing mortality rate an analytical assessment is not meaningful.

Fishing Mortality: No information available.

Recruitment: The year-classes 1986 to 1990 are all estimated to be poor.

State of Stock: The stock is presently dominated by the 1985 year-class which is believed to have a strong component of Icelandic origin. In 1991 it may therefore undertake a significant emigration as the 1984 year-class did in 1990.

Forecast for 1991: Yield-per-recruit considerations and assuming year-class sizes of 20 million as have conventionally been applied to poor year-classes, annual catches of 9,000 tons are indicated. However, because some cod of the 1985 year-class are still available, catches in 1991 and 1992 are expected to exceed this level

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation:

Special Comments: Since 1982 no specific TACs have been advised, but a number of management options to let the 1984 year-class grow up before exploitation, have been advised. However, emigration of this year-class has been more extensive than assumed.

SUMMARY SHEET - Cod in Division 3M

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	0	0	0	0	0	0	0	0
Agreed TAC	13	13	13	13	0	0	0	13
Nominal catch	13	14	15	11	2	1[1]	2[1]	
Non-reported catches					-[2]	39	30	
Sp. stock biomass								
Recruitment (age)				*No information available*				
Mean F								

[1] Provisional.
[2] No information available.

Weights in '000 tons

Catches: Catches ranged from 22,000 to 33,000 tons in late-1970s and have been stable around 12,000 tons for 1980-87. Reported nominal catches were less than 2,000 tons since 1988. Catches were estimated to be around 40,000 tons in 1989 and 31,500 in 1990.

Data and Assessment: Surveys conducted by the USSR since 1971 indicated that biomass and abundance had declined to a minimum in 1987. Both USSR and EEC surveys showed an increase in stock biomass from 1988 to 1989 due to a relatively abundant 1986 year-class and a sharp decline from 1989 to 1990.

Fishing Mortality: Uncertain but assumed to be high. Research vessel surveys suggest it may have been greater than 1.0 during 1989-90.

Recruitment: 1986 year-class is abundant.

State of Stock: Spawning stock biomass in 1990 was at the lowest limit of its critical size range.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: If cessation of fishing cannot be achieved, no action can be advised that would result in an improvement of the stock.

Special Comments: Catch, effort and sampling data of the fleets fishing for cod on the Flemish Cap should be collected and made available to STACFIS.

SUMMARY SHEET - Cod in Divisions 3N and 3O

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	26	33	33	33	40	25	18.6	13.6
Agreed TAC	26	33	33	33	40	25	18.6	13.6
Reported catches	27	37	51	42	43	33[1]	18[1]	
Total landings	27	37	51	42	43	33[1]	29[1]	
Non-reported catches	-	-	-	-	-	-	11	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Catches declined from a peak of 225,000 tons in 1967 to a low of 15,000 tons in 1978. Since 1974 the maximum catch occurred during 1986 but they have subsequently declined. The 1990 catch was about 29,000 tons. TACs were introduced for this stock in 1973. Until 1978 catches were substantially lower than TACs, but since 1981 they have exceeded those recommended.

Data and Assessment: An analytical assessment of catch-at-age data using Canadian and USSR survey indices in a formulation of the adaptive framework was attempted but there was uncertainty with the results. This may have been related to variability of survey results as well as poorly estimated numbers at age. The results of the SPA were considered useful only as an indication of general population trends.

Fishing Mortality: Mean fishing mortalities were high in the 1960s and early-1970s and during some years were in excess of 1.0. They decreased in the early-1980s to levels below 0.30. An increasing trend has been indicated in recent years, however Fs for 1990 have not been determined.

Recruitment: Research vessel surveys indicate that the 1983 to 1987 year-classes are extremely weak. There are indications that the 1988 year-class may be larger.

State of Stock: The SPA, calibrated with RV indices and as an approximate estimate of stock size, indicates that the stock is at an extremely low level. Although catch rate indices are not used for calibration they indicate similar trends.

Forecast for 1992: Because of uncertainties with the results of the assessment it was considered inappropriate to conduct formal catch projections.

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =		
F_{90} =	No information available	
F_{max} =		

Recommendation: This stock is currently at a low level. The approximate SPA and available abundance indices indicate that the adult population is declining and several year-classes in the most recent period are among the lowest observed. Given the current state of the stock, the catch for 1992 should not exceed the 1991 TAC of 13,600 tons.

Special Comments: Preliminary 1991 Canadian RV results indicate that biomass continued to decline while abundance increased marginally. This suggests the presence of relatively more younger cod in the 1991 survey than in 1990, although total abundance remains low. Maintaining the TAC at the relatively low level of 13,600 tons may allow recruiting year-classes to contribute additional yield per recruit and eventually increase spawning stock biomass.

SUMMARY SHEET - Redfish in Subarea 1

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC				No TAC				
Agreed TAC		11.5	18	19	19	19	19	19
Actual landings	6	4	5	1	1	1[1]	0.5[1]	90.5
Sp. stock biomass								
Recruitment (age)				*No information available*				
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Mainly by-catches in the cod fishery; catch in 1979 was 9,000 tons.

Data and Assessment: Stratified-random shrimp trawl surveys since 1988, stratified-random trawl surveys designed for cod since 1982.

Fishing Mortality: No estimates.

Recruitment: No direct estimates but information from surveys on nursery grounds off West Greenland.

State of Stock: Survey estimates indicate considerable decline of stock biomass and abundance in recent years.

Forecast for 1992:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =		
F_{90} =	No information available	
F_{max} =		

Recommendation: As long as catches remain limited to by-catches of the fisheries directed to other species, no TAC is advised.

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

SUMMARY SHEET - Redfish in Division 3M

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	20	20	20	20	20	20	<50	43
Agreed TAC	20	20	20	20	20	20	50	50
Actual landings	20	20	29	44	23	58[1]	83[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.
[2] Includes estimates of non-reported catch.

Weights in '000 tons

Catches: Averaged 20,000 tons or less from 1979 to 1985. Increased thereafter to 44,000 tons in 1987. Catches declined again in 1988. In 1989 and 1990 catches of 58,000 and 83,000 tons were the highest in the history of this fishery.

Data and Assessment: SPA carried out but not usable since input catch for 1990 was only 39,000 tons. Catch rates declined from 1987 to 1990. Trawlable biomass estimates from the EEC bottom trawl surveys and total biomass estimates from USSR trawl-acoustics surveys indicate a reduction from 1987 to 1990. The average biomass estimated from USSR trawl-acoustic surveys from 1989 to 1990 is 307,000 tons.

Fishing Mortality: No estimate available but believed to be above F_{max}.

Recruitment: No estimate available.

State of Stock: Appears to be declining in recent years, based on both commercial catch rates and survey data.

Forecast for 1991: Fishing mortality in 1991 expected to be about same as that in 1990.

Option Basis	Predicted catch (1992)[1]	Predicted SSB (1.1.1993)
$F_{0.1}$ = 1.2	35,000	
F_{90} =	No information available	
F_{max} = .22	60,000	

[1] Based on $F_{0.1}$ and F_{max} exploitation of the 1989-90 average total biomass estimate from USSR trawl-acoustic surveys.

Recommendation: TAC for 1992 be set at 35,000 tons.

Special Comments: This stock cannot sustain fishing mortality (above F_{max}) thought generated by the 1990 catch. Unless catches are reduced there is danger of a long-term depression of the resource.

SUMMARY SHEET - Redfish in Divisions 3LN

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	25	25	25	25	25	25	25	14
Agreed TAC	25	25	25	25	25	25	25	14
Actual landings	15	21	43	78[1]	53[1]	34[1,2]	29[1,2]	-
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Includes STACFIS estimates for non-members who do not report to NAFO.
[2] Provisional data.

Weights in '000 tons

Catches: Average catch was about 20,000 tons prior to 1985. In 1986, landings doubled to 43,000 and increased again in 1987 to 78,000. Catches have declined since to 29,000 tons. The TAC has been exceeded each year since 1985.

Data and Assessment: Catch rates in both divisions indicate stability but may not be reflective of stock abundance. Trawl surveys inherently variable because of patchy distribution of redfish in this area. Exploitation rates at reference levels applied to USSR trawl-acoustic data.

Fishing Mortality: No estimate available for 1990.

Recruitment: No estimate available but appears poor in Div. 3L. In Div. 3N a pulse first appeared in 1989 but the strength of this cannot be evaluated.

State of Stock: Difficult to determine because of possible movement of fish between Div. 3N and Div. 30.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No Information available	
F_{90} =		
F_{max} =		

Recommendation: TAC for 1992 be 14,000 tons.

Special Comments: Possible migratory interactions with Div. 3O, may be the cause of the changes seen in the estimates of total biomass from USSR-trawl acoustic surveys between years.

SUMMARY SHEET - Silver Hake in Divisions 4VWX

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	100	100	100	100	167	235	-	100
Agreed TAC	100	100	100	100	120	135	135	100
Actual landings	74	75	83	62	74	91[1]	69[1]	-
Sp. stock biomass								
Recruitment (age 1)				No information available				
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: The fishery is conducted primarily by large Cuban and USSR otter trawlers using small-meshed bottom trawls. Recently (since 1989), Canadian Tonnage Class (TC) 2 and 3 otter trawlers entered this fishery. Nominal catches since 1970 ranged from a maximum of 300,000 tons in 1973 to a minimum of 36,000 tons in 1983. Since 1977 catches have generally increased, with the exception of 1983, from 37,000 tons in 1977 to 91,000 tons in 1989. Prior to 1977 the fishery was not restricted by season or area, however since 1977 the fishery has been restricted to April 1 through November 15 and to the area seaward of the small mesh gear line. Catch rates declined in May and June, then increased again in July. As was the case in recent years, the 1990 catch fell short of the TAC due to limited Canadian allocations. Since 1986 both the Cuba and USSR generally have taken more than 90% of their respective allocations.

Data and Assessment: The age composition of commercial catches from 1977 to 1990 were constructed from Canadian observer length frequency data. These length frequencies were used with Canadian age length keys for 1977-88, and combined Canadian/USSR age length keys for 1989 and 1990. Standardized commercial catch rates were calculated using data reported to NAFO and from data collected by Canadian observers. The Canadian July research vessel survey was used as another index of stock abundance. Since 1981 Canada and the USSR have jointly conducted a fall juvenile survey in 4WX. These data currently provide a measure of incoming recruitment. ADAPT not accepted but all formulations suggested 1988 year-class at age 1 was between 1.5 and 2.0 billion fish. Set 1990 year-class equal to that of 1988 and 1989 year-class equal to that of 1987 based on results of juvenile surveys. These formed the basis for projections.

Fishing Mortality: Could not be estimated but believed to be about $F_{0.1} = 0.72$.

Recruitment: Recruitment prospects are good, with the size of the 1990 year-class estimated from the juvenile survey similar to that of the strong 1988 year-class. The 1989 year-class is moderate and similar in size to the 1987 year-class. 1988 year-class set at 1.75 billion at age 1 for projections.

State of Stock: The standardized commercial catch rates show a general increase over the period 1980-89, although the value for 1982 appears anomalously high. In 1990 however, the catch rate dropped steeply to a level similar to that of 1983. The 1989 catch rate remains the highest since 1977. Population biomass estimates from the Canadian July research vessel surveys show a decline from 1984 to 1989 with a slight increase in 1990.

Forecast for 1991: Catch in 1991 is expected to be 66,000 tons based on non-Canadian allocations.

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1} = .72$	105,000	
F_{90} =		
F_{max} =		

Recommendation: TAC for 1992 be set at 105,000 tons based on projection at $F_{0.1}$.

Special Comments: STACFIS recommends that the entire issue of how to best assess this stock be revisited. This should include further studies of the ADAPT formulation as well as further development of useful indices for ages 1 and 2. In this context, the continuation of the joint Canada-USSR juvenile research vessel surveys is encouraged. STACFIS recommends that upon completion of the radio-nucleotide studies, one comprehensive document be prepared by Canadian and USSR authors.

SUMMARY SHEET - American Plaice in Division 3M

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	2	2	2	2	2	2	2	2
Agreed TAC	2	2	2	2	2	2	2	2
Actual landings	1.3	1.7	3.8	5.6	2.8	3.5[1]	1[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional data.

Weights in '000 tons

Catches: Ranged between 600 and 1,900 tons from 1974-85, then increased in 1986-89 to between 2,861 and 5,600 as effort was directed on this stock, decreasing to 996 tons in 1990.

Data and Assessment: No analytical assessment. Commercial data scarce in most years. Information from USSR survey (1972-88) and EEC survey (1988-89) used to evaluate stock status.

Fishing Mortality: No information available.

Recruitment: 1986 year-class is strong based on information from EEC surveys (1988-90).

State of Stock: Appears to be relatively stable around 10,000 tons based on estimates from EEC surveys.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: A TAC of 2,000 tons is advised which approximates to the $F_{0.1}$ level based on EEC survey estimates.

Special Comments: STACFIS noted the necessity of more information on stock age composition in order to facilitate a more thorough evaluation of this stock. It is recommended that age composition of surveys and commercial catches be presented at the June 1992 Meeting.

SUMMARY SHEET - American Plaice in Divisions 3LNO

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	55	49	55	48	28	30.3	24.9	25.8
Agreed TAC	55	49	55	48	40[1]	30.3	24.9	25.8
Reported landing	37.6	49.5	60.3	55.0	41.4	40.5[2]	23.9[2]	
Non-reported catches	1.8	4.7	4.3	0	0.1	3.1	8.1	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Effective TAC was 33,585 tons.
[2] Provisional.

Weights in '000 tons

Catches: Highest catches occurred in the late-1960s with a peak catch of 94,000 tons taken in 1967. Catches were stable at about 50,000 tons during the 1970s. Overall catches declined from an 18-year high of about 65,000 tons in 1986 to about 32,000 tons in 1990.

Data and Assessment: Analytical assessment of catch-at-age data using the Adaptive framework with Canadian CPUE and RV survey data were rejected due to uncertainties with the data and lack of fit of the model.

Fishing Mortality: No information available.

Recruitment: From RV surveys, recruitment of year-classes of the late-1970s and early-1980s was well below the levels of the year-classes of the late-1960s and early-1970s. The 1985 and 1986 year-classes appear to be larger than average.

State of Stock: The stock is at a relatively low level. RV surveys indicate a continuing but variable decline while Canadian C/E indicates stability from 1986-90 at a relatively low level. Improved recruitment from the 1985 and 1986 year-classes.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: Catches for 1992 should not exceed current TAC of 25,800 tons.

Special Comments: Continuation of the catches above the TACs, coupled with increased targeting of the fisheries in the Regulatory Area on young fish, will reduce the potential benefits of improved recruitment.

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

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	5	5	5	5	5	5	5	5
Agreed TAC	5	5	5	5	5	5	5	5
Actual landings	3	9	9	8	6	4[1]	4[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional data.

Weights in '000 tons

Catches: In the period 1970-84, catches ranged from a low of 2400 tons in 1980-81 to a high of 9,200 tons in 1972. From 1985 to 1988, catches exceeded the TAC by large margins but have been declining since 1986. It was believed that catches by non-member countries in the most recent years may not be significant.

Data and Assessment: Estimates of stock size from research vessel surveys were variable, but were not considered adequate for this stock because they do not cover deeper areas where witch flounder are found. Abundance indices are not adequate to draw firm conclusions on stock status.

Fishing Mortality: Unknown

Recruitment: Unknown

State of Stock: Stock size could not be firmly established, however, it appears it may have declined in recent years.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: TAC of 5,000 tons should remain in effect.

Special Comments: More detailed information from the commercial fishery is required to properly evaluate this resource. RV surveys do not cover the total area of distribution.

SUMMARY SHEET - Yellowtail Flounder in Divisions 3LNO

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	17	15	15	15	15	5	5	7
Agreed TAC	17	15	15	15	15	5	5	7
Reported catches	14.9	24.0	24.5	16.3	16.2	9.1	8.9	
Non-reported catches	1.8	5.0	5.7	0	0.1	1.1	5.1	
Total landings	16.7	29.0	30.2	16.3	16.3	10.2[1]	14.0[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Catches peaked in 1972 at 39,000 tons, declined rapidly, and stabilized at 10,000-15,000 tons for most of the 1970s and early-1980s. They were about double the TAC during 1985-86 as effort increased in the Regulatory Area in Div. 3N. Catches declined in 1989, as the TAC was reduced, but increased to about 14,000 tons in 1990.

Data and Assessment: No analytical assessment possible. Data from Canadian catch rates and Canadian and USSR RV surveys were used to determine trends in stock abundance.

Fishing Mortality: No information.

Recruitment: The 1984-86 year-classes appeared to be stronger than the 3 preceding weak year-classes.

State of Stock: The stock is still at a low level, however, there is improved recruitment from the 1984-86 year-classes.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: 7,000 tons TAC advised for entire stock.

Special Comments: STACFIS again expressed concern about the removals of large quantities of juvenile yellowtail in the Regulatory Area, particularly as it appears that small mesh gear is being used in some yellowtail directed fisheries. Although impossible to quantify, it was noted that continuation of the current exploitation pattern in these fisheries would result in a substantial decline in yield-per-recruit.

STACFIS noted that catches in the Regulatory Area increased from 1988 to 1990 and re-emphasized that this fishery will be impossible to manage if unregulated catches by non-member countries increase from the low levels of 1987-88 to the levels estimated in 1985-86.

SUMMARY SHEET - Greenland Halibut in Subareas 0 and 1

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	25	25	25	25	25	25	25	25
Agreed TAC								
Reported landings	7	10	9	10	10	9[1]	19[1]	
Actual landings								
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: The catches increased in 1990 due to increased fishery in Div. 0B by Canada, Faroe Islands and USSR. In Subarea 1, 88% of the catch was taken by Greenland in the fjords of West Greenland by gillnets and longlines.

Data and Assessment: Results from three bottom-trawl surveys indicate stable biomass. No analytical assessment.

Fishing Mortality: No information available.

Recruitment: No information available.

State of Stock: Only a part of the inshore component in Subarea 1 is fully exploited.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: TAC be maintained at a level of 25,000 tons.

Special Comments: Any expansion of the fishery should be directed towards the offshore areas.

There appears to be no biological reason to maintain separate assessments for the stocks in Subareas 0+1 and 2+3, however, at present, there are practical difficulties which preclude a combined assessment.

SUMMARY SHEET - Greenland Halibut in Subarea 2 and Divisions 3KL

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	55[1]	75	100	100	100	100	50	50
Agreed TAC	55	75	100	100	100	100	50	50
Reported landings	25	19	16	31	19	19[2]	29[2]	
Non-reported catches							18	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] TAC for Div. 2J3KL only.
[2] Provisional.

Weights in '000 tons

Catches: Peaked at 38,500 tons in 1978 then declined to an average of 20,000 tons during the last 5 years. Increased sharply in 1990 because of developing fishery in the Regulatory Area of Div. 3LM.

Data and Assessment: Analytical assessments considered unacceptable until migratory patterns, at least, can be quantified. RV surveys continue to be the more important indices of abundance for this stock distributed in the survey area.

Fishing Mortality: Unknown

Recruitment: The 1984, 1985 and 1986 year-classes appear good and should contribute significantly to the fishery in forthcoming years.

State of Stock: Stock biomass within the survey area estimated to be relatively stable currently at a level of about half that estimated in mid-1980s. Stock abundance within the survey area at relatively high level due to improved recruitment.

Forecast for 1992:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: A TAC of 50,000 tons would approximate fishing at $F_{0.1}$. This TAC should apply to the entire stock, including the fishery in the Regulatory Area in Div. 3LM.

Special Comments: Little is known of the population in the 3LM area, but STACFIS concluded that these fish are part of the SA 2 and Div. 3KL stock.

There appears to be no biological reason to maintain separate assessments for the stocks in Subareas 0+1 and 2+3, however, at present, there are practical difficulties which preclude a combined assessment.

SUMMARY SHEET - Roundnose Grenadier in Subareas 0 and 1

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	8	8	8	8	8	8	8	
Agreed TAC	8	8	8	8	8	8	8	
Actual landings	0.05	0.06	0.09	0.38	0.52	0.05[1]	0.15[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

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

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

Fishing Mortality: No estimate available.

Recruitment: No estimate available.

State of Stock: Not possible to evaluate. Research surveys by Japan and Greenland in 1987 and 1988 resulted in biomass estimates of about 45,000 tons. The 1989 estimate of 5,900 tons and the two estimates of 7,000 tons and 20,300 tons in 1990 were not considered to be realistic.

Forecast for 1992:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: TAC for 1992 remain at 8,000 tons.

Special Comments:

SUMMARY SHEET - Roundnose Grenadier in Subareas 2 and 3

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	11	11	11	11	11	11	11	11
Agreed TAC	11	11	11	11	11	11	11	11
Actual landings	4	5	7	8	6	5[1]	4[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Catches have been below 10,000 tons since 1978. In 1990 Portugal accounted for over 50% of the total, with catches in the Regulatory Area of Div. 3LM associated with their Greenland halibut fishery.

Data and Assessment: Catch rates indicate a gradual decline in recent years but this may reflect movement of the fish to deeper waters inaccessible to trawling.

Fishing Mortality: No estimate available.

Recruitment: No estimate available.

State of Stock: Not possible to evaluate.

Forecast for 1992:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: TAC for 1992 remain at precautionary level of 11,000 tons.

Special Comments: It is not anticipated that data necessary to provide more meaningful advice will be available in the near future.

SUMMARY SHEET - Capelin in Divisions 3N and 3O

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	0	0	0	10	10	28	30	30
Agreed TAC	0	0	0	10	15	28	30	30
Actual landings	0	+	0	1	7	5[1]	21[1]	
Sp. stock biomass[2]	88	212	527	273	560	28	-	
Recruitment (age)	No information available							
Mean F								

[1] Provisional
[2] In some years, these are averages of USSR and Canadian acoustic surveys and in other years only Canadian estimates were available. These are estimates of mature biomass.

Weights in '000 tons

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

Data and Assessment: Acoustic surveys of the spawning stock through 1981-89. No estimates available for 1990 spawning biomass.

Fishing Mortality: Exploitation considered to be less than 10% of long-term mean spawning biomass.

Recruitment: 0-group surveys do not indicate a decline in recent years.

State of Stock: Mean stock size 1981-89 was about 303,000 tons. USSR acoustic surveys during 1975-77 indicated mean biomass of 912,000 tons.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: No basis on which to change the previous advice of 30,000 tons.

Special Comments: STACFIS concluded that a conservative exploitation rate is appropriate. This is based on possibly imprecise acoustic estimates, variable projection parameters and importance of capelin as a prey species.

SUMMARY SHEET - Squid in Subareas 3 and 4

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	150	150	150	150	-	-	-	-
Agreed TAC	150	150	150	150	150	150	150	150
Actual landings	1	1	+	2	1	7[1]	11[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional

Weights in '000 tons

Catches: Peaked in 1979 at 162,000 tons, declined to less than 2,000 tons during 1983-88. Increased to 11,000 tons in 1990.

Data and Assessment: Commercial fishery data available in recent years. No sampling or research data available for 1990.

Fishing Mortality: No information available.

Recruitment: No information available.

State of Stock: Dependent on one year-class only.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available	
F_{90} =		
F_{max} =		

Recommendation: No advice possible

Special Comments: STACFIS is not able to provide more precise advice than it did at 1980 meeting without up-to-date information on squid stock, especially for recruitment. No research is presently being conducted on this stock of squid.

SUMMARY SHEET - Shrimp in Subareas 0 and 1

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Offshore SA 0+1 (south of 71°N)								
Recommended TAC	29.5	36	36	36	36	44	50	50
Agreed TAC	34.9	42.1	42.1	40.1	40.1	40.1	44.9	46.2
Actual landings	35.9	42.2	44.6	46.2	43.6	51.1	52.4	-
Offshore SA1 (N of 71°N)								
Recommended TAC	-	-	-	-	-	-	-	2.5
Agreed TAC	-	-	-	11.6	11.5	8	6.8[1]	6.8[1]
Actual landings	-	4.3	11	10.7	6.7	2.5	2.1	-
SA 0+1 total (including inshore catches in SA1)								
Actual landings	43.4	54.0	63.1	63.8	60.5	68.1	69.6	-

[1] Including the area from 60°30'N to 71°N, west of 58°W. Weights in '000 tons

Catches: Increased to about 50,000 tons in 1976, decreased to about 45,000 tons in 1980-84, then increased to 70,000 tons in 1990.

Data and Assessment: Trawl surveys showed a biomass estimate for 1990 comparable to that of 1988. Standardized CPUE indices from SA 0 and SA 1 declined from 1987 to 1989 and levelled off between 1989 and 1990.

Fishing Mortality: No information available.

Recruitment: No quantitative information available

State of Stock: Commercial fisheries and research data show a potential for improved recruitment to the fishery in 1991 and 1992 depending on the actual strength of the 1985 year-class. However, the significance on recruitment in the coming years of the higher catch levels in the range of 45,000-52,000 tons from 1986 can not yet be evaluated.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =	No information available.	
F_{90} =		
F_{max} =		

Recommendation: TAC for 1992 not to exceed 50,000 tons (for Subarea 0 and offshore Subarea 1 south of 71°N).

Special Comments: Concern over high discard rates in Subarea 1.

SUMMARY SHEET - Shrimp in Denmark Strait

Source of Information:

Year	1984	1985	1986	1987	1988	1989	1990	1991
Recommended TAC	4.2	5	-	-	-	10	10	10
Agreed TAC[1]	5.3	6.1	7.5[2]	7.7[2]	8.7[2]	9[2]	14.1	14.5
Actual landings	6.7	8.1	11	12.2	12.6	10.7[3]	10.3[3]	-
Sp. stock biomass								
Recruitment (age)	No information available.							
Mean F								

[1] On Greenland side of midline only.
[2] Not including Greenland fishery north of 66°30'N.
[3] Provisional.

Weights in '000 tons

Catches: Increased from less than 400 tons in 1978 to around 12,500 tons in 1988, then decreased to approximately 10,300 tons in 1990.

Data and Assessment: General biological data, catch and effort data from the fishery, standardized assessment of the CPUE and general production model. No analytical assessment.

Fishing Mortality: Not known.

Recruitment: Not known.

State of Stock: The decline of CPUE suggests that shrimp abundance from 1988 to 1990 is substantially lower than in previous years. This might be due to the fishery given that the overall decline in CPUE was coincidental with the increased effort. The apparent decrease in the size of sex reversal in 1990 and the increased proportion of males in the commercial catches and in the Norwegian survey estimates may also indicate a response to either fishing pressure or to changes in environmental conditions.

Forecast for 1991:

Option Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =		
F_{90} =	No information available.	
F_{max} =		

Recommendation: A lower TAC is considered to be appropriate but information is not sufficient to determine an exact lower level and therefore an arbitrary reduction from 10,000 to 8,000 tons is advised.

Special Comments: STACFIS recommends that all historical data (commercial sampling, research survey, etc.) be thoroughly analyzed in relation to hydrographic data and results made available for future assessments.

4. Responses to Questions by the Fisheries Commission

The following responses to questions by the Fisheries Commission were approved by the Scientific Council:

a) Cod in Divisions 2J, 3K and 3L (SCR Doc. 91/51; SCS Doc. 91/15, 16)

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

After reviewing a detailed study on stock discrimination in 1986 (NAFO Sci. Coun., Rep. 1986, pages 121-124), STACFIS concluded that it was appropriate to assess cod in Div. 2J, 3K and 3L as a single stock complex. At present, this conclusion remains unchanged, however, studies on stock structure in this area are ongoing. The potential of including mixing rates in assessment models is also being evaluated.

Estimates of the proportion of the cod biomass in Div. 3L in the Regulatory Area were updated to include the 1990 Canadian spring and autumn research vessel (RV) surveys. These results are similar to those presented previously and are as follows:

Season RV survey conducted	Years RV survey conducted	Range of proportions of biomass occurring in the Regulatory Area (1990 value in brackets)	Average proportion (%)
Winter	1985-86	23.8-26.8	25.3
Spring	1977-90	0.4-6.1 (5.6)	2.9
Autumn	1981-90	0.5-7.7 (2.9)	3.0

Results of the autumn survey conducted in all three Divisions (2J, 3K and 3L) by Canada since 1981, continued to show that the proportion of the cod in the Regulatory Area at that time of year was less than 1%, on average of the total Div. 2J+3KL biomass. The average breakdown of biomass by Division is as follows:

Division	Relative proportion of biomass (%)
2J	38
3K	33
3L	29

By assuming that the relative distribution observed between divisions during autumn was similar to that at other times of the year, it has been previously concluded that "the proportion of the entire Div. 2J+3KL cod biomass estimated to occur in the Regulatory Area is less than 10% in winter and less than 5% on average throughout the year" (NAFO Sci. Coun. Rep., 1990, p. 103). Updating these data leaves this conclusion unchanged and because the proportions of cod in the Regulatory Area in Div. 3L exhibit no annual trends, the proportions expected to occur in this area in the future would be about the same as those observed.

Age compositions derived from Canadian RV surveys in areas inside and outside 200 miles were also updated. The results continued to indicate that proportionately larger numbers of young cod occur in the Regulatory Area than inside 200 miles, however, during 1990 this pattern was less clear. The proportion at age inside and outside 200 miles were more similar in 1990 than previously observed because of the presence of the strong 1986 and 1987 year-classes, ages 3 and 4 in 1990 (Fig. 1). The 1989 results representing a more typical year are also included in Fig. 1.

Age compositions for Spanish pair-trawl and Portuguese otter-trawl fisheries in 1990 were similar to those observed for the Canadian RV data for corresponding months (Fig. 2).

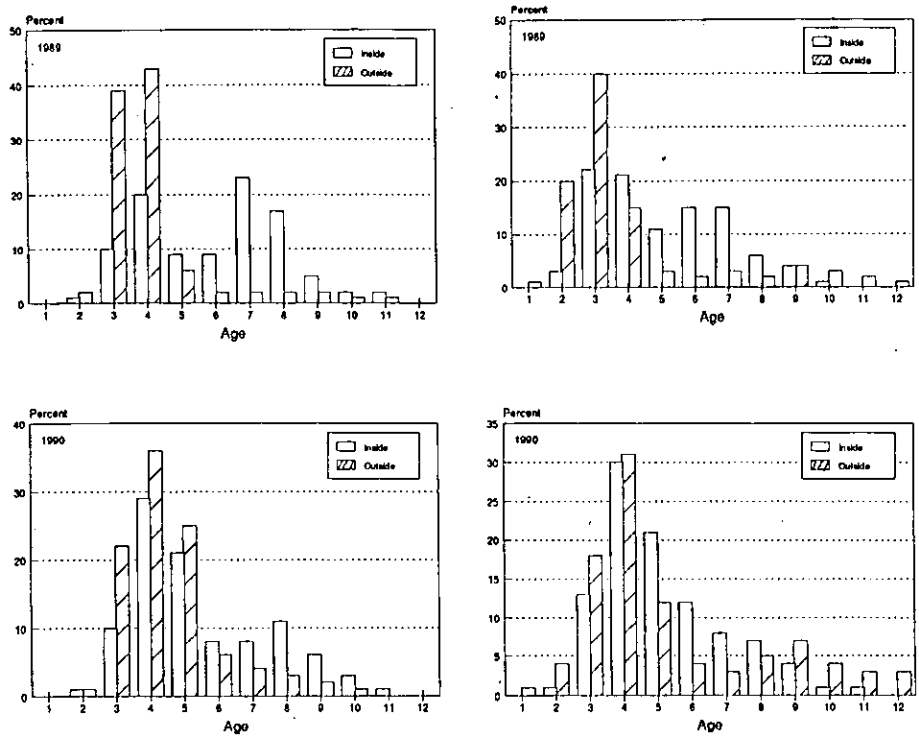

Fig. 1. Cod in Div. 2J+3KL: spring and autumn catch-at-age for Canadian research vessel surveys.

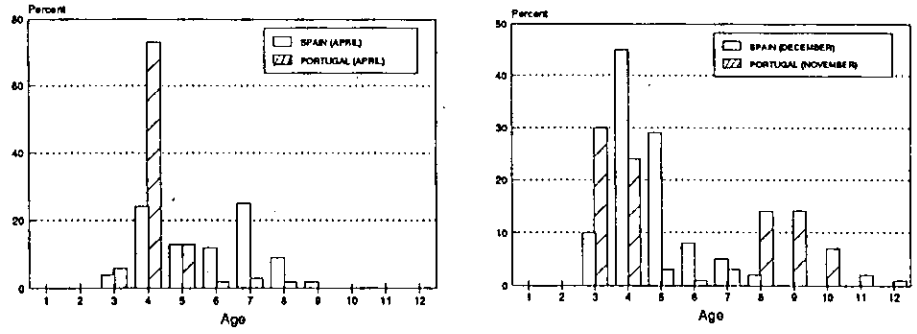

Fig. 2. Cod in Div. 2J+3KL: spring and autumn catch-at-age for EEC-Spain and EEC-Portugal fisheries.

b) Flounders in Divisions 3LNO

With respect to flounders in Div.3LNO, the Scientific Council is requested to: *provide advice on management options that would reduce the extent to which the fisheries reduce the potential yield due to harvest of small fish.*

STACFIS again noted that large numbers of juvenile flatfish were caught in the Regulatory Area in Div. 3N, although there was more uncertainty with the catch-at-age in 1990 for yellowtail flounder and American plaice because a higher proportion of the catch was comprised of estimates for which there were no sampling data. It was concluded that the effective mesh size for some fisheries in the Regulatory Area was still likely to be much smaller than the NAFO regulation mesh size, and may have been as low as 60 mm again in 1990.

STACFIS once again emphasized that the obvious way to reduce the loss in potential yield due to the harvest of small fish is to enforce the minimum mesh size regulations in the Regulatory Area. Until this is done, it is not practical to advise on measures such as closed areas or seasons. In any case, the information required to develop advice on such measures, as requested by Scientific Council in 1989, has not been provided to date.

c) Witch Flounder in Divisions 3NO

With respect to witch flounder in Div. 3NO, the Scientific Council is asked to: *provide an analysis of the effect on stock status of the lowering of the TAC to 5,000 tons for 1981 and the maintenance of that TAC level in subsequent years.*

STACFIS noted that catches have averaged about 5,000 tons since the TAC was placed at that level, but the TAC had been exceeded in each year from 1985 to 1988. The indices of abundance for this stock are not adequate as measures of total stock size, as surveys do not extend into the deeper areas covered by the fisheries and catch-rate data are not complete or continuous for many fleets. There was nothing in the survey data to suggest that the stock had increased, in fact there were indications to the contrary. STACFIS concluded that until the indices of abundance for this stock are improved, it will be very difficult to evaluate the effect of management strategies on stock status. It was noted that the report of the assessment of this stock contained a number of recommendations dealing with the indices of abundance.

d) Squid in Subareas 3 and 4

With respect to squid in SA 3 and 4, the Scientific Council is asked to *examine all data available to it and if possible to present options for the management of the stock that are based on the NAFO principles of optimum utilization and conservation.*

STACFIS noted that there were no new research results available at this meeting and that no research is presently being conducted on squid. Until such time as new research is initiated and results made available for evaluation by STACFIS, it will not be possible to contemplate the provision of advice on this species.

e) Capelin in Divisions 3NO

The Scientific Council is requested to: *advise at its June 1991 Meeting on the most rational level of management of capelin in Divisions 3NO, on the basis of the main principles of NAFO: optimum utilization and conservation of stocks. The Council should evaluate the importance of capelin at different stages of their life history to the marine ecosystem and in particular, given the mass mortality following spawning, the significance of a management option that refers to harvesting during the period immediately prior to spawning. Other management options such as maintaining minimum spawning biomass should be evaluated in terms of both maintaining stock size and the impact on the ecosystem.*

Management, catches and TACs

TACs on capelin in Div. 3LNO were first applied in 1974. The stocks occurring in Div. 3LNO and Subdiv. 3Ps were originally managed as a stock complex because of the mixing of these stocks during the prespawning portion of their life history. National allocations were provided for Div. 3L, 3NO and Subdiv. 3Ps but because of the migration routes of capelin and the pattern of fishing, countries with specific allocations could add to their 3NO allocations any part of their Subdiv. 3Ps and Div. 3L allocations not taken in the latter two areas (see e.g. p. 15, 1975 ICNAF Redbook). All capelin stocks in the Northwest Atlantic declined during the late-1970s but it appeared that the Div. 3NO capelin stock had declined at a faster rate (p. 37, 1979 ICNAF Redbook). In 1979, for the first time, advice was provided separately for capelin in Div. 3NO advising a closure of this fishery. This advice was followed and no fishery in Div. 3NO occurred during 1979-86 inclusive. During the 1986 meeting, STACFIS determined that this stock had recovered enough to permit a small fishery and advised that a 10,000 ton catch would probably not be detrimental to the stock and would represent approximately 5% of the average biomass observed since 1981. This precautionary TAC advice stayed in effect until the 1988 meeting when STACFIS advised that an exploitation rate be applied to the average biomass.

TACs since then have been advised based on 10% of the average biomass from acoustic surveys during the 1980s. A summary of the TACs and catches ('000 tons) since 1970 is given below.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Advised TAC	-	-	-	-	[1]	[1]	[1]	1	1	0	0
TAC	-	-	-	-	[1]	[1]	[1]	1	1	0	0
Catch	0	1	21	127	101	132	110	47	5	0	0

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Advised TAC	0	0	0	0	0	0	10	10	28	30	30
TAC	0	0	0	0	0	0	10	15	28	30	30
Catch	0	0	0	0	+	0	1	7	5	21	

[1] Part of TAC for Div. 3LNO and Subdiv. 3Ps.
[2] Provisional.

Stock structure

Capelin spawn on the bottom at depths approximately 50-60 m on the Southeast Shoal (Div. 3N) during June and July. This spawning time is coincidental with spawning of capelin on beaches in Newfoundland and this observation has been the basis for stock discrimination studies.

Morphometric and meristic studies have separated this spawning group from inshore spawners. However, more recent genetic studies have not shown a difference between Southeast Shoal fish and those spawning inshore in Newfoundland. An alternate hypothesis is that capelin spawning on the Southeast Shoal do so in greater numbers when the abundance is high over the entire range in the Northwest Atlantic and therefore, this is not a separate spawning stock.

Juvenile and pre-spawning capelin from the Div. 3NO stock are believed to use the Grand Bank as a nursery area and as a result, mix with juveniles from the Div. 3L stock. It is clear from recent tagging studies that maturing capelin destined to spawn on inshore beaches occur in Div. 3O prior to spawning. As a result of these observations, it is probable that an offshore fishery in Div. 3L and 3O (and possibly 3N) could operate on mixed stocks of Div. 3L and Div. 3NO capelin.

Biomass estimates

Acoustic estimates of abundance of mature capelin measured on the spawning grounds are available since the 1970s. The 1972 estimate was derived from a Norwegian survey but the others were from USSR and Canadian surveys. Only two estimates in the 1980s exceeded 500,000 tons. In contrast, the 1972 Norwegian estimate (or range of estimates) is lower than most estimates during the 1980s and the three USSR estimates during 1975-77 are higher than other estimates. A summary of these estimates ('000 tons) is given below (top row is Norwegian/USSR and bottom row is Canadian).

1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
125-170			1050	687	1000	*	**	**	109	-	269	***	***	559	315	***	***
									223	419	219	88	212	495	230	560	28

* No mature capelin found by USSR and Canadian surveys.

** No mature capelin found by USSR; mature capelin found in Canadian survey but biomass estimates considered unreliable.

*** Biomass estimate for Div. 3NO could not be separated from total Div. 3LNO estimate.

Stock and recruitment

No stock-recruit relationship has been demonstrated for capelin in Div. 3NO. The time-series of estimates is short and the data exhibit considerable scatter.

A stock-recruit relationship has been shown for Barents Sea capelin using data from the 1970s. This relationship was used as a basis for defining a target spawning stock biomass and for several years, catch levels were based on conservation of this spawning stock biomass. However, during the latter part of the 1980s, this relationship has deteriorated. For example, in 1984 and 1985, recruitment failed completely even though spawning stocks of comparable abundance had produced much higher recruitment during 5 other years. In contrast, the strong 1988 year-class was produced from a small spawning stock. While the exact cause for the change in the stock recruit relationship has not been determined, one possible explanation is the increase in the herring stock in the Barents Sea in the 1980s which may be having negative effects on capelin recruitment. As a result of this observation, the relevant ICES Working Group recommended that the spawning biomass of capelin during 1991 should be higher than the previously established target, based on the likelihood of poor survival of the 1991 year-class of capelin.

In the Northwest Atlantic, the environment has been shown to be an important regulator of larval survival and subsequent recruitment in beach-spawning capelin. An analogous environmental effect has been hypothesized for Div. 3NO capelin and data from one year support this hypothesis. However, more years of study are needed to fully test the hypothesis.

Capelin as prey

Capelin is an important prey species for seabirds, marine mammals and many commercial species of fish, especially cod. Because feeding data for cod are more extensive than for other predators and because of the relevance of cod in a management context, STACFIS focused most of its discussion on cod feeding.

Capelin stocks are believed to mix in Div. 3L and 3NO and as a result, cod in both areas may be affected by capelin abundance and distribution.

Cod on the northern slopes of the Grand Banks feed on capelin in winter. Cod also feed on capelin in various parts of the Avalon Channel and the northern, western and central Grand Banks in spring and summer. Predation on capelin also occurs in autumn

central Grand Banks in spring and summer. Predation on capelin also occurs in autumn but there has been less study during that season. The spatial pattern of cod predation on capelin varies annually within the same season.

Predation by cod on capelin in Div. 3NO appears to occur primarily in spring and summer, although this may reflect a low level of study in autumn and winter. Prior to the decline of haddock on the Grand Bank, they were reported to have fed heavily on capelin spawn.

There is a lack of data on physiological parameters (e.g. digestion rate) of cod for the Northwest Atlantic and this taken with the lack of detailed feeding data especially for Div. 3NO prohibits the quantification of predator-prey interactions. STACFIS noted that this has been done in the Barents Sea and has been incorporated into scientific advice for capelin in this area. In spite of the inability to quantify these cod-capelin interactions, STACFIS concluded that capelin is an important prey for many species and this should be borne in mind when providing advice for catch levels for capelin.

Conclusions

The recommendation for a 10% exploitation rate was first advised by ICNAF in 1979. At that time, recruitment was poor and capelin stocks were low. STACREC concluded that during periods of poor recruitment, the exploitation rate should be low to protect the spawning stock. A conservative exploitation rate of 10% was used and applied to the capelin in Div. 3LNO with the recommendation that the TAC be applied to Div. 3L only and the fishery in Div. 3NO be closed.

This 10% exploitation rate has been maintained for the Div. 3L stock since 1979 and as noted above, was applied to the Div. 3NO stock in 1988. Recruitment in the capelin stocks has been higher during the 1980s but the advice for a 10% exploitation rate has been maintained based on other considerations. These other considerations have been the importance of capelin for cod, possible imprecise acoustic estimates and the fact that projections of mature biomass are dependent on the estimates of the age-specific proportion of mature capelin and age-specific mortalities, both of which probably exhibit annual variation. While these considerations are not cited each year, they have been the reasons for recommending a conservative exploitation rate of 10% for capelin.

STACFIS noted that the recommendation of a 10% exploitation rate was not based on an analytical analysis nor was one performed for this meeting. However, the Council agreed with STACFIS and it continues to recommend *a conservative exploitation rate for capelin based on the reasons outlined above.* STACFIS was especially concerned about possible deleterious effects on predators that might occur due to a decline in capelin precipitated by overexploitation. The decline of capelin in the Barents Sea, and the negative effects on predator stocks due to this decline have been severe. The complex predator-prey interactions and several aspects of capelin biology including stock structure and factors affecting survival and recruitment are poorly understood in the Northwest Atlantic.

STACFIS noted that a modelling study has been initiated using the Div. 3L database. This model is a risk analysis and will examine the current methods of projecting Div. 3L biomass from acoustic surveys. Although the database for Div. 3NO capelin is not as extensive, the principles of management should be applicable to both stocks. The results of the study are expected to be available by the end of 1991 but some preliminary results might be available by the September 1991 Meeting.

Recommendations

The Council endorsed STACFIS recommendations that *research be conducted in the following areas:*

i) Research on stock structure and mixing should be continued.

ii) More research should be directed towards predator-prey interactions with the aim of incorporating the results in the advice for capelin.

iii) Studies on reproduction capacity estimation on different stocks of capelin should be initiated. This information would be useful in determining minimum spawning stock biomass.

The possibilities of alternate management strategies should be considered. Capelin are schooling fish and bottom spawners and they spawn in a predictable area on the Southeast Shoal.

The egg beds and spawning behaviour may be disrupted by commercial fishing and alternate management techniques such as closed fishing areas and/or closed fishing seasons, alone or in conjunction with quotas, may be effective conservation measures.

5. Environmental Research

The Council noted that the Environmental Subcommittee of STACFIS had met on 11 June 1991 with M. Stein as Chairman. The total number of documents reviewed, specifically addressing environmental issues and the additional biologically oriented papers which had environmental

data, had decreased substantially from the previous year. The Subcommittee had discussed a wide range of subjects including the general environmental overview of the NAFO Convention area, and the possible implications for fish and fisheries of global warming and Greenhouse gas interactions.

The Council particularly noted the absence of observers from USA and some environmental data that they normally submit. The Council recognizing the importance of longtime series of data, endorsed the recommendation requesting data usually submitted particularly on the variation in the shelf water front position from Georges Bank and Cape Hatteras and on the *anticyclonic warm-core Gulf Stream rings*.

6. Ageing Techniques

The Council noted that the collaboration between Canada and the USSR pertaining to ageing of silver hake has progressed to the point where agreement is sufficiently good so that combined age/length keys could be used to construct the 1989 and 1990 data. Further work is ongoing, and once this is completed, a comprehensive manual will be produced.

There was no progress in 1990 on the planned exchange of American plaice and Greenland halibut otoliths between Canada and the EEC. An ageing workshop will be held at St. John's, Newfoundland in early December 1991 (B. Brodie - Canada, and P. Ernst - EEC as co-convenors) at which time further work will be done on both species. Representatives from all Contracting Parties will be invited to attend.

7. Gear Selectivity

The Council noted that a single paper was reviewed by STACFIS on the effect of tow duration on gear selectivity.

8. Review of Scientific Papers

The Council noted that nine papers which were not reviewed by STACFIS during general assessments were reviewed and summarized separately.

9. Other Matters

a) Review of the Current Arrangements for Conducting Stock Assessments and Document of *Assessments*

Because of the changes in the content of the STACFIS report in 1991, it was agreed to defer this item until September in order to allow time for the receipt of feedback pertaining to these changes.

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

1. Fishery Statistics

a) The Council again noted with concern that the timeliness of the submission of STATLANT 21A and 21B data reports was not improving. This meant that the most recent catch and effort data were often not available for stock assessments. This also meant a severe delay in the publication of the Statistical Bulletin and of the availability of confirmed data for use by the scientists. The Council noted that other aspects of NAFO business, such as budgets, were also affected by late submissions of these data.

The Council took note that the updating of catch and effort database by the Secretariat was completed. The data going back to 1960 could be used in a summary report on the 30 year time series when disaggregated catches for EEC-France (M) and France (SP) for 1983-85 are received.

b) The Council was pleased to note that separate catch and effort statistics for fisheries occurring in the NAFO Regulatory Area were to be requested from Contracting Parties, and that this may lead to NAFO statistics being collected on a finer geographic scale.

c) The Council endorsed the recommendation by STACREC that a delegate from the USSR attend the Fifteenth Session of CWP at NAFO Headquarters from 8-14 July 1992 and noted that in order to prepare for that meeting, the Assistant Executive Secretary was scheduled to attend the *Ad hoc* Inter-Agency Consultation meeting which precedes the 79th Statutory Meeting of ICES, in September 1991.

2. Biological Sampling

The Council noted that the next publication of the list of Biological Sampling Data would cover the period 1985-89, and would be published when outstanding information was received. The Council took note of the recommendation to try to obtain sampling data for catches of non-member countries along with the catch and effort data for those nations.

3. Biological Surveys

It was noted that STACREC was presented with the inventories of surveys conducted in 1990 and of surveys proposed for 1991 and early 1992.

The lists of surveys, by stock, were reviewed by STACFIS in the reports of each stock assessment. The Council agreed that the lists would be published as an SCS document and similar compilations would be made annually from updates prepared by the Designated Experts for stocks reviewed by STACFIS.

4. Other Matters

The Council observed that the List of Fishing Vessels for 1989 was to have been published in 1990, but that data are still outstanding from 4 countries or components.

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

1. Review of STACPUB Membership

The Council supported STACPUB in expressing acknowledgement of the conscientious work of W. R. Bowering in the Committee over the last 2 years and welcomed his replacement, J. E. Carscadden.

2. Review of Scientific Publications

The Council was pleased to note that Journal Volume 10 containing the first invitational paper was published as planned in December 1990. Volume 11 was also published as planned with the publication date of February 1991. The Council noted the single issue of the Journal with papers presented at the 1989 Special Session on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic over the Last 30 Years and Their Possible Causes" was still in preparation, and also the next regular issue of the Journal would hopefully be ready for publication by late 1991.

The Council noted Studies Number 15 was in its final stages of printing and was pleased with the rapid turn-around time in preparation of Studies Number 16 containing 20 papers presented at the 1990 Special Session on "Management under Uncertainties Related to Biology and Assessment, with Case Studies on Some North Atlantic Fisheries", which is expected to be completed in 2-3 months.

The Council was pleased to note that the Scientific Council Reports 1990 was published and distributed as planned in December 1990. NAFO Statistical Bulletin Vol. 38 was published in February 1991 in a rapid turn-around time once data were received.

3. Production Costs and Revenue for Scientific Council Publications

The Council noted that no significant departures from the previous years production costs and revenues were observed. The Journal Vol. 4 continued to attract interest and sales since June 1990 had in fact increased.

4. Promotion and Distribution of Scientific Publications

The Council felt that high quality Journal papers with quick turn-around time from submission to publication were very important factors in maintaining the position of NAFO publications. Issues of Studies, such as the publication from the 1990 Special Session, was an especially useful avenue for publication.

The Council noted that Vol. 10 containing the first invitational paper by A. T. Pinhorn and R. G. Halliday had been well-received. In view of this success the Council endorsed the continuation of the policy of inviting papers for publication from selected authors.

5. Editorial Matters

Council noted that of the 22 papers presented at the September 1990 Special Session, 20 were submitted and processed for publication in Studies. Of the 8 papers nominated at the June 1990 meeting, 4 papers had been submitted. Council was pleased to note that a total of 40 papers were published or were in their final stages of preparation since June 1990.

In addition a total of 32 papers were currently in various stages of editorial review for the Journal. Council agreed with STACPUB that the review process had been very slow for some papers and that the general editorial process should be improved in order to shorten the turn-around time.

6. Papers for Possible Publication

The Council noted that STACPUB had considered 94 SCR Documents and 16 SCS Documents presented to this meeting and invited the authors of 20 papers to submit them in a suitable form for publication in the Journal or Studies.

The Council also noted that 8 papers have been submitted and 5 more expected for Journal consideration from the 26 oral presentations at the USSR-Canada Bilateral Meeting on Capelin held in St. John's, Newfoundland, 28-30 November 1990.

7. Microfiche Projects

The Council noted that no sets were sold during 1990 meaning that a total of 13 out of the 30 sets of ICNAF documents have been sold. The Council noted also that STACPUB discussed an alternative possibility of archiving NAFO documents on optical storage discs (CDs).

8. Other Matters

The Council noted that most laboratories had telefax equipment and any urgent matters could be dealt with by using them.

V. RULES OF PROCEDURE

The Executive Secretary introduced NAFO Circular Letter 91/37 which had been circulated to Contracting Parties on 25 March 1991. This document, which included all Rules of Procedure relevant to the Scientific Council, was described as containing a complete update of the NAFO Handbook which was last printed in 1984 along with all subsequent amendments and insertions. The Executive Secretary requested the Council to forward to the Secretariat, any comments with respect to revisions and publication of the new handbook.

VI. COLLABORATION WITH OTHER ORGANIZATIONS

1. a) Joint ICES/NAFO Working Group on Harp and Hooded Seals

The Chairman noted that arrangements for this joint working group was well underway with ICES undertaking all administrative aspects. There were no requests for a meeting to date.

b) With ICES on other stocks

Also, with respect to collaboration with ICES, the Chairman noted that a STACFIS discussion on the cod stock in SA 1 focused on its migration into ICES areas. It was recognized that some Contracting Parties were presently considering which international body would be most appropriate to conduct the assessments and provide advice on this stock. Having considered whether NAFO should contact ICES to address possible collaboration, it was agreed that no Council initiative was needed at the present time. However, with respect to knowing whether the Council would do assessments of SA 1 cod stocks in June 1992, it was agreed that informal communications by the Executive Secretary before the September Meeting would be advantageous.

2. Fifteenth Session of CWP, July 1992

The Assistant Executive Secretary reported that the *Ad hoc* Inter-Agency Consultation was scheduled for 25-26 September 1991, at the beginning of the ICES Statutory Meeting, and the meeting arrangements and agenda for the July 1992 CWP Meeting would be discussed and established then. As recommended by the Council at its June 1990 Meeting, the Assistant Executive Secretary had planned to attend the *Ad hoc* Inter-Agency Consultation.

As recommended by the Council at its June 1990 Meeting, the CWP Meeting of 8-14 July 1992 is planned to be hosted by NAFO at its headquarters in Dartmouth, Nova Scotia, Canada.

VII. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Symposium of September 1991

The Council was pleased to note that the convener, H. Hovgård, of the 4-6 September 1991 Symposium on "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes", had received 20 submissions to date. Noting that the deadline date for submissions was extended to 30 June, the Council was hopeful of a successful meeting.

The Council once again noted that this meeting would be dedicated in memory of Dick Wells.

2. Special Session of September 1992

The Council noted that STACFIS had an extensive discussion on this matter and some progress had been made with constructive proposals from the co-conveners R. K. Mohn (Canada) and R. Cook (EEC-UK).

The Council agreed with the view of STACFIS that this tutorial/workshop would be sponsored by NAFO, and requested the Executive Secretary to extend a note of thanks to E. Anderson, General Secretary, ICES, for the invitation to co-sponsor this meeting, with a short explanation of the intent of this session. The Council was hopeful that if the Session was successful, the possibility of jointly sponsoring such sessions could be pursued in the future.

3. Special Session in 1993

The Council agreed with the STACFIS decision to defer this item to the September 1991 Meeting.

VIII. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting and Special Session in September 1991

The Council would meet in conjunction with the Annual Meeting of NAFO in Dartmouth, Nova Scotia, Canada, during 9-13 September 1991. The meeting would be preceded by the Symposium on "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes" which would be held during 4-6 September 1991 at NAFO Headquarters in Dartmouth, Nova Scotia, Canada.

2. Scientific Council Meeting in June 1992

The Council confirmed that the Scientific Council together with its Standing Committees and Subcommittee would meet during 3-17 June 1992 at NAFO Headquarters in Dartmouth, Nova Scotia, Canada.

3. Annual Meeting and Special Session in September 1992

The Council noted the proposed dates for the Annual Meeting were 9-18 September 1992. The Council agreed the arrangements for the Special Session of the Scientific Council titled "State-of-the-Art in Fish Stock Assessments: a Tutorial/Workshop on Calibration Methods and Their Practical Use" would be subject to the proposal from the co-conveners, which would be reviewed during the September 1991 Meeting of the Scientific Council.

4. Scientific Council Meeting in June 1993

The Council agreed on the tentative dates of 2-16 June 1993 for the Meeting of the Scientific Council.

IX. NOMINATION AND ELECTION OF OFFICERS

The Chairman's proposal (7 June 1991) to set up a Nominations Committee composed of C. A. Bishop (Canada) and H. Lassen (Denmark/Greenland) was accepted.

On 18 June 1991, the Chairman proposed elections be held noting that the appointments were for two-year terms beginning at the end of the September 1991 Annual Meeting of the Scientific Council and the Nominating Committee was requested to respond. C. A. Bishop reported that the Committee, after consulting with representatives and participants, was ready to make nominations.

The Chairman accordingly called for nominations from the Committee stating that any additional nominations were welcome from the floor.

For the office of Chairman of Scientific Council, the current Vice-Chairman, V. P. Serebryakov (USSR) was nominated. The Chairman noting that there were no other nominations, declared V. P.Serebryakov as duly elected next Chairman of the Scientific Council.

For the office of Vice-Chairman of Scientific Council, recognizing that the Vice-Chairman of the Scientific Council would become *ex officio* Chairman of STACPUB, H. Lassen (Denmark-Greenland) was nominated. The Chairman, noting there were no other nominations, declared H. Lassen as duly elected next Vice-Chairman and STACPUB Chairman.

For the office of Chairman of STACREC, A. M. C. Avila de Melo (EEC-Portugal) was nominated. The Chairman, noting there were no other nominations, declared A. M. C. Avila de Melo as duly elected next Chairman of STACREC.

X. OTHER MATTERS

1. STACPUB Membership

The Chairman noted that W. R. Bowering (Canada) was away from his Department in Newfoundland and consequently from the Council for a 2-year period and there was now a vacancy in STACPUB membership. J. E. Carscadden (Canada) was nominated and appointed by the Council to fill the vacancy.

2. Executive Summary

The Council noted that there had been discussions on this subject at STACFIS. It was agreed that the Summary Sheets prepared at this meeting would be in the present format but enhanced to contain additional information to effectively stand alone. Depending on the stock being considered, catches, TACs and any other indices will be presented graphically to show important patterns.

With respect to the format and logistics, the Chairman outlined that the document would consist of a duplication of the Scientific Council section of the SCS Document prepared and adopted at this meeting. The duplicated part would be separately bound and ready for presentation at the September 1991 Annual Meeting, while the complete SCS Document would be prepared and circulated in the usual manner sometime after this meeting.

The Council agreed with STACPUB that the publication will be titled *Scientific Council Report, 1991, Executive Summary,* and since it would represent a duplication of part of the June Meeting report, it would not be assigned a special series number.

The Chairman thanked the Executive Secretary and Assistant Executive Secretary for their initiative to develop this new idea.

3. Accommodation at NAFO Headquarters

The Chairman recalled that comments had been made at last year's meeting relating to difficulties in clearly hearing speakers due to the seating arrangements of the meeting room. He reported that alternative arrangements had been considered but it had not proved possible to resolve the problem within the constraints of the existing meeting room dimensions. In addition, the Chairman noted the very cramped accommodation which was available for people working with computers or needing to hold small group meetings. The Chairman commented that it appeared unlikely that these problems could be resolved unless additional space was made available for meetings of the Scientific Council.

XI. ADOPTION OF REPORTS

1. Standing Committee Reports

At its concluding session on 19 June 1991, the Chairman of STACFIS, STACREC and STACPUB presented summaries and comments of their respective reports. The Council then adopted each report.

2. Scientific Council Report, June 1991.

At its concluding session on 19 June 1991, the complete report of the June 1991 Meeting of the Scientific Council (excluding minutes of that session), along with the report of STACFIS, STACREC and STACPUB and annexes, was tabled. The report was reviewed and adopted.

XII. ADJOURNMENT

There being no further business, the Chairman extended a special thanks to the Executive Secretary, the Assistant Executive Secretary and the staff of the Secretariat for their efficiency and support during the meetings. He thanked W. B. Brodie, V. P. Serebryakov and M. Stein for their work as Chairmen of STACREC, STACPUB and Environmental Subcommittee respectively. Noting the major work load fell on the STACFIS Chairman, he thanked D. B. Atkinson for skilfully conducting his meetings. Thanks were extended to the participants particularly the Designated Experts for their valuable contributions. He adjourned the meeting, looking forward to seeing most of the participants at the Annual Meeting in September, and at the Symposium being convened by H. Hovgård.

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

Chairman: D. B. Atkinson Rapporteur: Various

The Committee met at NAFO Headquarters, Dartmouth, Nova Scotia, Canada during 5-19 June 1991 to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain finfish and invertebrate marine stocks (see Agenda at Appendix IV). Participants attended from Canada, Denmark (Faroe Islands/Greenland), European Economic Community (EEC), Iceland, Japan and Union of Soviet Socialist Republics (USSR), and the Assistant Executive Secretary was in attendance.

Various scientists assisted in the preparation of the initial draft reports considered by the Committee. The report of the Subcommittee on Environmental Research (M. Stein, Chairman) is summarized in Section IV and detailed in Annex 1 below.

I. GENERAL REVIEW

1. Opening

Participants were welcomed to NAFO Headquarters by the Chairman.

Initial discussions on the feasibility of providing separate documentation containing only the Summary Sheets was held. It was agreed that the provision of such documentation would be beneficial to managers and that further discussion should take place within Scientific Council.

Discussion was also held relating to the content of both the Summary Sheets and the STACFIS Report itself. It was felt that the inclusion of more graphics would enhance both the Summary Sheets and the Report. As such, it was agreed that plots of catches and TACs, as well as other pertinent information would be included in the future. It was also noted that sections of the Report detailing descriptions of the fishery were variable between stocks, often providing incomplete information. It was suggested that Designated Experts preparing drafts should be more careful in their descriptions so that managers could easily obtain a complete overview from this section.

2. Catch Statistics

STACFIS noted that for 1990, the proportion of unreported catches from the Regulatory Area was quite high. This severely hampered the Committee's ability to interpret trends in indices of stock abundance due to the many uncertainties with the catch data. In addition, sampling data from these unreported catches were unavailable and STACFIS was concerned that precisely estimated catches-at-age were not possible under these circumstances, limiting the Committee's ability to comment on fish sizes in the catch and the impacts of catching fish of such sizes. STACFIS agreed to request the Scientific Council bring these problems and concerns to the attention of the Fisheries Commission.

For this year, independent estimates for both NAFO member and non-member countries were incorporated into the assessments rather than limiting catch levels to those reported in official statistics. The proportions estimated are as follows:

Stock	Proportion estimated
Cod in Division 3M	0.94
Cod in Divisions 3NO	0.37
Redfish in Division 3M	0.19
Redfish in Divisions 3LN	0.16
American plaice in Divisions 3LNO	0.25
Witch flounder in Divisions 3NO	0.08
Yellowtail flounder in Divisions 3LNO	0.21
Greenland halibut in Subarea 2 + Divisions 3KL	0.39

3. Dynamic Analytical Assessments

The Fisheries Commission has, in the past, expressed concern about the relatively few stocks for which there have been dynamic type assessments which include projections at specific reference fishing levels. In 1990, there were only 3 stocks for which this type of information could be provided. For 1991, specific projection levels were provided for Div. 4VWX silver hake only, and these were only partially based on results of an analytical assessment.

STACFIS reviewed some of the reasons for the apparent 'deterioration' of advice. The process of carrying out analytical assessments such as SPA have become more refined in recent years. The availability of higher powered computers has enabled the increased use of sophisticated models which output many diagnostics along with the more traditional outputs. Whereas calibration techniques used in the past were often interpreted in a subjective way, these increased diagnostic tools enable evaluations based on sound statistical practises. The result is that in many instances analyses which may have been acceptable in the past would no longer be acceptable based on current evaluation practises.

In some instances, the indices of abundance (catch rates and research vessel surveys) are showing dissimilar trends which make calibration impossible. The reasons for this type of observation are unknown at present, and it is only through continued research that the problems may be addressed.

The fishing effort by non-member countries in the Regulatory Area has been increasing and as a result STACFIS is less confident in the estimates of total catches. In addition, the sampling data are becoming less representative of total catches and this renders estimates using these data less precise. As noted above, concern also existed that some 1990 catches in the Regulatory Area by Contracting Parties were unreported.

STACFIS was unable, with the data available, to determine the relative contribution of each of the above when analytical methods failed, but noted that clarification and better understanding of all of the processes related to the fisheries and associated research will be necessary before the difficulties might be resolved.

4. Timely Availability of Assessment Related Data

STACFIS continued to be concerned about the late availability of assessment related data to the Designated Experts. As was the case in 1990, some of the assessments could not be completed until after the start of the meeting because many of the necessary data were not available until at least the first day of the meeting. The negative implications of this are three-fold: 1) STACFIS is severely hampered in its ability to carry out its work during the first few days because of the unavailability of some assessments, 2) Designated Experts do not have sufficient time to fully evaluate and contemplate all available data in the resulting time frame, and 3) some Designated Experts are not present to participate in the peer-review process during the first part of the meeting because they are busy preparing assessments. The impacts of these on the quality of assessments cannot be evaluated, but the potential for improvements would be increased if the necessary data were available earlier.

STACFIS agreed with STACREC that this is a difficult problem for which there may be no reasonable solution, but nonetheless that Contracting Parties should be requested to make every effort to provide all necessary data relevant to the assessments so that they are received by the Designated Experts by 15 May each year. It was noted that even with this deadline, only 2-3 weeks are available for assessment preparation. In addition, STACFIS recommends that *Scientific Council bring this problem to the attention of the Fisheries Commission.*

5. General Trends for the Northwest Atlantic

While recognizing EEC-France (M) and France (SP) data for 1990 were missing, the following provisional observations from STATLANT 21A reports were noted in the reported catches (Table 1). The provisional overall catch (round fresh weight) of all finfish and invertebrate stocks was 3.13 million tons in 1990, an increase (5%) over the 1989 catch of 2.98 million tons. The total "groundfish" catch, which represented 35% of the overall catch in 1990, was 8% less than in 1989 (1.18 and 1.09 million tons in 1989 and 1990 respectively). Decreases were noted for cod (17%), haddock (19%), silver hake (14%), pollock (16%), American plaice (38%) and witch (24%) and increases noted for redfish (30%), yellowtail (86%) and Greenland halibut (49%). The total "pelagic" catch, which represented 23% of the overall catch in 1990, increased (16%) from 628,000 tons in 1989 to 728,000 tons in 1990, and increases were noted for herring (21%) and menhaden (19%) while mackerel decreased (10%). The total "other finfish" catch, which represented 9% of the overall catch in 1990, increased substantially (41%) from 191,000 tons in 1989 to 270,000 tons in 1990 with increases noted for capelin (53%), spiny dogfish (219%), dogfishes (NS) (426%), skates (32%) and finfish (NS) (39%), while decreases were noted for alewife (45%), American eel (27%), American shad (17%), Atlantic croaker (25%) and Atlantic salmon (34%). The total catch of "invertebrates", which represented 33% of the overall catch in 1990, increased (6%) from 982,000 in 1989 to 1,041,000 in 1990 while increases were noted for squids (5%), clams (2%), scallops (6%), crabs (25%), lobsters (6%). Shrimp catches remained unchanged at 109,000 tons.

6. Fishery Trends by Subarea

Noting that catches in 1990 do not include the French data, the following are the trends:

a) Subarea 0

The overall total nominal catch in 1990 was 19,000 tons, a 46% increase over the 1989 catch of 13,000 tons. The catch consisted of 11,000 tons of Greenland halibut (up from 1,000 tons reported in 1989) and 7,000 tons of shrimp (compared to 12,000 tons in 1989).

b) Subarea 1

The overall total catch decreased (20%) from 173,000 tons in 1989 to 139,000 tons in 1990. This was mainly due to a decrease in cod (40%) from 100,000 tons in 1989 to 60,000 tons in 1990. An increase in shrimp (11%) was noted. The shrimp represented the largest catches (in tons) in this Subarea.

Table 1. Provisional nominal catches ('000 tons) by subarea for 1989 and 1990. (+ indicates less than 500 tons; the 1990 data exclude EEC-France (M) and France (SP) reports).

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
Cod	-	+	100	60	57	32	275	236	156	141	43	57	1	+	633	528
Haddock	-	-	+	+	-	-	10	5	16	14	5	6	-	-	31	25
Redfishes	-	+	1	+	+	+	74	115	62	63	1	1	-	-	138	179
Silver hake	-	-	-	-	-	-	+	1	88	70	10	13	7	7	106	91
Red hake	-	-	-	-	-	-	+	+	+	+	1	1	+	+	2	2
Pollock	-	-	-	-	-	+	4	2	42	36	12	11	+	+	58	49
American plaice	-	-	-	-	3	1	50	30	11	8	2	2	+	+	66	41
Witch flounder	-	-	-	-	+	+	10	9	5	3	2	1	+	+	17	13
Yellowtail flounder	-	-	-	-	-	-	7	9	2	3	5	14	1	+	14	26
Greenland halibut	1	11	9	8	6	9	15	21	5	2	-	-	-	-	35	52
Other flounders	-	+	+	+	+	+	1	5	7	9	11	9	6	4	26	26
Roundnose grenadier	+	+	+	+	+	+	5	4	-	-	-	-	-	-	7	4
White hake	-	-	-	-	+	+	3	4	11	10	6	6	+	+	19	20
Wolffishes	-	+	1	1	+	+	1	3	1	1	1	+	-	-	4	5
Other groundfish	-	+	1	+	+	+	1	1	4	4	16	16	5	5	25	27
Atlantic herring	-	-	-	-	+	+	9	8	208	252	41	51	+	+	257	311
Atlantic mackerel	-	-	-	-	-	+	2	1	18	23	3	5	49	36	72	65
Atlantic menhaden	-	-	-	-	-	-	-	-	-	-	9	11	275	326	284	337
Other pelagics	-	-	-	-	-	-	2	1	1	1	6	5	6	7	15	15
Capelin	-	-	+	+	22	44	90	131	7	6	-	-	-	-	119	182
Other finfish	-	+	+	+	2	3	20	27	19	14	12	24	18	20	72	88
Squids	-	-	-	-	-	-	4	5	3	6	11	8	19	20	37	39
Clams	-	-	-	-	-	-	2	11	12	10	44	38	344	350	402	409
Scallops	-	-	-	-	+	+	3	2	50	37	93	134	69	55	216	228
Other molluscs	-	-	-	-	+	+	+	+	2	2	29	23	34	54	66	78
Shrimp	12	7	61	68	13	11	3	2	15	15	4	4	1	1	109	109
Crabs	-	-	-	-	+	1	8	10	15	15	5	4	55	74	83	104
Lobsters	-	-	-	-	-	-	1	1	37	38	21	24	3	4	63	67
Other invertebrates	-	-	-	-	-	-	-	-	+	+	5	7	1	1	6	8
Total	13	19	173	139	104	102	601	644	796	784	398	476	894	965	2979	3129

c) Subarea 2

The overall nominal catch decreased slightly (2%) from 104,000 tons in 1989 to 102,000 tons in 1990. Decreases were noted for cod (44%) and shrimp (15%) but capelin catches doubled to 44,000 tons in 1990. The capelin represented the largest catches (in tons) in this Subarea.

d) Subarea 3

The overall total catch increased (7%) in 1990 to 644,000 tons from 601,000 tons in 1989. This was due mainly to increases in redfishes (55%), Greenland halibut (40%) and capelin (46%). Cod continued to decline, 14% from 1989 to 1990 (in addition to 14% from 1988 to 1989).

e) Subarea 4

The overall nominal catch decreased slightly (1.5%) from 796,000 tons in 1989 to 784,000 tons in 1990. Decreased catches were noted for cod (10%), silver hake (20%), pollock (14%) and scallops (26%). Increases were noted for herring (21%) and mackerel (28%). Cod (18%) and herring (32%) continued to be the dominant species, followed by silver hake (9%), redfishes (8%), lobsters (5%), scallops (5%) and pollock (5%).

f) Subarea 5

The overall total nominal catch increased by 20% in 1990 to 476,000 tons from 398,000 tons in 1989. Increases were noted for cod (33%), herring (24%) and scallops (44%). There were no substantial decreases noted for any of the species with reported large catches.

g) Subarea 6

The overall nominal catch increased by 8% in 1990 to 965,000 tons from 894,000 tons in 1989. Increases were noted for menhaden (19%), clams (2%), crabs (35%), other molluscs (59%) and decreases were noted for mackerel (27%) and scallops (20%). Menhaden and clams continued to account for more than 70% of the overall catches (in tons).

II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 91/35, 62, 63, 64, 65, 76; SCS Doc. 13).

a) Introduction

The cod in West Greenland can be considered as being composed of four components spawning in different areas. The West Greenland offshore component spawns off Southwest Greenland (Div. 1DEF) and the eggs and larvae are carried northwards towards the Great Hellefiske Bank (Div. 1B). Inshore stock components are found in various fjord areas and their offspring probably remain and settle within the coastal area. Moreover, larvae and 0-group are carried by the Irminger current from spawning areas off East Greenland and from Iceland. The inflow of larvae from Iceland varies from year to year but for some year-classes, such as those of 1973 and 1984, it was very important. The nursery areas for these cod are found in southeast and southwest Greenland.

Tagging studies in West Greenland have shown migration patterns which can be associated with the different stock components. Inshore cod remain mainly within the area where they were tagged whereas West Greenland offshore cod migrate between summer areas in Div. 1BCD and wintering areas in Div. 1DE. Recaptures at Iceland come primarily from cod tagged in southwest Greenland. The emigration from West Greenland is observed for almost all year-classes but is most evident for year-classes which were observed earlier as 0-groups drifting from Iceland to Greenland.

The contribution of the four stock components to the West Greenland population is believed to have changed significantly during the last 30 years. The offshore components of the 1984 and 1985 year-classes, which have completely dominated the fisheries in recent years, are both believed to be mainly of Icelandic origin.

b) Commercial Fishery Data

i) Trends in catch and effort

The fishery for cod in NAFO Subarea 1 is partly an offshore trawl fishery, and partly a coastal and fjord fishery, dominated by pound nets.

Following low catches during early-1940s, they rose to an annual level of 300,000-400,000 tons in the 1950-68 period (Fig. 3) with the major part taken by non-Greenland vessels in the offshore areas. Due to recruitment failure for a number of years, catches declined significantly after 1968 to a low of 33,000 tons in 1976. With recruitment of the strong 1973 year-class, catches increased to 99,000 tons in 1979. During 1980-83, catches stabilized at a level of 55,000 tons but decreased thereafter by about 50 % annually to the low level of only 6,600 tons in 1986, the lowest catch on record since the start of the fishery in the 1920s. From 1987 catches increased significantly due to the recruitment of the very strong 1984 year-class reaching a high of 108,000 tons in 1989.

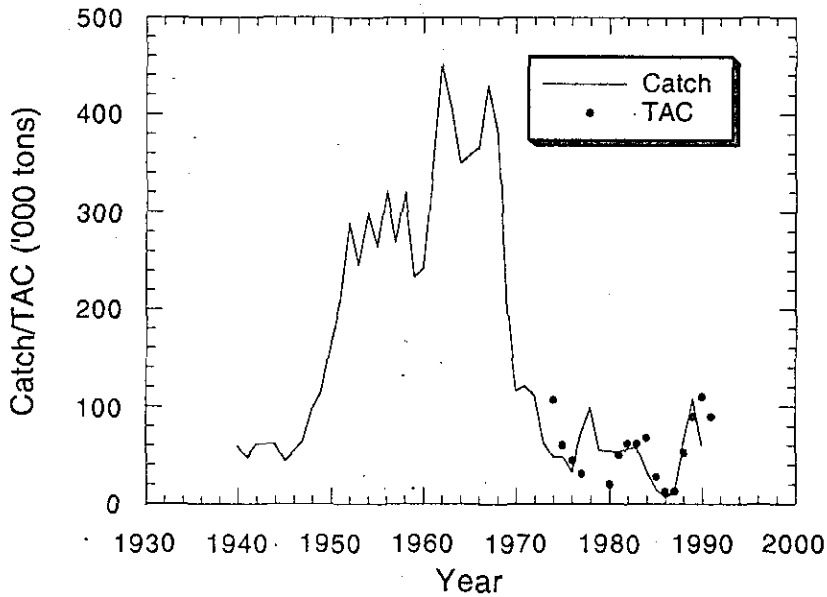

Fig. 3. Cod in Subarea 1: annual catch since 1940 and TACs since 1974. TACs until 1977 only covered the offshore fishery. TACs from 1981 onwards refer to both inshore and offshore areas.

The reported catch in 1990 was about 60,000 tons (provisional figures), which was a 42% decrease compared to the 1989 catch and well below the TAC of 110,000 tons.

Greenland vessels landed about 51,000 tons or 86% of the total catch; the remainder was taken by trawlers from the EEC-Federal Republic of Germany (EEC-FRG) and the United Kingdom (UK). Trawl catches constituted 65% of the total catch.

In 1990, 98% of the trawling effort was exerted in Div. 1EF and this was the most southerly effort distribution seen in the time series. During the year there was a shift to the more southern banks. Unstandardized CPUE decreased throughout the year (Fig. 4). The overall unstandardized CPUE decreased from 4.3 tons/hour in 1989 to 1.7 tons/hour in 1990. Standardized CPUE from the Greenland Home Rule owned fresh fish trawlers indicated a similar reduction.

Recent catches, unstandardized CPUEs and TACs are given below:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Trawlers	14	29	42	20	7	1	1	40	73[1]	39[1]	
Other vessels	39	27	21	13	8	6	12	22	35[1]	21[1]	
Total ('000 tons)	53	56	58	33	15	7	13	62	108[1]	60[1]	
TAC ('000 tons)	50	62	62	68	28.3	12.5	12.5	53	90	110	90
CPUE (tons/hr)	2.90	1.93	1.23	0.89	0.7	-	1.61	2.87	4.33	1.75[1]	

[1] Provisional data.

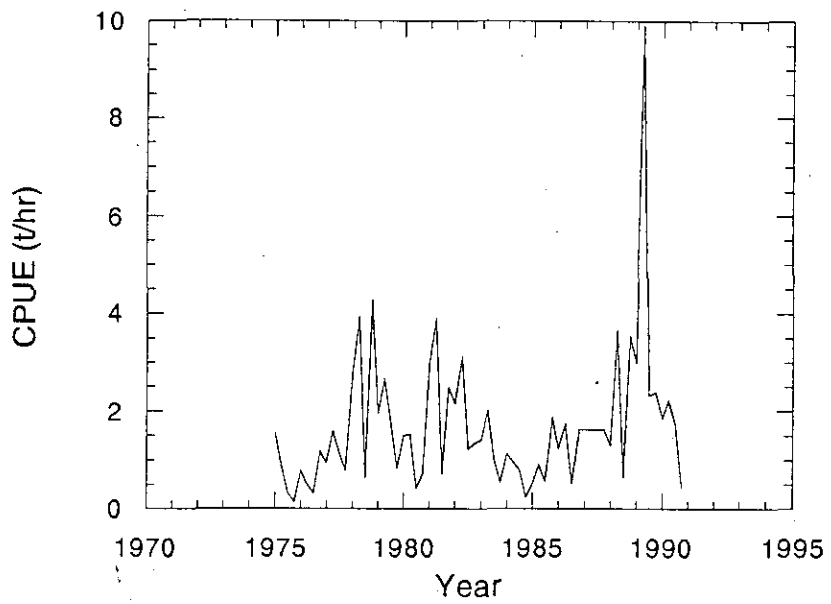

Fig. 4. Cod in Subarea 1: CPUE by quarter for six sister trawlers owned by the Greenland Home Rule.

ii) Catch in numbers-at-age and catch composition

During the first half of 1990 age 6 cod were dominant (80% by numbers) in Greenland trawl landings. This was also observed in the EEC-FRG landings (60% age 6, age 5 cod accounting for the rest). From August there was a change in age composition with age 6 and age 5 respectively accounting for approximately 40% and 60% by numbers in the Greenlandic trawl landings and 20% and 50% in the EEC-FRG trawl fishery. Some of this difference between countries was due to differences in minimum landing size (40 cm in the international fishery; 44 cm being enforced on Greenlandic landings).

The inshore catches were dominated by age 5 (50-90% by numbers) the remaining part being mostly of age 6. In the northern part (Div. 1B) however, some age 4 cod (22% by numbers) were caught.

Overall, the 1984, 1985 and 1986 year-classes accounted for 52, 42 and 6% of the 1990 catch by numbers.

iii) Discards

Observations on the discard rates in pound nets and trawl catches were made in the Greenland fisheries. The discard rates were 100% for age 3, 73% for age 4, 34% for age 5 and 4% for age 6. However, cod are not damaged by the pound net and if sorted immediately after catching, as is the current practice, mortality will be low. In the Greenland trawl fishery in March, 30% of age 5 cod and 1% of age 6 cod were discarded. No cod of younger age groups were caught in this fishery.

iv) Mean weight-at-age in the catches

The average weight of the age groups 5 and 6 was 1.02 and 1.36 kg, respectively. Mean weights for these age groups have been declining since 1987 and the 1990 weights were the lowest in the last 15 years.

v) Maturity ogive

In March, 1990, the maturity of cod was observed aboard a Greenland commercial trawler in Div. 1F. Only 8% of the 1984 year-class and 6% of the 1985 year-class were found to be sexually mature. These values were significantly lower than previously observed for cod of these ages. As noted above, these two year-classes accounted for almost all of the catch in the offshore trawl fishery in spring.

c) Surveys and Research Data

i) The EEC-FRG groundfish survey off West Greenland

The EEC-FRG trawl survey has been carried out in late autumn since 1982 using a standard bottom trawl. Survey abundance and biomass were calculated by the swept area method, i.e. by assuming a catchability coefficient of 1.0.

From 1982 until 1984, a decline in the indices of cod biomass and abundance was observed (Fig. 5). The indices increased considerably since 1986 due to increasing recruitment from the outstanding 1984 year-class. In spite of additional recruitment, mainly of the 1985 year-class the total abundance started to decline in 1988, whereas biomass still increased due to individual growth.

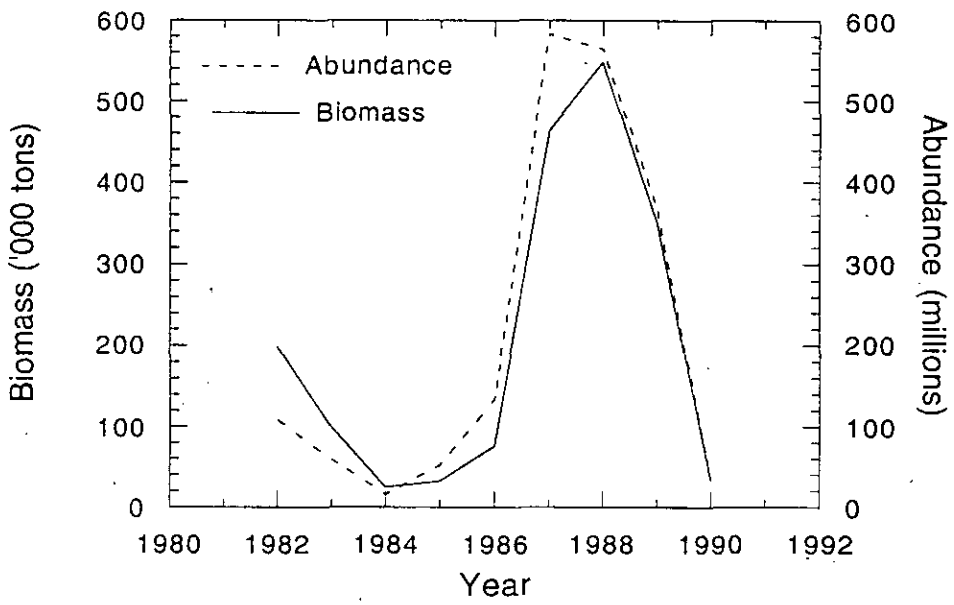

Fig. 5. Cod in Subarea 1: trends in survey biomass and abundance in EEC-FRG groundfish survey off West Greenland, 1982-90.

The survey results in 1989 showed a decrease by 35%, both in biomass and abundance as compared to 1988. This decrease was mainly caused by a reduction in the abundance of the 1984 year-class. Also a pronounced southward displacement of the stock was observed as 93% of the total survey biomass and abundance was found in Division 1EF compared to 17% in 1988.

In 1990, the estimates of survey abundance and biomass declined by 92% compared to 1989. This decrease was caused by the nearly complete disappearance of the 1984 year-class and also by a significant reduction in abundance of the now dominating 1985 year-class.

This reduction in the abundance of the 1984 and 1985 year-classes was observed in all areas. The stock was still distributed to the south with 88% of the survey biomass and 82% of the survey abundance found in Div. 1EF.

ii) EEC-FRG 0-group survey

Sampling carried out using an Isaacs-Kidd midwater trawl on hydrographical sections during July and August 1990, revealed no pelagic 0-group cod off West Greenland.

iii) West Greenland young cod survey

Since 1985, Greenland has carried out a survey of young cod in inshore areas of West Greenland. The surveys cover three inshore areas in Div. 1B, 1D and 1F. The mesh sizes used efficiently catch age 2 cod, whereas only the larger cod of age 1 are taken.

The overall catch-per-hour has been used as an index of year-class strength. Up to 1988, this index correlated well with the abundance estimate of age 2 cod found in the EEC-FRG groundfish survey. However, the correspondence between the two indices was poor in 1989 and 1990.

The inshore catch rates were quite different in the three areas over the years. For the abundant 1984 year-class the catch rate was high in all areas. For the subsequent year-classes catch rates were generally high in Div. 1B, whereas the catch rates in Div. 1D and 1F varied considerably. The trend in Div. 1F closely resembled the offshore abundance as seen in the EEC-FRG groundfish survey.

Therefore, it is misleading to use the overall gillnet index as a measure of total stock year-class strength. The high catch rates observed inshore since 1988 in Div. 1B and in 1989 in Div. 1D probably reflect good year-classes from the local fjord populations only.

iv) Tagging off West Greenland

In August 1989, Greenland conducted a cod tagging experiment off Southwest Greenland. A total of 2,500 cod were tagged, almost exclusively belonging to the 1984 year-class.

In total 39 tags were returned in 1990 of which 14 (36%) were caught off Iceland. Historically, recoveries at Iceland have been greatest 2 to 3 years after tagging at West Greenland. Analyses of previous experiments for cod tagged within the size range tagged in 1989 showed a first year proportion of total returns from Iceland of only 1.8%. The results of the 1989 tagging experiment therefore indicate a substantial migration from West Greenland to Iceland.

v) Other research information

Surveys in deeper waters for Greenland halibut by Japan (covering depths between 400-1500 m) and for shrimp by Greenland (150-600 m) have been carried out in Div. 1ABCD since 1987 and 1988, respectively. In 1990, two Greenland halibut surveys were carried out in June and September with almost no cod caught. The shrimp survey in 1990 also found very few cod. These findings in the deep water surveys are in accordance with the normal distribution pattern, as cod is rarely found in the deeper waters. Therefore, the observed changes in cod abundance and distribution seen from the directed cod surveys in 1990 can not be explained by a migration of cod into deeper waters.

A survey by the EEC-FRG in July-August in Div. 1BDF, with the objective to collect cod stomachs, indicated almost no cod except in Div. 1F where the commercial fishery took place.

Tagging work in coastal and bank areas of Div. 1DEF showed quantities only in one coastal area in Div. 1D, and the abundance was low compared to the previous year.

d) Cod off East Greenland

FRG groundfish surveys were carried out in September-October off East Greenland since 1980. The survey abundance declined from 19 million in 1981 to 6 million in 1982 and remained at this level until 1985. In the following year the abundance increased to 17 million due to the recruitment of the 1984 year-class. This stock size was maintained until 1989 when the abundance increased to 54 million cod indicating that a migration from West to East Greenland took place during 1989. In 1990 the abundance was estimated to be 17 million cod indicating that the migration has continued further towards Iceland during 1990.

The East Greenland cod stock has since 1987 been dominated by the 1984 and 1985 year-classes. However the importance of the 1984 year-class has increased relative to that of the 1985 year-class since 1988. This change in stock composition should be expected assuming a migration of the 1984 year-class from West Greenland to East Greenland.

Due to stock displacement, the TAC of West and East Greenland were combined to a single TAC for the entire area. This allowed the trawl fishery to move to East

Greenland. As a consequence landings from the area increased from 15,000 tons in 1989 to 30,000 tons in 1990.

Information on the Cod Fisheries in Early 1991

Catch rates off West Greenland were poor in spring which is usually the period with the best fishing. Total trawl catches by the end of April amounted to 1,963 tons compared to 16,402 tons in the same period in 1990. The fishery takes place in Div. 1F. In East Greenland catches amounted to 7,761 tons by the end of April compared to 11,089 in the same period of 1989.

Age samples from the trawl fishery at West Greenland in January and February showed that 78% belong to the 1985 year-class and only 17 % to the 1984 year-class with the remainder coming from the 1986 and 1987 year-classes.

Assessment

During 1989 a large displacement of the cod stock from West to South Greenland was observed. At that time it could not be concluded whether this was due to environmental changes or whether it was a spawning migration to East Greenland or Iceland (ICES Doc.C.M. 1990/Assess:12).

In 1990 the offshore trawl fishery off West Greenland took place even more southerly with almost no catches taken north of Div. 1E. During 1990 catch rates declined and the offshore fishery had almost stopped in spring 1991 with catches taken until May being 88% lower than the same period last year.

The 1990 survey abundance and biomass estimates decreased in all areas of West Greenland compared to the 1989 survey. The 1984 and 1985 year-classes, which according to the surveys accounted for about 90% of the stock, were reduced from 327 million in 1989 to 30 million in 1990. The survey also showed that the stock was concentrated in the south similar to 1989. The first year tag returns, from tagging experiments conducted in 1989, showed a high proportion of returns from Iceland.

All together the available information indicates a significant migration from West to East Greenland and further to Iceland in 1990, especially for the 1984 year-class. It is likely that this migration is a return migration to the areas where the cod were initially spawned.

The proportion migrating is related to the overall stock composition in West Greenland. In periods when the cod of Icelandic origin are abundant relative to cod of West Greenland origin the emigration will be high. From tagging experiments carried out in the 1950s and 1960s, i.e. in a period where the West Greenland stock component was abundant, the emigration rate was estimated at 0.05. In recent assessments, migration rates between 0.05 and 0.30 have been used. In last year's assessment a value of 0.15 was used because this level could account for the migration to East Greenland in the 1983 to 1989 period. However, to account for the increased migration of the 1984 year-class in 1989, a migration rate of 0.25 was used for that year-class. With the dramatic decline observed in 1990 for the 1984 year-class, a much higher emigration rate must be applied in this year. Total mortality of this year-class including emigration derived from the 1989 and 1990 surveys is estimated to be 3.3.

In this situation, where the migration rate far exceeds the fishing mortality, an analytical assessment is not meaningful.

Recruitment Prospects

The results of the EEC-FRG surveys indicated that the 1987, 1988 and 1989 year-classes are all poor. In contrast, the gillnet survey indicated relative high recruitment indices in some areas. However, as the latter finding may merely reflect good recruitment from local fjord stocks, the overall recruitment of these year-classes is expected to be low.

No significant inflow of larvae from Iceland to East Greenland was detected in the Icelandic 0-group survey in 1990. The very low proportion of mature fish of the 1984 and 1985 year-classes, which completely dominated the stock, indicated almost no spawning activity off West Greenland. This was confirmed by the complete absence of 0-group fish in pelagic samples taken in summer 1990. Although some 0-group fish were caught in the EEC-FRG trawl survey in Div. 1F, the size of the 1990 year-class is expected to be low.

Forecast

The cod stock measured as age 3+ cod by the EEC-FRG survey in November 1990 was about double that observed in the period 1983 to 1986, i.e the years prior to the recruitment of the 1984 year-class.

The stock was dominated by the 1985 year-class of which a significant proportion is probably of Icelandic origin. A well-above average emigration of this year-class from West Greenland may therefore be expected. Cod of the 1986 year-class and younger were scarcely represented in both surveys and offshore trawl catches in 1990. However, in some inshore areas these year-classes were relatively abundant. Under these circumstances it is not possible to estimate stock development in the coming years from the latest survey abundance.

Based on the present weight-at-age, the historical fishery pattern, and migration

rates and natural mortalities as used in recent assessments, a yield-per-recruit curve was constructed (Fig. 6). $F_{0.1}$ was F = 0.43 whereas F_{max} was not defined.

Parameters used to calculate yield-per-recruit for West Greenland cod 1991 are as follows:

Age	Mean Weight (kg)	M+E	Relative F
3	0.86	0.3	0.039
4	0.91	0.3	0.52
5	1.02	0.35	1
6	1.36	0.35	1
7	2.04	0.35	1
8	2.12	0.35	1
9	2.20	0.35	1
10	2.89	0.35	1
11	3.79	0.35	1
12+	5.36	0.35	1

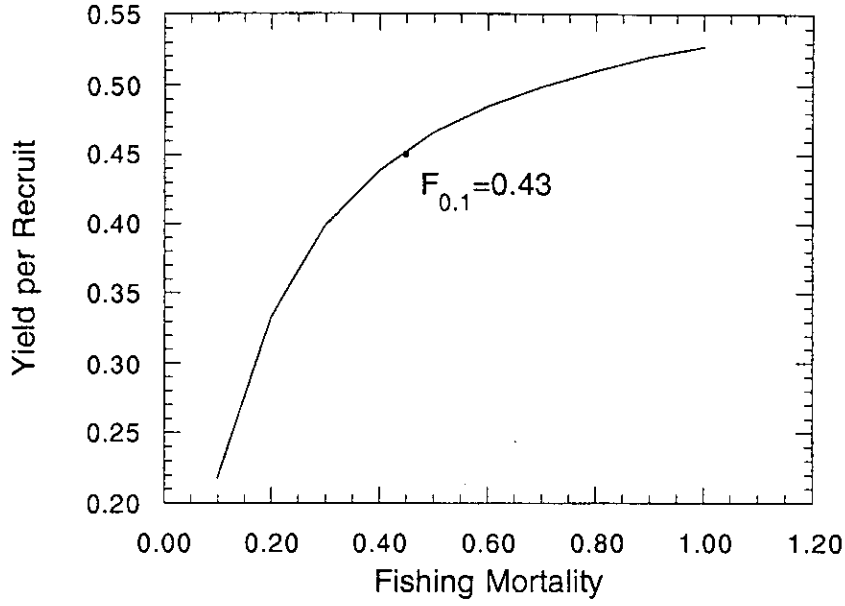

Fig. 6. Cod in Subarea 1: yield-per-recruit curve.

The year-classes of 1987 to 1990 are all expected to be small. Conventionally a recruitment size of 20 million cod age 3 has been used in projections for small year-classes. Assuming a fishing mortality of 0.43 corresponding to $F_{0.1}$ and the associated yield-per-recruit, a steady recruitment of 20 million cod leads to an annual catch of approximately 9,000 tons. This catch level must, for several reasons, be taken as indicative only. Size-at-age has shown a considerable decrease in the 1980s and this trend might be reversed. Also the fishery pattern might change if a larger proportion of the fishery is carried out by poundnet fishing on the local fjord stock components. Finally, the migration rate might differ from the value of 0.15 previously used. However, a catch level of 9,000 tons agrees with the levels taken in the years just prior to the recruitment of the 1984 year-class.

The prospects for the fishery are expected to be poor at least until 1995 when the 1991 year-class, the size of which is still unknown, is recruited. Catches in 1991 and 1992, where some cod of the 1985 year-class are still available, are expected to be somewhat higher than the estimated 9,000 tons. The inshore summer fishery will be affected to a lesser degree than the offshore trawl fishery as the relative importance of the local fjord stocks will increase.

As has been the case in recent years, the expected development in length distribution of stock and catches has been requested by Greenland. Previous attempts to estimate size distributions have generally not been successful due to unexpected slow growth of the 1984 and 1985 year-classes. Under the present uncertainties it is even more difficult to estimate the future size distributions. However, catches in the inshore areas are dominated by younger cod and as this fishery is expected to be the most important in the coming years, only a small proportion of the catch is expected to exceed 55 cm.

STACFIS noted that in the recent period the West Greenland cod stock has been substantially affected by larval inflow as well as large scale emigrations. STACFIS therefore, advises that studies on these processes should be enhanced.

2. Cod in Division 3M (SCR Doc. 91/5, 25, 28, 44, 67, 78, 95; SCS Doc. 91/5, 11, 15, 16)

a) Introduction

i) Description of fishery

The fishery on the Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod is also caught as by-catch in redfish and flatfish fisheries conducted by EEC-Spain and EEC-Portugal. The fleet currently operating in Div. 3M includes vessels from non-contracting parties.

ii) Nominal catches

From 1974, when a TAC was first established, to 1979, catches ranged from 22,000 to 33,000 tons. Catches had been at that level or higher for the previous ten years. The TAC was 13,000 tons for 1980-87, while the reported nominal catches were about 12,000 tons (Fig. 7).

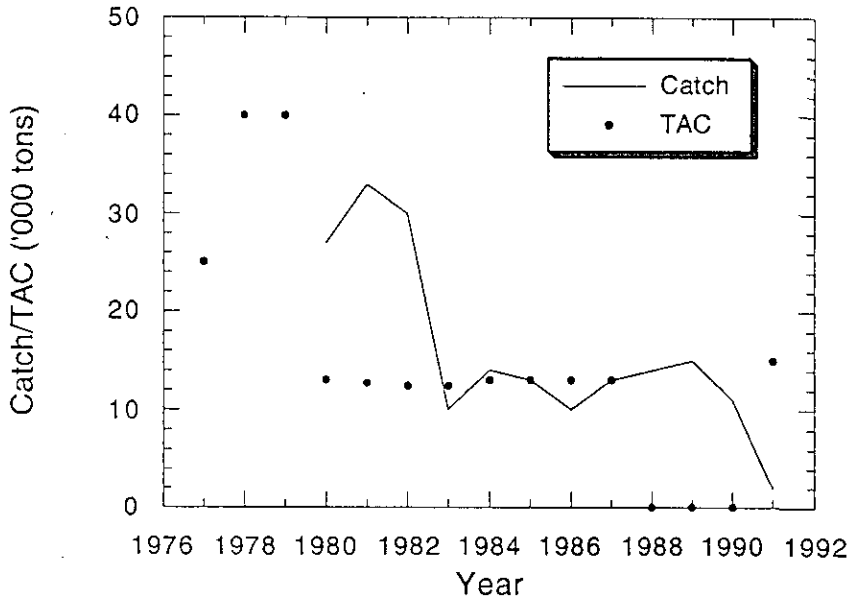

Fig. 7. Cod in Div. 3M: catches and TACs.

A moratorium on the Flemish Cap cod fishery was established by the Fisheries Commission for 1988 to 1990. However, catches for 1989 and 1990 have been estimated to be about 40,000 and 32,000 tons respectively. Reported catches for 1989 and 1990 were about 1,000 and 2,000 tons respectively. No estimates were available for 1988, but it is believed that actual catches also exceeded those reported for that year.

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

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	13	12.7	12.4[1]	12.4[1]	13	13	13	13	0	0	0	13
Catch	10	14	13	10	13	14	15	11	2	40[2]	32[2]	

[1] Excludes expected catches by EEC-Spain.

[2] Includes estimates for NAFO member and non-member countries.

b) Input Data

i) Commercial fishery data

Sampling data were available for Portuguese and Spanish stern-trawlers for 1990 as well as for a Faroese experimental longline fishery. Extensive sampling data from pair-trawlers fishing on Flemish Cap during the 1988-90 period were also reviewed. The 1985 year-class dominated the trawl catches in 1989 and the longline catches in 1990. The 1986 year-class dominated the trawl catches in 1990.

Catch rates of non-specified flag pair-trawlers fishing for cod on the Flemish Cap during 1988-90, showed an increasing trend. These data, when included with CPUE indices from Spanish pair-trawlers (1983-87), showed a decrease in catch rates from 1984 to 1987 with a subsequent increase. The catch rate for 1990 was double that estimated for 1987.

Data from the Faroese longliner fisheries available for the 1973-90 period indicated that catch rates peaked at 400 kg per thousand hooks in 1977 then declined to 75 kg per thousand hooks in 1987. Only one vessel fished in 1988 and none in 1989. The catch rate for 1990 was 200 kg per thousand hooks, which may indicate some recovery of the stock but anecdotal information for early 1991 suggested a decline in catch rates from 1990 levels.

ii) Research vessel data

Biomass and abundance estimates were available from research vessel trawl surveys conducted by USSR from 1977 to 1990 (Fig. 8). Abundance and biomass for 1988 were estimated to be 26.7 million fish, and 7,720 tons respectively. Abundance and biomass increased to 170.9 million fish and 36,500 tons in 1989 and decreased to 7.4 million fish and 6,800 tons in 1990. The decrease observed from 1989 to 1990 was considered to be inconsistent with the estimated catch of around 30,000 tons for 1990. Acoustic estimates of stock biomass indicated that about 40% of total biomass was distributed pelagically, i.e. these fish were out of reach of the bottom survey gear.

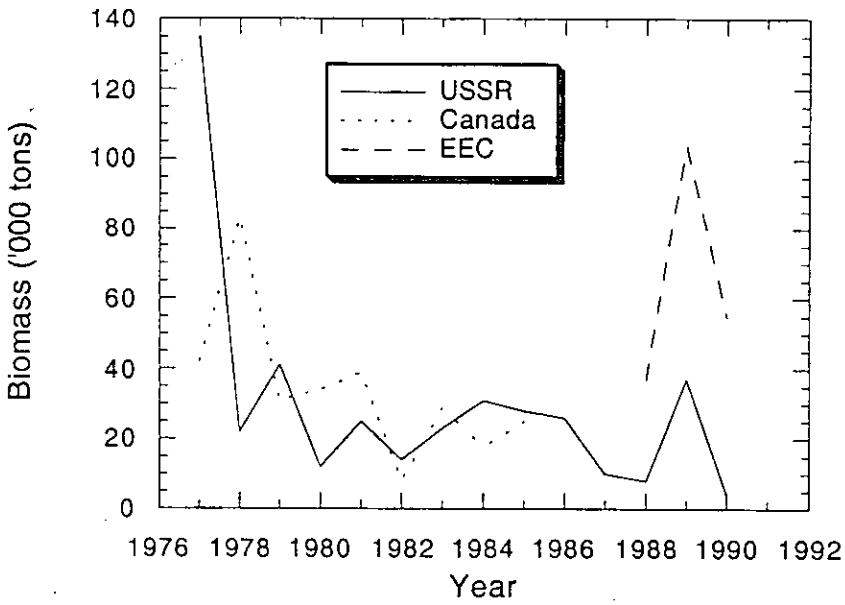

Fig. 8. Cod in Div. 3M: biomass estimates from research vessel data.

Stratified-random bottom trawl surveys were conducted by the EEC from 1988 to 1990. Biomass increased from 37,000 tons in 1988 to 104,000 tons in 1989 then decreased to 55,000 tons in 1990. This decrease in biomass corresponded to a fishing mortality greater than 1.

In both surveys the 1986 year-class (age 4 in 1990) was the most abundant since 1988. This year-class was also present in the 1987 USSR survey. The 1985 year-class was the next most abundant in recent years. The 1987 year-class appeared weak in both USSR and EEC surveys.

c) Estimation of Parameters

Analytical assessments of the stock have not been conducted since 1984 because of perceived inadequacies in the commercial fishery database (NAFO Sci. Coun. Rep., 1986, page 51). This situation remains unchanged for the current assessment.

Spawning stock biomass probably increased in 1990 as a consequence of the maturing 1985 year-class. However, research survey results suggest that the spawning stock biomass in 1990 was at the lowest limit of its critical size range. The increase of spawning stock biomass may continue during 1991 with fish from the relatively strong 1986 year-class attaining maturity, but high fishing activity observed during 1990 and expected in 1991 may inhibit any potential increase. No new year-classes are expected to contribute significantly to the spawning stock in the next 2 or 3 years. Consequently, spawning biomass is expected to eventually decrease, especially if fishing effort is maintained at current high levels.

d) Prognosis

The low level of stock biomass in 1987 and 1988 was due to the appearance of several consecutive weak year-classes (1982, 1983 and 1984) coupled with a high exploitation rate on fish of young ages. The stock biomass increased in 1989 as a consequence of the recruitment of the relatively abundant 1985 and strong 1986 year-classes. The excessive fishing effort during 1990 reduced the abundance of these two cohorts and consequently the possibility that the spawning stock biomass will increase beyond its current low level is doubtful. At present, there are no new year-classes that will

significantly contribute to an increase in spawning stock biomass in the years after 1991. STACFIS notes that if cessation of fishing cannot be achieved, no action can be advised that would result in an improvement of the stock.

3. Cod in Divisions 3N and 3O (SCR Doc. 91/5, 83; SCS Doc. 91/5, 11, 15, 16)

a) Introduction

i) Description of the fishery

Nominal catches increased during the late-1950s and early-1960s, reaching a peak of about 227,000 tons in 1967, and subsequently declined to a low of about 15,000 tons in 1978 (Fig. 9). Catches increased after 1978, peaking at 50,000 tons in 1988, but again declined to about 33,000 tons in 1989. The total catch for 1990 including those reported and estimated was 29,000 tons.

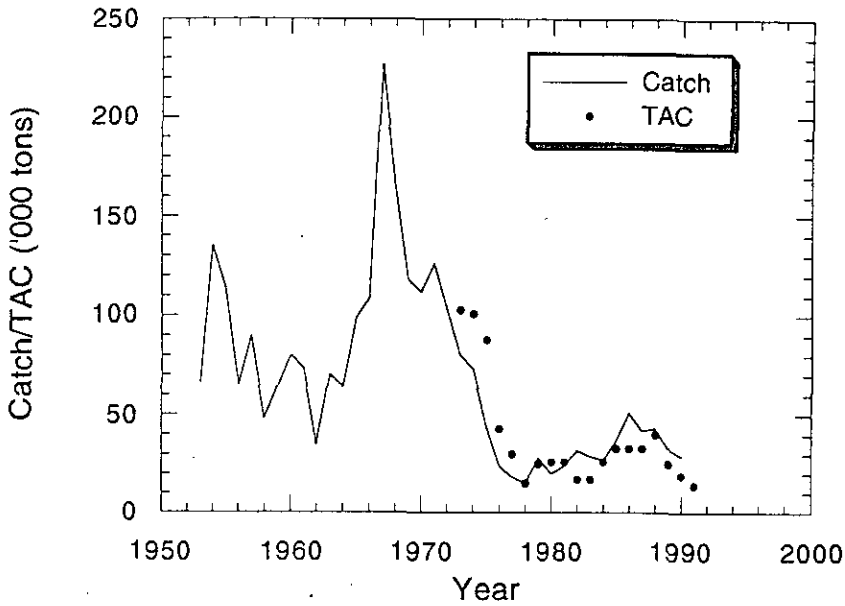

Fig. 9. Cod in Div. 3NO: catches and TACs.

TACs were first introduced for this stock in 1973 at a level of 103,000 tons. Until 1978, catches were substantially lower than the TACs but since 1981 they have exceeded those recommended. In 1990, catches were about 55% higher than the recommended TAC.

For the period since 1978, catches have been taken predominantly by Canada and EEC-Spain. All non Canadian catches in 1990 were from the Regulatory Area. Canadian catches have been taken mainly within the Canadian 200-mile fishery zone by otter-trawlers, with an increasing proportion by other gears, especially longline. Canadian catches were stable at approximately 19,000 tons from 1985 to 1988 but have since declined to about 11,000 tons in 1991. Catches by EEC-Spain, mainly by pair-trawlers, averaged approximately 17,000 tons from 1986 to 1989 but were reported to be about 5,000 tons in 1990. Catches by EEC-Portugal decreased from about 7,000 tons in 1986 to 1,000 tons in 1989 but increased to 2,000 tons in 1990. The latter were taken almost equally by gillnet and otter trawl fleets. Otter-trawl catches were obtained mainly as a by-catch in the American plaice and redfish fisheries.

In recent years catches have been estimated for non-member, non-reporting countries fishing in the Regulatory Area, and in 1990 this amounted to about 3,600 tons. In addition, estimates of non-reported catches by Contracting Parties totalled about 7,000 tons.

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	26	17[1]	17[1]	26	33	33	33	40	25	18.6	13.6
Catch	24	32	29	27	37	51	42	43	33[2]	29[2,3]	

[1] Excludes expected catches by EEC-Spain.
[2] Provisional data.
[3] Includes estimated catches for non-members and Contracting Parties (10,600 tons).

b) Input Data

i) Commercial fishery data

Catch rates. In recent assessments of this stock standardized catch-rate indices from the Canadian otter-trawl and Spanish pair-trawl fisheries have not been used in the calibration model because it was concluded that they were not reflective of stock abundance. The main concerns were the definition of directed effort for Canadian otter-trawlers which take a large portion of their cod catch as by-catch in flounder fisheries and that the Spanish catch rates only relate to a small portion (20%) of the stock area when distributional changes have occurred in the time series (NAFO Sci. Coun. Rep. 1990, p. 55). These issues are still a concern and consequently the indices were not used for calibration in the current assessment. In spite of these problems, STACFIS considered that these annual indices could be useful as indicators of general trends. Canadian catch rates increased from 1977 to 1982 but have declined steadily since that time. The 1990 index is estimated to be the lowest since 1980.

The Spanish pair trawl catch rates have displayed larger year-to-year variation than the Canadian time series. Catch rates generally increased from 1977 to 1984 with a subsequent decline.

Catch-rate data were also presented for the Portuguese gillnet fishery in 1989 and 1990 and, if available in future years will potentially provide an additional index. Gillnet catch rate estimates for 1989 and 1990 were similar.

Catch-at-age data. Biological sampling data from the Canadian otter-trawl and seine fisheries as well as Spanish pair-trawl and Portuguese gillnet fisheries were used to estimate the age composition of the commercial catch in 1990. The 1985 and 1986 year-classes (ages 5 and 4) were most numerous in the Canadian and Spanish catches and the 1978-81 year-classes (ages 9-12) in the Portuguese fishery. The presence of age 2 cod in the Spanish pair-trawl catch (about 4% of total numbers) and in the December Portuguese trawl catch supported the observations from the fall Canadian survey that the 1988 year-class may be better than those of recent years (1983-87).

STACFIS considered that the 1990 catch-at-age may not be well estimated as it was obtained using sampling from countries and gears representing only about 60% of the catch. The remaining 40% of the catch came from the area outside the 200-mile boundary and its age composition was estimated using Spanish pair trawl age compositions. The latter were obtained using sampling relative to about 35% (fourth quarter only) of that country's catch.

ii) Research survey data

Stratified-random research vessel surveys have been conducted by Canada in Div. 3N for the 1971-91 period, with the exception of 1983, and in Div. 3O for the years 1973-90 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. Biomass for Div. 3N and 3O combined, gradually increased from the early-1970s to the early-1980s and increased considerably between 1982 and 1984 (Fig. 10). Another sharp increase occurred in 1987 but survey biomass has been declining steadily since that time. The increase in 1987 was caused by a large increase in Div. 3O. However, since that time the decline has been observed in both Divisions. The 1991 Div. 3NO biomass was the lowest observed since 1982.

Abundance estimates for Div. 3NO suggested similar trends to those observed for biomass with a large value occurring in 1987 resulting mainly from a high estimate for Div. 3O. The abundance estimates for the 1988 to 1991 period have been stable but were at the lowest level of abundance observed in the time series.

The low levels of biomass and abundance in recent years has been attributed to a succession of very weak year-classes. Abundance estimates-at-age indicated that the 1983 to 1988 year-classes were among the lowest observed in the time series. The dominant ages in the 1990 survey were 4 and 5 (the 1986 and 1985 year-classes respectively) as well as those at ages 14+.

For the first time, the 1991 spring survey also covered the deeper water strata (366-732 m). Biomass in the depth range (366-545 m) was substantial in Div. 3O only (about 25% of the total for this Division). Information was not available to determine whether the 1991 distribution was similar to previous years when this depth had not been covered. Other surveys extending into the deep water areas but using different survey design and conducted at a different time of the year did not produce significant cod catches. An extension of distribution to deeper water may have occurred in 1990 as a similar phenomenon was observed in the surveys and commercial fisheries of adjacent cod stocks. STACFIS noted that additional information on depth distribution of cod are needed and might be available from commercial fisheries in this area.

An additional stratified-random survey was conducted by Canada during the autumn of 1990. Abundance estimates were similar to those from the spring surveys while biomass was somewhat lower. Age compositions were also similar

although the age-groups 14+ were less dominant and the 1988 year-class (age 2) appeared to be somewhat stronger in the fall survey.

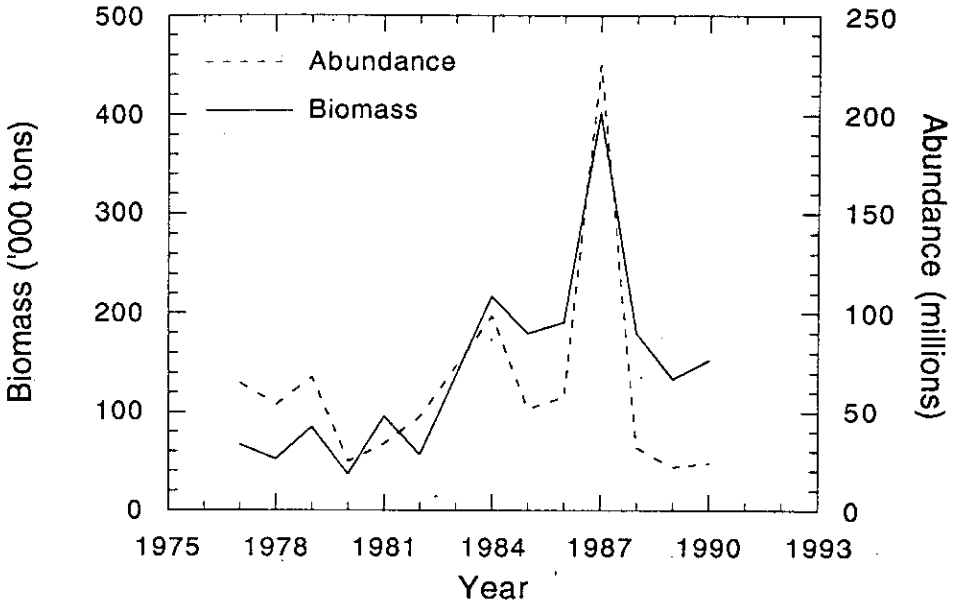

Fig. 10. Cod in Div. 3NO: biomass and abundance from Canadian research vessel data.

Surveys by the USSR were conducted on a random-stratified basis (1983-90), and those for 1977 to 1982 were reanalysed to make both comparable. The abundance and biomass estimates generally increased from 1979 to 1985, but have decreased substantially since (Fig. 11). The 1990 abundance estimate was the lowest in the time series while biomass was lowest since 1981. Cod of ages 3 to 5 were not abundant in the survey catches during 1990.

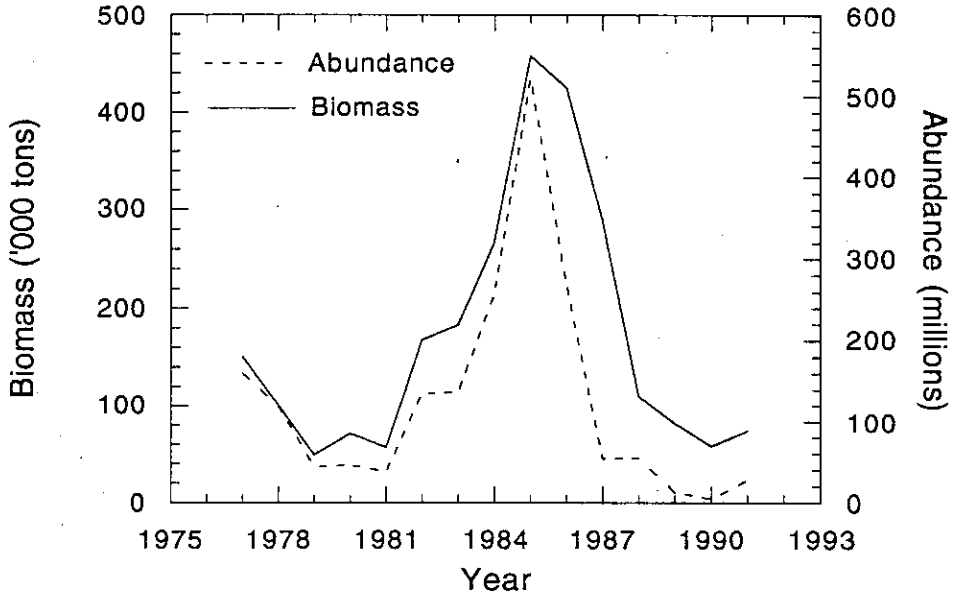

Fig. 11. Cod in Div. 3NO: biomass and abundance from USSR research vessel data.

Acoustic estimates of cod abundance from the 1987-90 USSR surveys indicated that the proportion distributed pelagically was variable. The acoustic abundance was highest in 1988 but decreased substantially, as have the trawl estimates, in 1989 and 1990. Consequently, movement of cod pelagically did not account for the current very low trawl abundance estimates.

c) Estimation of Parameters

(i) Sequential population analysis

Canadian and USSR research vessel survey data were used in an attempt to calibrate the SPA. The formulation of the Adaptive framework (ADAPT) was the same as that used during the 1990 assessment. The coefficients of variation (CV) on the age 4 to 6 abundance estimates were in the range of 21% to 28%, while those on ages 7 to 11 were between 42% and 45%. The CV on age 3 was somewhat higher at 54%. All research vessel age specific catchabilities were estimated with CVs of approximately 30%. Residuals indicated the presence of several year effects, both negative and positive, in both the Canadian and USSR survey indices. The high CVs on most abundance estimates and the patterns observed in the residuals suggest considerable uncertainty with the results of this calibration analysis. This could be attributed to a combination of factors such as: surveys displaying large year-to-year variations, and poorly estimated removals at age.

Diagnostics examined during the 1990 assessment of this stock indicated a similar degree of uncertainty to that described for the current analysis, however, results were accepted and terminal year population estimates were used to project catches at the requested reference levels. However, during the 1990 assessment, terminal year fishing mortalities (for 1989) implied by populations estimated by ADAPT were extremely high, with that for some ages associated with the highest in the period since 1977. The fishing mortalities on ages 5 and 6 in 1989 were in excess of 1.0.

Fishing mortalities derived from the current analysis show a similar pattern to those estimated last year with those on ages 4, 5 and 6 for 1990 being 1.4, 1.6 and 1.2 respectively. However, the Fs on ages 5 and 6 for 1989, which were previously evaluated to be in excess of 1.0, are now estimated to be approximately 0.7.

Given the combination of: the uncertainty in the ADAPT results described above; the magnitude of fishing mortalities on ages 4-6 in 1990; and the large differences in the 1989 fishing mortalities on ages 5 and 6 between the current assessment and that accepted last year, the results of this formulation were viewed with considerable doubt. STACFIS concluded that, although the general trends in the SPA population were approximately correct, these results were not appropriate to conduct formal catch projections.

Some of the uncertainty in ADAPT results may have been caused by changes in research vessels and survey design in the early years of the research vessel time series. STACFIS therefore recommends, that *ADAPT formulations for cod in Divisions 3NO be attempted utilizing survey data excluding periods of perceived uncertainty.*

d) Prognosis

The results of ADAPT were not considered appropriate to conduct catch projections, however, all available indices indicated that the stock is at a very low level. The SPA, as an approximate estimate of stock size, indicated that the stock is at its lowest observed level with the year-classes of 1983 to 1987 all among the lowest in the time period examined (1959-90). Both the Canadian and USSR research vessel indices showed trends similar to those from the SPA, which is expected, as these indices were used for calibrations. Although commercial catch rates are not considered appropriate to calibrate a SPA, both the Canadian otter-trawl and Spanish pair-trawl catch rates in 1990 were about the lowest in the most recent 10 years. This is consistent with the trends in the SPA and the research vessel indices of abundance.

It was estimated during the previous assessment of this stock, that if the 1990 TAC of 18,600 tons is taken, the $F_{0.1}$ reference level for 1991 would be achieved at a catch of 13,600 tons. The actual catch for 1990 was about 29,000 tons, considerably above the 1990 TAC. This would imply that the fishing mortality generated by the 1991 TAC will be in excess of $F_{0.1}$.

This stock is currently at a low level. The approximate SPA and available abundance indices indicated that the adult population is declining and several year-classes in the most recent period are among the lowest observed. STACFIS therefore recommends, given the current state of the cod stock in Div. 3NO, that *the catch for 1992 should not exceed the 1991 TAC of 13,600 tons.*

Preliminary 1991 Canadian research vessel results indicate that biomass continued to decline while abundance increased marginally. This suggested the presence of relatively more younger cod in the 1991 survey than in 1990 although total abundance remained low. Maintaining the TAC at the relatively low level of 13,600 tons may allow recruiting year-classes to contribute additional yield-per-recruit and eventually increase spawning stock biomass.

4. Redfish in Subarea 1 (SCR Doc. 91/35, 46, 48, 50, 73, 74; SCS Doc. 91/13)

a) Introduction

Redfish are taken mainly as by-catch in the trawl fisheries for cod. Landings are considered to be almost exclusively golden redfish (*Sebastes marinus* L.). Total nominal catches were stable between 1978 and 1983 averaging 8,000 tons (Fig. 12).

From 1984 to 1986, catches declined to an average level of 5,000 tons due to an effort reduction in the cod fishery by trawlers of the EEC-FRG. This reduction was only partly compensated for by a directed redfish fishery by Japanese trawlers. With the closure of the offshore cod fishery in 1987, catches decreased further to only 1,200 tons and remained at this low level in the following years in spite of increased effort in the cod fishery by trawlers from Greenland and the EEC-FRG. Recent catches ('000 tons) are as follows:

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Catch	9	8	6	8	7	6	4	5	1	1	1[1]	0.5[1]

[1] Provisional data.

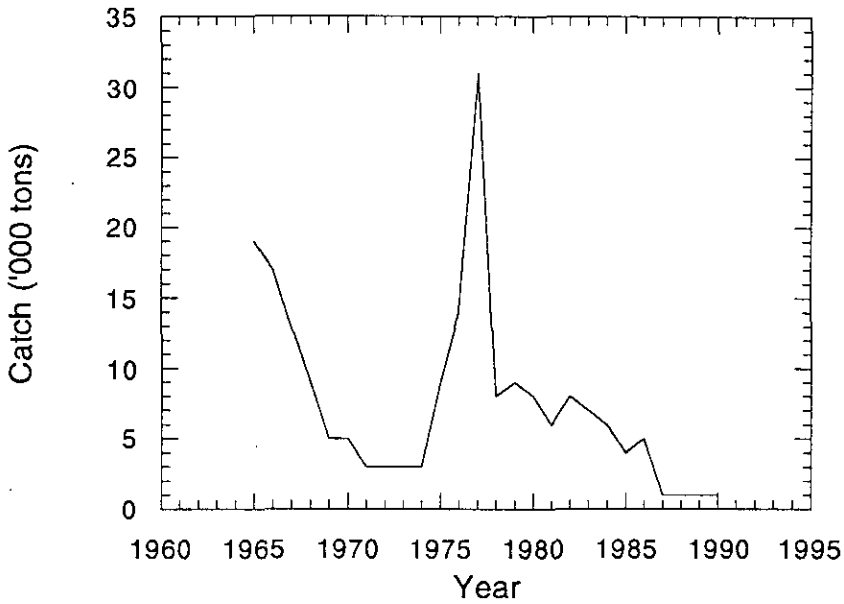

Fig. 12. Redfish in Subarea 1: catches.

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

b) Input Data

i) Commercial fishery data

No data available.

ii) Research vessel data

EEC-FRG groundfish survey. Biomass and abundance estimates were derived from the stratified-random bottom trawl surveys conducted by the EEC-FRG since 1982. These surveys were primarily designed for the assessment of cod and did not cover the entire depth distribution of either golden redfish or beaked redfish. Additionally, the pelagic occurrence of these species possibly caused the highly variable estimates. The abundance and biomass indices of golden redfish were found to be the lowest on record in 1990, whereas the estimates of beaked redfish lacked any definite trends over the total time series 1982-90. The predominance of small individuals (below 20 cm) in the northern strata (Div. 1BC) underlined the importance of this area as a nursery ground.

Greenland shrimp survey. Stratified-random shrimp surveys have been conducted by Greenland since 1988. In 1990, abundance and biomass estimates of small redfish amounted to about 400 million and 12,800 tons, respectively. Comparing these results to the 1988 estimates, both abundance and biomass indices declined substantially by approximately 36%. In 1990 there was a decrease in average individual size compared to 1988. Individual length increased in deeper strata. The large catches of small redfish confirmed the coincidence of their nursery grounds with the distribution area of shrimp.

EEC-FRG O-group studies. Pilot studies on the distribution of larval and O-group fish were carried out in summer 1989 and in summer and autumn 1990. In both years, almost no redfish larvae were caught during the summer. In autumn 1990, considerable numbers of O-group fish occurred. Off southwest Greenland they were most abundant close to the coast and found in water

temperatures less than 3°C, whereas in the northern region high densities were observed predominantly at the outermost stations in warmer water.

Food and feeding. Preliminary investigations of feeding habits in June-November 1990 indicated that shrimp were an important part of the diet. It was suggested that redfish should be sorted by species in future studies of feeding habits.

c) Catch Projections

In view of low catch levels in recent years, the considerably low indices of redfish abundance and biomass as indicated by survey results can obviously not be solely attributed to the cod fishery. Large amounts of juvenile redfish in the northern part of Subarea 1 were caught by the shrimp fishery which may have adversely affected recruitment. Larval and 0-group drift originating from the Irminger Sea was also considered important for the recruitment of redfish.

As long as catches remain limited to by-catches of the fisheries directed to other species, no TAC is advised by STACFIS.

5. Redfish in Division 3M (SCR Doc. 91/28, 32, 77; SCS Doc. 91/5, 12, 14, 15, 16)

a) Introduction

From 1979 to 1985, catches were at or below the TAC Level (20,000 tons). Catches began to increase in 1986, and were over double the TAC in 1987 (58,000 tons) and 1989 (83,000 tons). The estimated catch for 1990 was the highest on record for this stock.

Provisional data for 1990 indicate a catch of about 83,000 tons, an increase of about 25,000 tons from 1989. For the past number of years, this fishery has been prosecuted mainly by EEC-Portugal, South Korea and USSR. Cuba has also accounted for about 1700 tons annually. In 1990, the majority of the catch was again taken by South Korea (8,000 tons), EEC-Portugal (12,000 tons) and USSR (35,000 tons). An additional 16,000 tons was estimated to have been taken by non-member countries not reporting to NAFO. Nominal catches and TACs ('000 tons) for the recent period are as follows (Fig. 13):

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	20	20	20	20	20	20	20	20	20	50	50
Catch	14	15	20	20	20	29	44	23	58[1,2]	83[1,2]	

[1] Includes estimates of unreported catch.
[2] Provisional data.

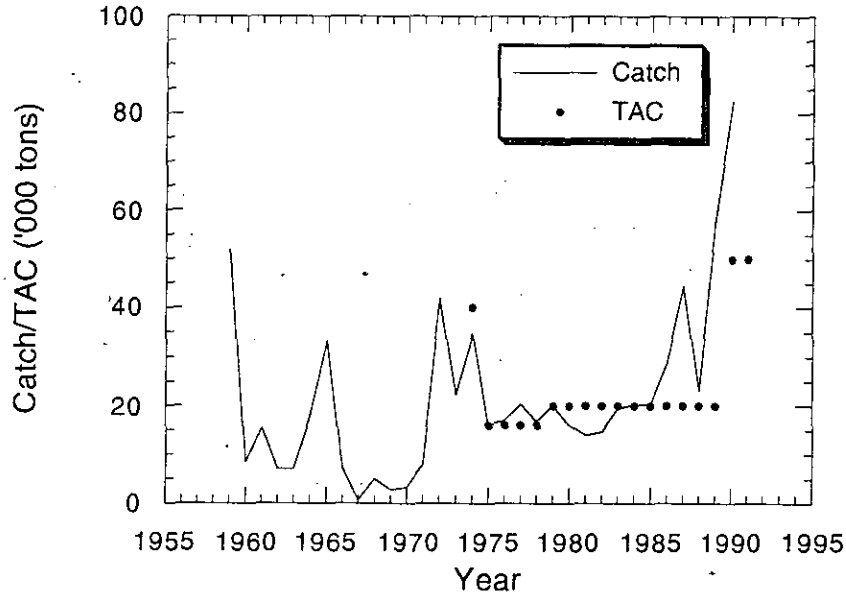

Fig. 13. Redfish in Div. 3M: catches and TACs.

b) Input Data

i) Commercial fishery data

Catch and effort data from ICNAF/NAFO for the period 1968-1988 were combined with provisional data for 1989 and 1990 and analyzed using a multiplicative model to derive an estimate of standardized catch rate and effort.

Catch rates increased from 1969 to 1970 and subsequently declined to 1973, were stable from 1973 to 1986, increased in 1987 and subsequently declined. Estimates for 1988 and 1989 were in the range observed from the mid-1970s to the mid-1980s, however the catch rate for 1990 is the second lowest in the time series (Fig. 14).

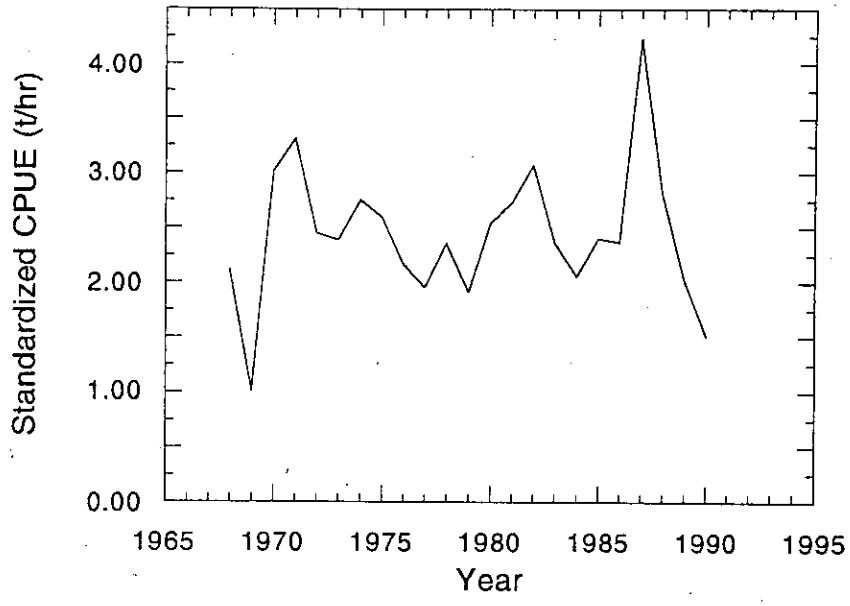

Fig. 14. Redfish in Div. 3M: standardized catch rates.

Catch-at-age estimated from the USSR fisheries in 1968-90 indicated ages 7-9 dominated the catch in 1990. Estimated catch-at-age from the Portuguese bottom trawl fishery in 1990 indicated that ages 8-10 predominated in the catch. Length frequencies available from the 1990 Spanish fishery indicated a predominant mode at 27-29 cm and a smaller mode at 17-19 cm.

ii) Research data

The results from EEC trawl surveys indicated a decline in biomass from about 158,000 tons in 1988 to 104,000 tons in 1990. Estimates of trawlable biomass from USSR bottom trawl surveys for 1983 to 1990 showed large fluctuations from one year to the next, however, there was a general decrease from 1986 to 1990. The results of the USSR combined trawl and acoustic survey indicated a successive decline in total biomass over the four years they have been conducted. It was noted previously (NAFO Sci. Coun. Rep. 1989, page 64) that the proportion of the redfish biomass up in the water column above the swept area of the trawl may vary from year to year. In 1987, the percentage above the trawl was estimated to be about 70%. This was determined to be 90% in 1988, 87% in 1989 and 84% in 1990. Biomass estimates from the various surveys ('000 tons) are as follows (Fig. 15):

		1983	1984	1985	1986	1987	1988	1989	1990
USSR	Trawl	155	132	52	310	108	47	83	18
	Acoustic					322	322	283	229
	Total					428	379	366	247
EEC	Trawl						158	137	104

Redfish from a year-class of 1985/86 dominated the catches of the EEC survey during 1990. This year-class was also among those which dominated in the 1990 USSR trawl survey.

c) Estimation of Parameters

i) Sequential population analysis

An SPA was available but STACFIS was unable to accept it because a catch of only 39,000 tons in 1990 was assumed, although, preliminary data for 1990 indicated the total catch in Div. 3M to be in the range of 83,000 tons. STACFIS did note that the analysis indicated high fishing mortalities on the fully recruited ages in 1990, and that these are conservative estimates given that less than one half of the total catch was accounted for.

STACFIS considered that selectivity has probably changed during the 1968-90 period and recommends that *in future, partial recruitment be calculated for years as far back as 1985-86 only*. In addition, STACFIS considers that as

much sampling information as possible should be included on the construction of catch-at-age. Reference is also made to the recommendations included in the discussion of Div. 3LN redfish pertaining to the presentation of SPA results.

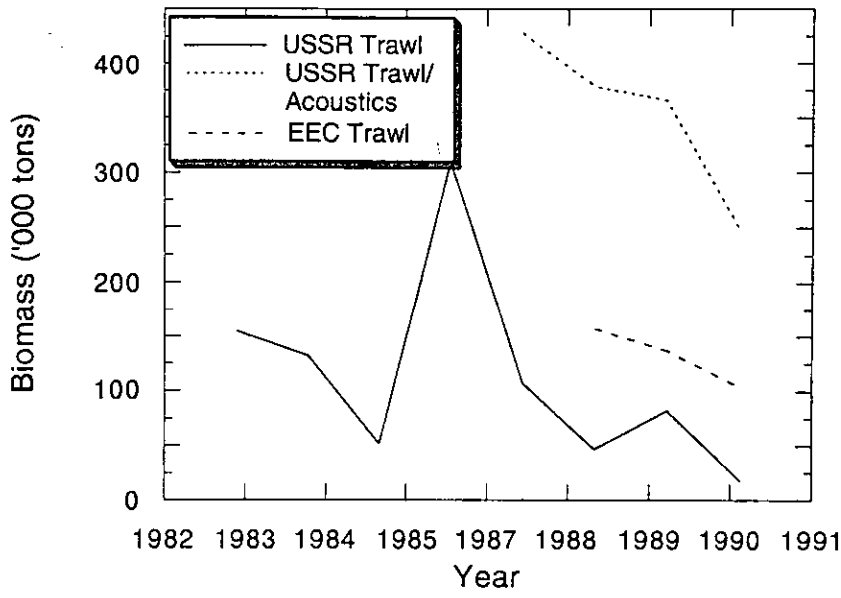

Fig. 15. Redfish in Div. 3M: biomass estimates from research vessel data.

d) Prognosis

Both trawlable biomass estimates from EEC bottom trawl surveys and total biomass estimates from USSR trawl-acoustic surveys indicated a reduction from 1987 to 1990. In addition, catch rates have shown a steady decline since 1987. Because of the consistent declines observed in recent years in all of the indices, STACFIS decided to adopt the same rationale as was used last year (NAFO Sci. Coun. Rep., 1990, page 63) and applied $F_{0.1}$ (11%) and F_{max} (20%) exploitation rates to the average total biomass estimates from the USSR trawl-acoustic surveys for 1989 and 1990 (about 307,000 tons). This resulted in yields of about 35,000 tons and 60,000 tons at $F_{0.1}$ and F_{max} respectively. STACFIS is concerned that provisional catches in 1990 exceeded both the advised and adopted TACs by a considerable amount (almost two times the advised TAC) and that such a total catch generated high fishing mortality. There are indications that the 1991 catch will also likely generate a high fishing mortality. STACFIS considers that this stock cannot sustain fishing pressure of this magnitude and unless catches are reduced significantly there is danger of a long-term depression. Accordingly, STACFIS recommends that *the TAC for redfish in Div. 3M be set at 35,000 tons in 1992.*

6. Redfish in Divisions 3L and 3N (SCR Doc. 91/6, 75, 90; SCS Doc. 90/12, 91/5, 12, 14, 15, 16)

a) Introduction

The average reported nominal catch for the period 1959-85 was about 21,000 tons. During this period catches were as high as 45,000 tons (1959) but never lower than the 8,000 tons taken in 1964. From 1980 to 1985 between 60%-80% of the total was taken in Div. 3N. Over this period catches averaged 19,000 tons. In 1986, reported landings doubled to 43,000 tons. This increase was due to the greater participation of EEC-Portugal in both Div. 3L (13,000 tons) and Div. 3N (8,000 tons). Catches increased again in 1987 to the highest reported historically at 71,000 tons then declined steadily to 25,000 tons in 1990. In the recent period the largest catches have been taken by the USSR, EEC-Portugal and South Korea.

Canadian surveillance estimates for non-member countries fishing in the Regulatory area, who do not report catches to NAFO are as follows:

Country	1987	1988	1989	1990
Cayman Islands	4500	3000	0	200
Malta	0	0	300	1000
Panama	2650	3900	1500	1500
St. Vincent	0	1000	0	1650
Total	7150	7900	1800	4300

The fishery is prosecuted throughout the year in Div. 3L and Div. 3N. The bottom trawl is the predominant gear in the fishery but in recent years midwater trawling has accounted for an increased portion of the reported catch.

Recent nominal catches and TACs ('000 tons) are as follows (Fig. 16):

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	25	25	25	25	25	25	25	25	25	25	14
Catch	24	22	20	15	21	43	78[1]	53[1]	34[1,2]	29[1,2]	

[1] Includes estimated catch for non-member countries who do not report to NAFO.
[2] Provisional.

There has been an increased concentration of effort in Div. 3L since 1985, because the USSR, a major participant in the fishery, has diverted a large portion of its effort to Div. 3L in recent years.

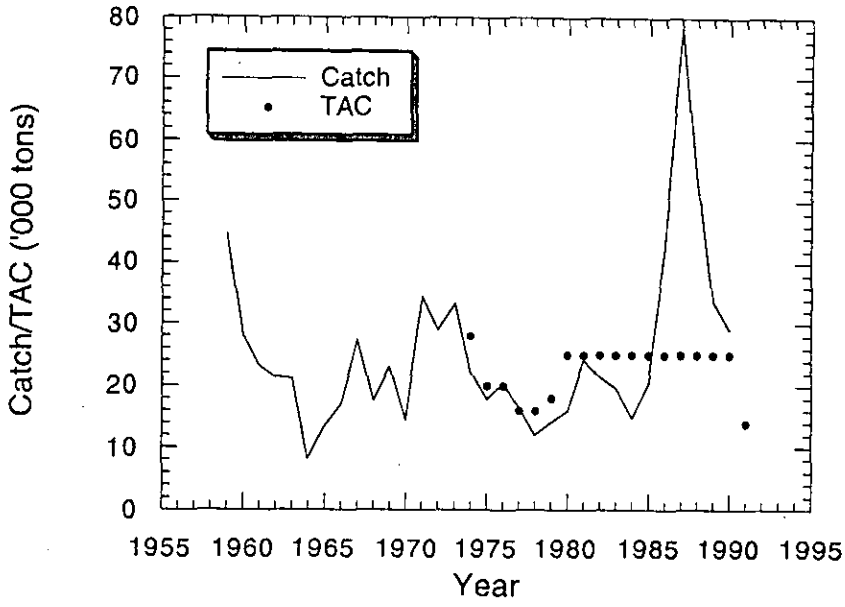

Fig. 16. Redfish in Div. 3LN: catches and TACs.

b) Input Data

i) Commercial fishery data

Divisional catch and effort were standardized using a multiplicative model. Although there was considerable within and between year variability in both series, neither exhibited any overall trends with time. These indices were not considered to be reflective of stock abundance.

In the past, observations with less than 10 tons catch or 10 hours of effort were excluded from the analysis. The use of other selection criteria may reduce the variability of the estimates. Therefore, STACFIS recommends that *alternative criteria for including observations in catch rate standardization utilizing effort in hours fished be investigated, and in addition, a standardization based on effort in days fished be presented for evaluation.*

Commercial catch-at-age and mean weight-at-age were available for the fishery from 1968 to 1990. STACFIS acknowledged that the availability of the data extending back to 1968 was in response to last year's recommendation (NAFO Sci. Coun. Rep., 1990, page 64). These data indicated that ages 7-8 dominated the catch in 1990 (80% by numbers and 72% by weight). Details of the sampling that formed the basis of constructing the 1990 catch-at-age were not available, although it was reported that only USSR data was used. STACFIS had reservations whether the reported catch-at-age was representative of all fleets. Other components (EEC-Portugal) had significant catches and length frequency data from their other fisheries with different length compositions to those from the USSR fishery.

ii) Research survey data

Results of bottom trawl surveys for redfish demonstrate a considerable amount of between year variability. Nonetheless, USSR bottom trawl surveys in Div. 3L and Div. 3N indicated a decline in abundance and biomass from 1984 to 1990. Estimates from Canadian bottom trawl surveys in Div. 3L since 1979 also indicated a decline.

USSR acoustic surveys of Div. 3LN have been conducted concurrently with bottom trawl surveys since 1987. Total biomass estimated from these surveys indicated there has been a substantial reduction from an average of 145,000

tons for 1987-88 to an average of 35,000 tons for 1989-90 (Fig. 17). STACFIS noted changes as well in total biomass estimates from trawl-acoustic surveys in adjacent Div. 3O but in the opposite direction, increasing from 75,000 tons in 1989 to 300,000 tons in 1990, indicating that there may be some interchange between Div. 3LN and Div. 3O. There was no information readily available to evaluate this. Therefore, STACFIS recommends that *an examination be conducted of survey data, including Div. 3O, for the purpose of determining whether a redistribution of fish near the boundary between Div. 3N and Div. 3O may account for changes noted in recent years.*

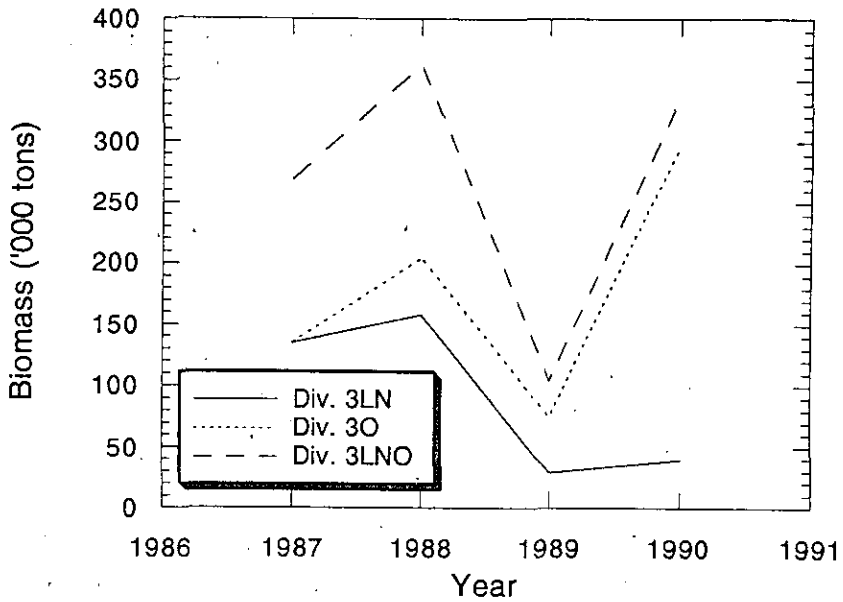

Fig. 17. Redfish in Div. 3LNO: total biomass estimates from USSR trawl-acoustic surveys.

Length compositions from USSR bottom trawl surveys in Div. 3LN from 1986 to 1990 exhibited quite different size distributions for each division. The size range in Div. 3N was generally between 18 and 29 cm while in Div. 3L there tended to be a considerable proportion greater than 29 cm. These surveys also indicated a pulse of recruitment in Div. 3N in 1989. This was not observed in Div. 3L. In 1990 this pulse was not as pronounced. STACFIS could not evaluate the strength of this recruitment as these frequencies were presented in terms of relative percentages at length for each year. Length composition from Canadian surveys in Div. 3L indicated there has been relatively poor recruitment observed since 1978.

It was noted that surveys by the USSR and Canada in Div. 3LN do not cover depths below 730 m, where in recent years a considerable amount of commercial catches were taken. This implied that both biomass and population structure estimated from these surveys may not be representative of the overall stock.

c) Estimation of Parameters

i) Sequential population analysis

SPA of Div. 3LN redfish was available but STACFIS was unable to evaluate the results. In order to properly evaluate an SPA, the following information must be available:

- details of the estimation of catch-at-age including number of length samples used; number of otoliths/scales aged per division, country, gear and month; the monthly landings these were weighted by and the length-weight relationships used.
- quantitative information about the indices used in the calibration, including how the indices were derived.
- details of partial recruitment and natural mortality estimates.
- population estimates (both numbers and biomass at age) and fishing mortality matrix from the SPA.
- all diagnostics of the calibration method (correlations with indices including the data regressed and associated figures, residual plots by age if appropriate).

Notwithstanding the inability to evaluate the SPA, STACFIS noted that the SPA utilized variable natural mortality rates and reiterated that the sensitivity of an SPA utilizing variable M would have to be evaluated through an

appropriate simulation study before acceptance of this procedure. This was was recommended previously (NAFO Sci. Coun. Rep., 1987, page 51).

Illustrative SPA at three terminal fishing mortalities (F_t = .25, .50 and .75) were used to estimate historic population sizes and fishing mortalities. Fishing mortality on the oldest age was set to the average (weighted by population numbers) for ages 11-17. Natural mortality was assumed to be 0.1 over all age groups.

ii) General production model

General production analysis has not been considered appropriate for this stock because there was not enough contrast in the catch and effort data for Div. 3L and Div. 3N (NAFO Sci. Coun. Rep., 1989, page 68). The update in the database for this year has not changed this view.

d) Assessment Results

i) Illustrative SPA

Results of the illustrative SPA indicated approximate convergence by 1984. The rapid convergence is a result of very high fishing mortalities in excess of 1.0 estimated for 1987 and 1988.

e) Prognosis

Given the rather large fluctuations in total biomass estimated from the USSR trawl-acoustic surveys between 1987-88 and 1989-90, an average of these estimates may be closer to the real situation. Based on yield-per-recruit calculations from 1989 (NAFO Sci. Coun. Rep., 1989, page 69), and applying $F_{0.1}$ and F_{max} exploitation rates (11% and 20% respectively) to the average trawl-acoustic biomass from 1987 to 1990 (about 90,500 tons) resulted in yields of about 10,000 tons (at $F_{0.1}$) and 18,000 tons (at F_{max}). Given the variability in survey estimates and the uncertainty about possible exchanges with Div. 3O, especially at the time the trawl-acoustic surveys are conducted, STACFIS could not discriminate the $F_{0.1}$ reference catch of 10,000 tons from the 1991 TAC of 14,000 tons. Therefore, STACFIS recommends that *for redfish in Div. 3LN the TAC for 1992 remain at 14,000 tons.*

7. Silver Hake in Divisions 4V, 4W and 4X (SCR Doc. 91/1, 2, 7, 14, 16, 18, 19, 42; SCS Doc. 91/5, 6, 8, 12)

a) Introduction

The fishery is conducted primarily by large Cuban and USSR otter trawlers using small-meshed bottom trawls. Recently (1989), Canadian Tonnage Class (TC) 2 and 3 otter trawlers entered this fishery. Nominal catches since 1970 ranged from a maximum of 300,000 tons in 1973 to a minimum of 36,000 tons in 1983. Since 1977 catches have generally increased, with the exception of 1983, from 37,000 tons in 1977 to 91,000 tons in 1989. Prior to 1977 the fishery was not restricted by season or area, however since 1977 the fishery has been restricted to April 1 through November 15 and to the area seaward of the small mesh gear line (SMGL). Recent catches and TACs ('000 tons) are as follows (Fig. 18):

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	80	80	80	100	100	100	100	120	135	135	100
Catch	45	60	36	74	75	83	62	74	91[1]	69[1]	

[1] Preliminary.

The 1990 fishery by Cuba and USSR opened on March 15. Catch rates declined in May and June, then increased again in July. This pattern was atypical and could be the result of changes in the oceanographic conditions.

As in previous years, dense, stable aggregations of silver hake were reported early in the fishery. However, these aggregations appeared to disperse earlier than usual, as both catch rate and mean length in the catch declined in May and June.

Similar to previous years, by-catch of haddock, pollock and cod in 1990 was less than 1%. In 1990 the by-catch of herring and mackerel was unusually high.

During 1989 and 1990 Canada conducted several fishing trials using TC 2 and 3 vessels. These vessels fished in Emerald and LaHave Basins using small meshed gear during the months of March, April and October with limited success.

As was the case in recent years, the 1990 catch fell short of the TAC due to limited Canadian allocations. Since 1986, both Cuba and USSR generally have taken more than 90% of their respective allocations.

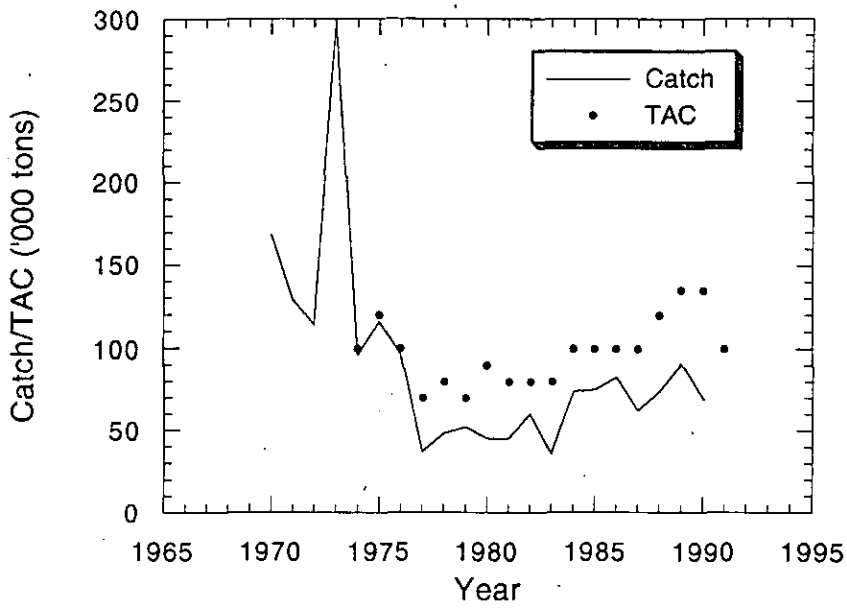

Fig. 18. Silver hake in Div. 4VWX: catches and TACs.

b) Input Data

i) Commercial fishery data

Standardized catch rates were estimated using a multiplicative model. The standardized catch rates showed an general increase over the period 1980-89, although the value for 1982 appears anomalously high (Fig. 19). In 1990 however, the catch rate dropped steeply to a level similar to that of 1983. The 1989 catch rate remained the highest in the series.

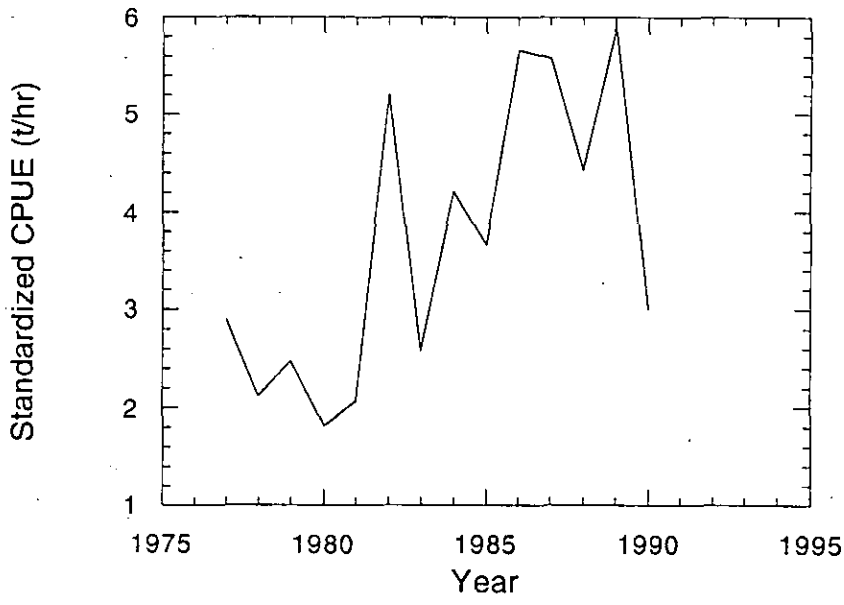

Fig. 19. Silver hake in Div. 4VWX: standardized catches rates.

ii) Catch-at-age data

The age composition of the catches from 1977 to 1990 were constructed from Canadian observer sexed length frequency data. These length frequencies were used with Canadian sexed age length keys for 1977-88, and combined Canadian/USSR sexed age length keys for 1989 and 1990.

The 1990 age composition by numbers in the catch was dominated by the 1988 year-class at age 2 (51%), followed by the 1987 year-class at age 3 (34%).

iii) Research vessel indices

The 1990 Canadian July research vessel survey results indicated that abundance and biomass both increased slightly from 1989. However, both have declined since the mid-1980s (Fig. 20). The abundance in 1990 was below average, at 84% (numbers) and 71% (biomass) of the 1977-90 mean. The 1988 year-class at age 2 was the highest at that age since the 1985 year-class.

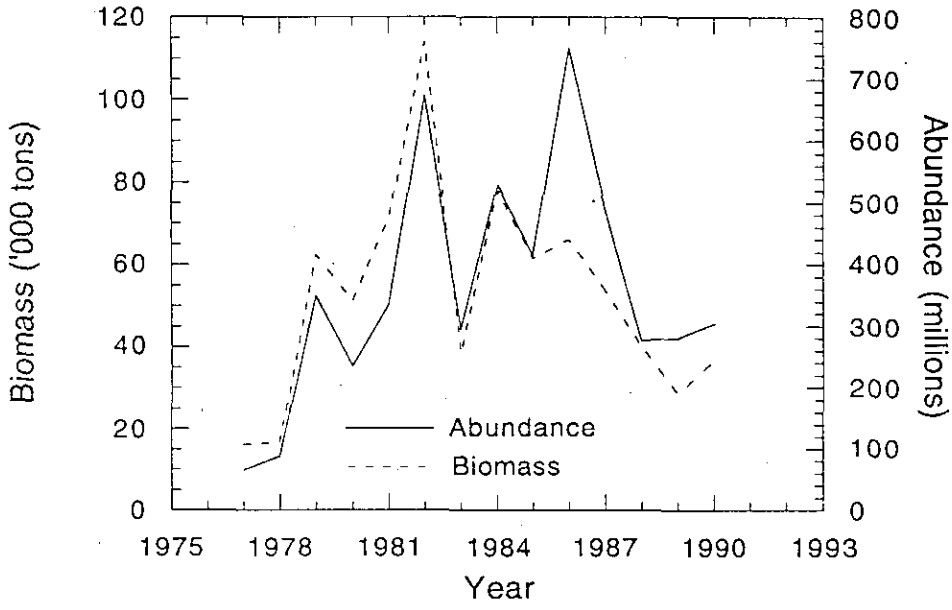

Fig. 20. Silver hake in Div. 4VWX: biomass and abundance estimates from July Canadian research vessel data.

The results of the joint USSR-Canada juvenile silver hake survey since 1981 are as follows:

	1981	1982	1983	1984	1985	1986	1987	1989	1990	1991
Mean/tow	579	9	232	43	285	198	102	205	132	187
C. V.	0.11	0.14	0.11	0.16	0.22	0.19	0.11	0.17	0.09	0.12

Results of the juvenile survey indicated the 1990 year-class is similar in size to that of 1986 and 1988 but weaker than the strong 1985 year-class. The 1989 and 1987 year-classes are considered to be about the same size.

The 1990 juvenile survey found high concentrations on Emerald and Western Banks in the fall. In winter these concentrations shifted to Emerald and LaHave Basins. A comparison of juvenile distribution over the period 1978-90 indicated that high concentrations are found near Emerald Basin, on Emerald and Western Banks. A decrease seen in condition factor and growth rate in 1981 and 1985, was attributed to the density and distribution of zooplankton prey.

Studies on vertical movement and feeding of juveniles in 1990 were reviewed. An absence of normally high cannibalism rates by larger juveniles was noted. Juveniles were observed to be feeding almost exclusively on copepods which were more abundant than in previous years. Compared to previously observed feeding behaviour a potentially higher than normal survivorship for the 1990 year-class was suggested.

iv) Environmental data

A review of 1990 water temperature anomalies on the Scotian Shelf suggested lower temperatures than usual. Changes were also noted in silver hake biological parameters, as well as low catch rates during May and June of the 1990 fishery compared to 1989. In addition, high by-catches of herring and mackerel were recorded. These observations were attributed to the unusual hydrographic conditions, and concern was expressed as to the reliability of the 1990 CPUE as a reflection of stock abundance.

v) Mortality estimates

An attempt was made to estimate silver hake natural mortality rates (M) by age, for age 4 and older. Using Paloheimo Z values and assuming a constant fishing mortality after age 4, M at age was estimated. These estimates

suggested that M increases from 0.332 at age 4 to 0.544 at age 6. STACFIS noted that a previous study in 1989 showed that M on ages 1-4 did change due to cannibalism. However, after age 4, assuming an average M of 0.4 for stock assessment purposes was acceptable. STACFIS encourages further investigation of variable M. However, for the purposes of assessing the population size in 1992, a constant M of 0.4 was accepted.

vi) Biological studies

Investigations into otolith microstructure in embryonic, larval, and young silver hake were reported. Given the relationship between length and otolith growth, it was found that back calculation of spawning dates may be possible. Based on this information the number of spawning groups and the resultant size of the year-class could be related. This could provide additional information to explain the success or failure of various year-classes. The number of spawning groups could be used in determining the potential success of the most recent year-class as estimated by the juvenile surveys. Also, the spawning date may be related to decreases in commercial catch rates as spawning occurs to the landward side of the SMGL.

c) Estimation of Parameters

i) Sequential population analysis

Several formulations of the Adaptive framework (ADAPT) were reviewed in an attempt to determine the stock size in 1990. These all utilized research vessel and CPUE, assumed a dome partial recruitment pattern and a constant M = 0.4. None were considered completely acceptable, and STACFIS recommends that *further investigation of different formulations be carried out prior to the June 1992 meeting.*

ii) Yield-per-recruit

The results of a Thompson and Bell yield-per-recruit presented last year were used in this assessment. That analysis indicated $F_{0.1}$ was 0.72 with a yield of 0.060 kg.

d) *Prognosis*

i) Catch projections

Although none of the ADAPT formulations were accepted, STACFIS noted that the size of the 1988 year-class ranged between 1.5-2.0 billion fish at age 1 in all formulations and considered that setting the size of this year-class at 1.75 billion at age 1 for projections would be reasonable. Based on 0-group surveys, the 1990 year-class was set equal to that of 1988, while the 1989 year-class was set equal to that of 1987 (1.16 billion). The juvenile and research vessel survey indices appeared to provide consistent estimates of year-class strengths. Therefore, the 1991 year-class was set equal to the geometric mean (1982-88) of 1.4 billion fish. As older ages (>3) in 1990 will not contribute significantly to yield in 1992, estimates were arbitrarily selected from one of the ADAPT formulations for projections.

The weight-at-age has remained fairly stable over the 1977-90 period, so mean weights for projections were calculated from that period. The partial recruitment for this projection was that used in the previous assessment. The Table below summarizes the parameters used in the projection:

Age	Jan 1, 1991 population numbers ('000)	Average weight (kg)	Partial Recruitment
1	1,750,000	0.057	0.035
2	772,273	0.137	0.235
3	609,396	0.182	1.000
4	138,221	0.224	1.000
5	55,474	0.259	1.000
6	16,130	0.308	0.761
7	2,313	0.411	0.381
8	1,537	0.525	0.141
9	911	0.665	0.078

Reports from the 1991 fishery suggest that the catch may be 66,000 tons on the assumption that Canada will not catch its allocation. A catch projection, using these data, indicated that the $F_{0.1}$ catch in 1992 would be 105,000 tons as given in the Table below.

1992 Catch (tons)	Population Numbers (1.1.1992) ('000)	Population Biomass (mid-year) (tons)
105,000	3,373,701	317,163

e) Future Studies

STACFIS recommends that *the entire issue of how to best assess silver hake stock in Div. 4VWX be revisited.* This should include further studies of the ADAPT formulation as well as further development of useful indices for ages 1 and 2. In this context, the continuation of the joint Canada-USSR juvenile research vessel surveys is encouraged. STACFIS supports other biological studies such as the investigation of silver hake natural mortality-at-age which may also prove useful for assessments.

8. American Plaice in Division 3M (SCR Doc. 91/12, 28, 60, 82; SCS Doc. 91/5, 15, 16)

a) Introduction

This stock has been regulated since 1974, when a TAC of 2,000 tons was agreed (Fig. 21). The TAC has been maintained since then with the exception of 1978. Until 1985 landings were lower than 2,000 tons, and were taken as by-catch of the cod fishery. In 1986 EEC-Spain and EEC-Portugal began to develop a freezer-trawler fishery in this area, increasing the catches to 5,600 tons in 1987. Nominal catches were higher than the TACs from 1986 to 1989 but then decreased to 996 tons in 1990.

The catch levels are not accurately known because of the lack of information of by-catches from vessels fishing cod in this area and catches by non-member countries. Recent TACs and nominal catches ('000 tons) are as follows:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	2	2	2	2	2	2	2	2	2	2	2
Catch	0.6	1.1	1.9	1.3	1.7	3.8	5.6	2.8	3.5[1]	1[1]	

[1] Provisional data.

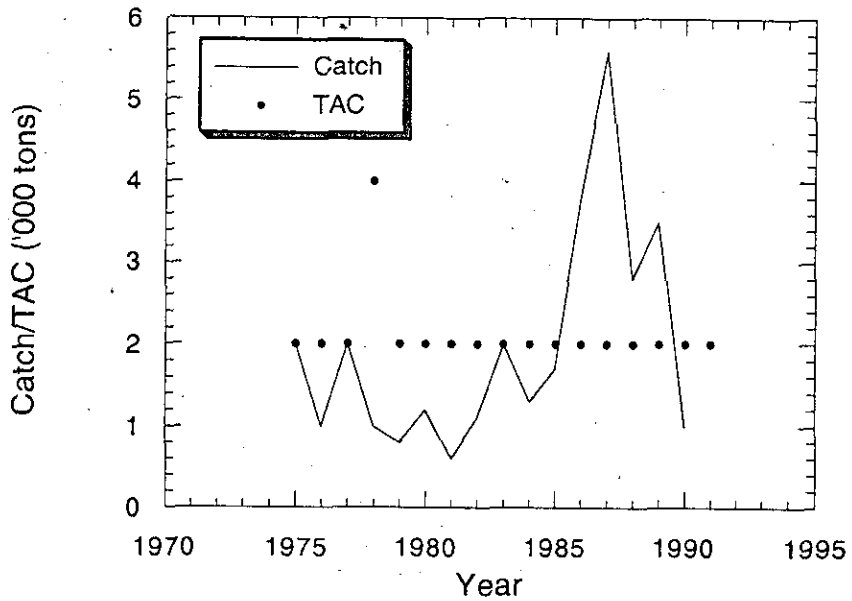

Fig. 21. American plaice in Div. 3M: catches and TACs.

b) Input Data

i) Commercial fishery data

Length compositions from the Spanish fishery were available for 1988. Length and age compositions were also available for 1989 and 1990, as were length compositions from the Portuguese fishery. Ages 6 and older dominated the catch in 1989 and ages 4 and older in 1990.

ii) Research vessel surveys (Fig. 22)

The USSR surveys showed a relatively stable biomass from 1983 to 1987 (7,500-9,300 tons) with a decrease from 1988 to 1990 (6,300-1,200 tons). Although the biomass estimated in 1990 was the lowest since the beginning of the survey (1972), this value was considered anomalously low in relation to commercial catches and biomass estimates from the 1990 EEC survey.

Total biomass estimates from the EEC surveys from 1988 to 1990 showed a gradual decrease to a biomass level near 10,000 tons in 1990. The stock age composition confirmed the strength of the 1986 year-class and the reduction in the abundance of older fish.

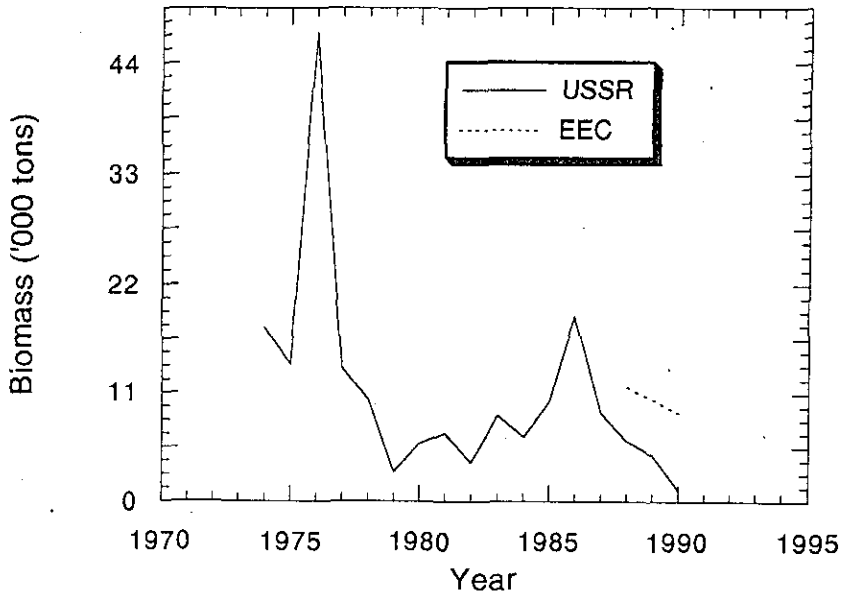

Fig. 22. American plaice in Div. 3M: biomass estimates from research vessel data.

c) Prognosis

STACFIS noted a slight decrease in the biomass from 1988 to 1990, and the presence of the strong 1986 year-class that could produce an important increase in the spawning biomass of 1992.

Due to the observed high variability in the American plaice biomass indices, STACFIS concluded that the biomass is stable at around 10,000 tons. Therefore STACFIS advises that the TAC for 1992 remain at 2,000 tons, corresponding to an exploitation rate of 20% of the present biomass level. Previous yield-per-recruit studies have indicated that this exploitation level corresponds to the $F_{0.1}$ level.

d) Future Studies

STACFIS noted the necessity of more information on stock age composition in order to facilitate a more thorough evaluation of this stock. STACFIS recommends that *age composition of surveys and commercial catch, be presented at the June 1992 Meeting.*

9. American Plaice in Divisions 3L, 3N and 3O (SCR Doc. 91/60, 81, 93; SCS Doc. 91/5, 15, 16)

a) Introduction

This stock has been exploited since the early-1950s, with a peak catch of 94,000 tons in 1967 (Fig. 23). USSR vessels took substantial catches from 1965 to 1976, while Canadian vessels accounted for over 90% of the catch from 1976 to 1982. Starting in 1982, other nations increased their involvement in the fishery, taking catches in the NAFO Regulatory Area on the Nose and Tail of the Grand Bank. These catches escalated rapidly from about 1,200 tons in 1982 to 27,000 tons in 1986, then declined to about 10,000-12,000 tons during 1988-90. Overall, catches declined from about 65,000 tons in 1986 to about 32,000 tons in 1989. Catches by EEC-Spain (10,895 tons) and Canada (27,892 tons) accounted for almost 90% of the total in 1989, which was similar to 1988. The Canadian catch in 1990 was down by 5,000 tons from 1989, and represented the lowest Canadian catch since 1963. The Spanish catch ranged from 9,000 to 14,500 tons between 1986 and 1989, but only 304 tons were reported in 1990. Catches by USA vessels were relatively stable around 1,200 tons from 1985 and 1989 but declined to only 10 tons in 1990. South Korean catches, which peaked in 1986 at about 4,000 tons, were about 700 tons in 1989 and 1990, based on reported catches and breakdowns of unspecified flounder catches. Catches for other non-member countries such as Panama and Cayman Islands, which accounted for an estimated total of over 4,000 tons in 1985 and 1986, were estimated as zero in 1987-88, as effort shifted into deeper water, primarily for redfish. In 1989 and 1990, estimated catches for these nations were about 1,900 tons. In addition to estimates of unreported catch for non-member countries in 1990, about 6200 tons was estimated for Contracting Parties.

Historically, most of the catch from Div. 3L has been taken by Canada, as was the case during 1990. The catch in Div. 3N was between 16,000-18,000 tons during 1987-89, which was about half the 1986 level, but declined to about 11,000 tons in 1990. The catches in Div. 3O have been relatively stable around 5,000 tons in the last 6 years.

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

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	55	55	55	55	49	55	48	40[1]	30.3	24.9	25.8
Catch	50	51[2]	39[2]	39[2,3]	54[2,3]	65[2,3]	55[2]	41[2,3]	44[2,3,4]	32[2,3,4,5]	

[1] Although the TAC was set at 40,000 tons, Canada reduced its domestic quota to 33,000 tons, therefore the effective TAC was 33,585 tons.
[2] Includes a percentage of the "flounder non-specified" catch reported to NAFO by South Korea.
[3] Includes estimates of catch based on surveillance reports.
[4] Provisional data.
[5] Includes estimates for non-members and Contracting Parties (8,100 tons).

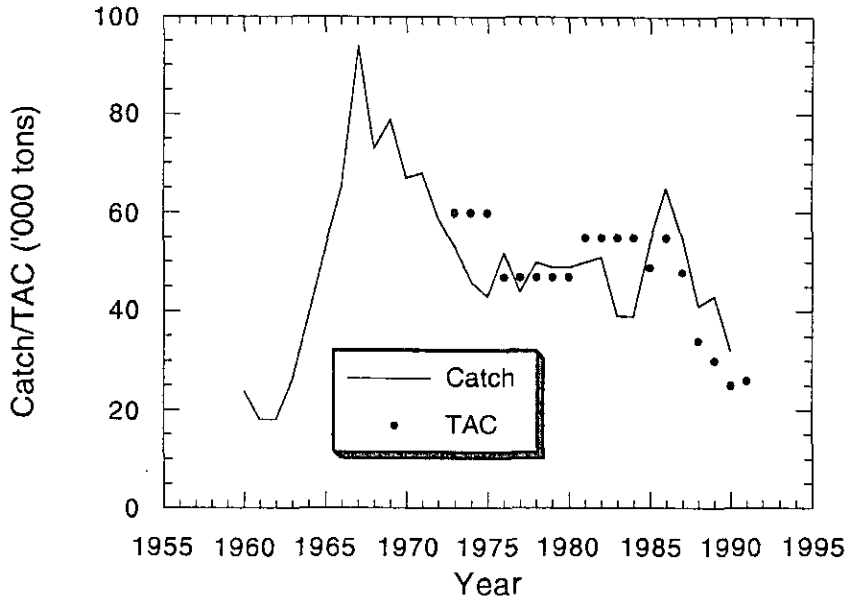

Fig. 23. American plaice in Div. 3LNO: catches and TACs.

b) Input data

i) Commercial fishery data

Catch and effort. Data from the Canadian commercial fishery in Div. 3LNO from 1956 to 1990 were analyzed using a multiplicative model to obtain a standardized catch rate series (Fig. 24). The data were from Canadian trawlers, tonnage classes 4 and 5, and the same procedure was followed as in the recent assessments of this stock. As has been noted previously, these are the only catch and effort data available for some years (e.g. late-1970s and early-1980s) from which a catch rate series can be calculated. The results showed a continuous decline for the first 20 years of the series to a low level in 1975-77. There was a gradual increase to 1980, and catch rates remained stable at this level until 1985. In 1986, the catch rates declined by about 25%, and has remained at this lower level over 1987-90. The 1990 catch rate was at the same level as the previous low observed in the mid-1970s. Anecdotal information from the 1991 Canadian fishery to date suggested that catch rate is lower in 1991 than for the same period in 1990, although it was noted that over 80% of the catch from this fleet occurred after June 1 in 1990.

Catch-at-age and mean weights-at-age. Catch-at-age was calculated from the length frequencies from the Canadian, Spanish and Portuguese catches in 1990. The Spanish length frequencies were combined based upon sample weights, as no monthly catch data were available. The dominant age-groups in the 2 major fisheries (Canada and EEC-Spain) were 9-11 and 4-6 respectively. The proportion of the catch at each age in both fisheries was similar to that observed in 1989. However, the Spanish catch-at-age in 1990 did not show any fish younger than age 4, although the length frequencies for some months indicated that such fish were present. The reason for this was that there were inadequate numbers of otoliths collected from the younger fish to allow calculation of the catch at these younger ages.

To derive the total catch-at-age for 1990, the catch-at-age for EEC-Spain in Div. 3LNO was adjusted to reflect a total catch of 9,095 tons, which included both the estimated and the unsampled catches in the Regulatory Area. This was then added to the catch-at-age calculated for Canada in Div. 3LNO and EEC-Portugal in Div. 3N. The resulting catch-at-age was bimodal, with peaks at ages 4-5 (total of 23.6 million fish) and ages 9-10 (total of 17.3 million

fish). The number of older fish (age 11+) in the catch continued to decline in 1990, and was at the lowest observed for this stock since 1974.

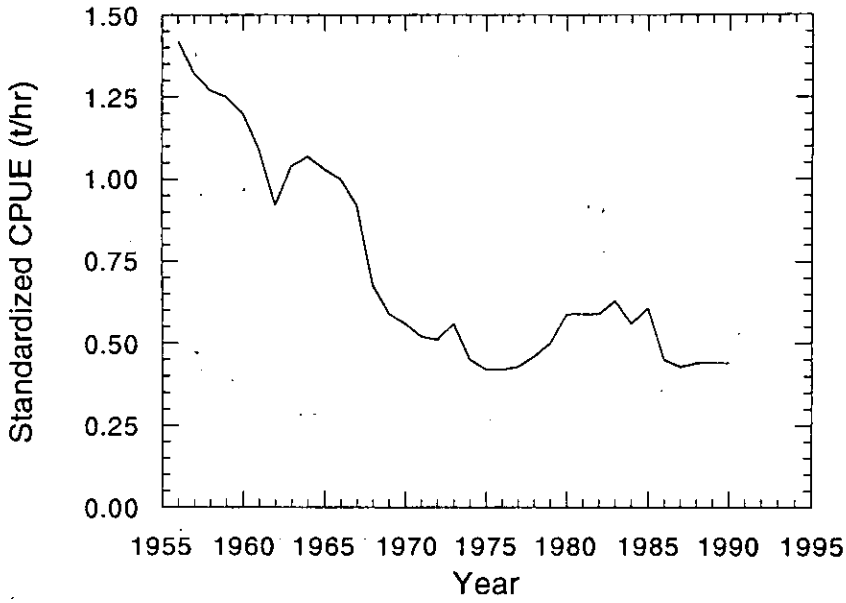

Fig. 24. American plaice in Div. 3LNO: standardized catch rates.

The mean weights-at-ages 6-11 were similar in the Canadian catches in 1989 and 1990, but the weights-at-ages 12+ showed an increase, continuing the trend in recent years. Weights-at-age for the total removals in 1990 were not calculated because of the absence of monthly catches required to properly weight the monthly sampling.

The size of American plaice in the Spanish catches indicated that the effective mesh size being used in some fisheries in the Regulatory Area was well below the minimum size, and may have been as low as 60 mm.

Catch rate-at-age. An index of catch rate-at-age was calculated from the Canadian commercial fishery. This was derived from the Canadian catch-at-age divided by the effort from the Canadian fishery. This effort was calculated from the multiplicative model described earlier, by dividing the estimated annual catch rate by the total Canadian catch. This index showed a stable but lower stock size in 1986-90, compared to the estimates of the early- to mid-1980s. STACFIS noted that there was an apparent change in the pattern of catch rate-at-age around 1980-81, with older ages predominating since 1981. It was recommended that *this change in catch rate-at-age for American plaice in Div. 3LNO be investigated for the next assessment of this stock.*

Fishing effort used to derive the index at age should relate only to offshore catches. The total Canadian catch was used including about 10% from inshore areas. It was concluded that the inclusion of this relatively small amount of inshore catch would not seriously bias the current results, but that this should be adjusted for the next assessment of this stock.

ii) Research vessel surveys (Fig. 25)

Canadian stratified-random groundfish surveys. Data from spring surveys in Div. 3L, 3N and 3O were available from 1971 to 1991, excluding 1983.

Age-by-age abundance estimates for Div. 3L, 3N and 3O for the 1971-90 period were derived using multiplicative models to fill in values for strata not fished in a given year. This procedure was the same as that used in the 1990 assessment. Data for 1991 could not be used at this time because the survey was just recently completed and ages were not yet available for the American plaice catches.

In Div. 3L, the biomass remained relatively stable from 1985 to 1988, ranging from 174,000 tons to 193,000 tons. However, the estimates for 1989 to 1991 were much lower at 153,000, 83,000 and 36,000 tons, respectively. The abundance in recent years was considerably lower than that observed from 1976 to 1982, when a number of strong year-classes were present in the population. Although the surveys during 1986-88 indicated that the 1979-81 year-classes were slightly larger than the preceding few, the estimates of these year-classes in subsequent surveys were well below the estimates observed for strong year-classes at the same ages in earlier surveys. Ages 7-9 dominated the survey catches in Div. 3L, and there was no evidence of improved recruitment at younger ages.

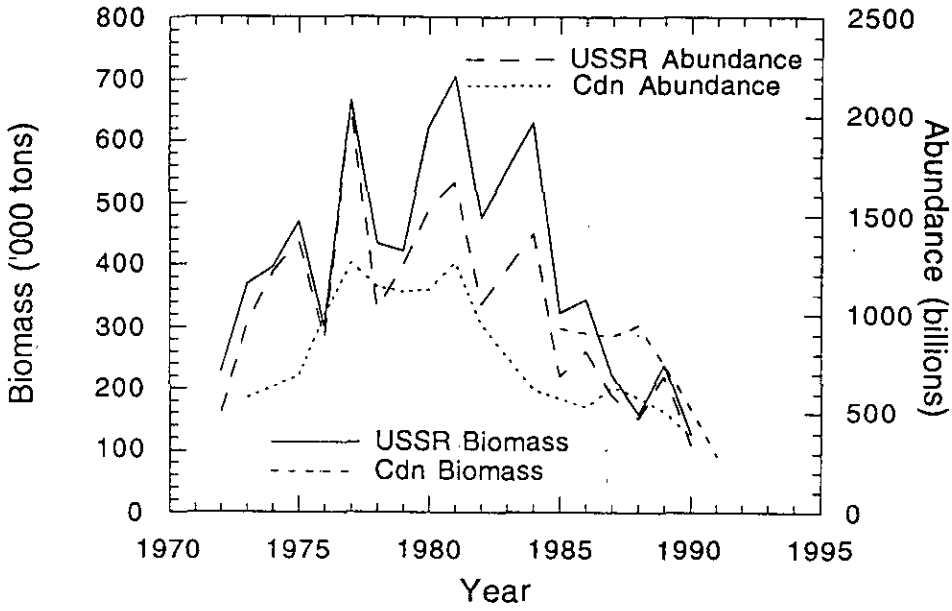

Fig. 25. American plaice in Div. 3LNO: biomass and abundance estimates from research vessel data.

In Div. 3N, the estimate of biomass declined from about 60,000 tons in 1984-85 to about 30,000 tons in 1990 and to 20,000 tons in 1991. The abundance estimates have shown more fluctuation over the series compared to Div. 3L, but it was again clear that the abundance during 1986-90 was substantially lower than average and was around the lowest level in the 18-year series. Unlike Div. 3L, there was no evidence of better than average recruitment in the 1987 and 1988 surveys in Div. 3N, although the 1989 and 1990 surveys indicated that the 1985 year-class was ranked 1 and 2 at ages 4 and 5 respectively in the 19 year series.

In Div. 3O, the biomass fluctuated between 44,000 tons and 77,000 tons in the 1984-90 surveys, with the 1991 estimate being about 35,000 tons. The estimates of abundance showed even more variability than Div. 3N, however, recent estimates were among the lowest in the series. There was evidence that the 1985 year-class is strong, as the value for this year-class in 1990 was the highest at age 5 in 9 years and was the fourth highest in the 16 year series.

Overall, the abundance in Div. 3LNO combined has declined in recent years to the lowest level observed in the series. There was a decline in abundance from about 1 billion fish at ages 6+ in 1981-82 to about 500 million fish in 1985-86, after which time the abundance remained at the lower level. In addition, the number of older fish (age 12+) in the surveys has continued to decline through 1987-90 to the lowest level observed.

From Canadian fall surveys in Div. 3L, population estimates in 1986-88 were lower than those from 1981 to 1984. In 1989, the population declined by about a third from the mean 1986-88 level but increased in 1990 to a value only 15% below the 1986-88 mean. There was evidence in these surveys to suggest that the 1985 and possibly 1986 year-classes are stronger than most cohorts since 1977. These surveys also indicated that the biomass in Div. 3L has declined from about 300,000 tons in 1983-84, to about 170,000 tons in 1986-88, to between 90,000 and 135,000 tons in 1989 and 1990.

A fall survey in Div. 3NO, carried out for the first time in 1990, showed the biomass and abundance to be almost identical to that from the spring survey in 1990. For Div. 3LNO overall, the indices were higher from the fall surveys, given that abundance and biomass estimates from Div. 3L were about 60% higher in the fall compared to the spring. Total biomass from the 1990 fall survey was 220,000 tons compared to 165,000 tons in the spring.

Bottom temperature data collected during the spring surveys indicated that the coldest bottom temperatures on the Grand Bank at the time of the surveys were 1972-74, 1985-86, and 1990. Indications are that 1991 is also a year of low bottom temperatures. These years corresponded to the lowest estimates of abundance for this stock. The years with the highest abundance estimates (late-1970s) also corresponded to the years with the highest mean bottom temperatures. STACFIS noted that studies are underway to determine if relationships exist between American plaice abundance or availability, and water temperature. Preliminary results indicate that American plaice can tolerate sudden decreases in water temperature without any short-term effects, but long term effects as well as the impact of bottom temperature on trawl catchability are not known.

USSR stratified-random surveys. Results from USSR surveys in Div. 3LNO were available for 1972-90. Abundance and biomass were at a relatively high level from 1977-84, then declined to the lowest levels in the time series in 1987-90. This decline was present in all 3 Divisions. Age compositions from 1984-90 showed the 1985 year-class to be the strongest in the time series at ages 3 and 4 but below average at age 5 (1990 survey). The 1986 year-class is the second largest in the series at age 3 but was also below average in the 1990 survey at age 4.

Canadian juvenile flatfish surveys. Stratified-random surveys of Div. 3LNO were conducted inside the 91-m depth contour from 1985 to 1988 and were extended to 183 m in the 1989 and 1990 surveys. In both 1989 and 1990, the largest catches of juveniles aged 1-4 years were taken in the Regulatory Area in Div. 3NO, consistent with previous surveys. Two other sites were identified as areas of major concentrations of juveniles: the Whale Deep area in Div. 3O, and the north and northeast slope of Div. 3L in depths up to 183 m. Although the areas of concentration of juvenile American plaice are localized, the distribution of adults is more widespread. In the Regulatory Area in Div. 3N there is considerable overlap between the distributions of adults and juveniles. The density of juveniles in the Regulatory Area in Div. 3NO is higher than that in Div. 3L, however, the area of distribution in Div. 3L is large, resulting in a higher total abundance of ages 1-4 in this Area. However, it was noted that there were differences in selectivities at age as well as age specific fishing mortalities between divisions, making comparisons of abundance at age between divisions difficult. The following Table shows the percentage of the abundance at each of ages 1-4 which was found in Div. 3L, 3N and 3O in the 1990 juvenile flatfish survey:

Age	Division 3L	3N	3O
1	3	45	52
2	12	32	56
3	39	43	18
4	61	18	21

In all three Divisions the 1985 and 1986 year-classes dominated the catches in both years. In Div. 3N, the 1985 and 1986 year-classes were the largest in the time series, with both showing consistent strength since their appearance in the surveys at age 1.

A comparison of catches of age 1 all 3 Divisions showed that the mean catch-per-tow was lowest in Div. 3L in both 1989 and 1990. Analysis of mean length-at-age showed that juveniles in Div. 3L were significantly smaller than those in the other 2 Divisions. Thus the lower numbers at age 1 in Div. 3L were not due to availability but to reduced vulnerability to the survey trawl.

STACFIS noted that additional fishing sets are planned for the upcoming survey to determine if further concentrations of juvenile American plaice exist in water deeper than 183 m.

c) Estimation of Parameters

i) Sequential population analysis

The catch-at-age from 1975-90, the abundance-at-age from the Canadian groundfish surveys, and the catch rate-at-age from the Canadian commercial fishery were used in the same formulation of the Adaptive framework (ADAPT) that was employed in the 1990 assessment of this stock. STACFIS noted the inadequacies in the catch-at-age for 1990 and that ages younger than 5 were not present in the catch matrix, despite relatively large catches of these ages in recent years in the Regulatory Area.

The results of the ADAPT indicated a lack of fit to the model, with almost all residuals in recent years in the age by age research vessel survey relationships being negative and the converse being true for the residuals in the catch rate relationships. This pattern had been noticed in previous years but was more pronounced in this assessment, and thought to be the result of divergent indices; the research vessel data indicating a decline in recent years and the catch rates indicating stability. The population estimates from the model are intermediate between these, generating the patterns of residuals. STACFIS also noted some other long-standing difficulties with the SPA for this stock; such as the retrospective pattern in fishing mortality estimates, e.g. population numbers for 1989 from the current assessment which are about 20% lower than those estimated for 1989 in last year's assessment, as well as the pattern of F increasing to high values at the older ages in the population. STACFIS concluded that these problems, particularly the uncertainties with the catch-at-age and the lack of fit in the ADAPT were serious enough to reject the results of the SPA.

d) Assessment Results

This assessment indicated the continuing divergence of indices from research vessel surveys *versus* those from the commercial fishery. The catch-rate index from the Canadian fishery suggested the stock to be very stable at a relatively low level since 1986. However, ancillary information from the commercial fishery suggested catch rates in 1991 were lower than the catch rates for the same period in 1990. Canadian and USSR spring surveys both indicate the stock to be at a relatively low level in recent years, and that the stock may still be declining.

There was some difficulty interpreting recent research vessel survey results, with the stock size from the fall survey in Div. 3LNO being about 40% larger than in spring 1990 and about 3 times as large as in spring 1991. If the spring 1991 survey results are an accurate measure of the stock, then the biomass is at a level well below that observed in any other year. There is evidence from most research vessel survey data that the 1985 and 1986 year-classes are strong, and that they dominated the fisheries in the Regulatory Area in Div. 3N in 1990. Recruitment of year-classes prior to these appeared to have been well below the levels observed for the year-classes of the early-1970s.

e) Prognoses

Although the catch was lower in 1988-90 than in the preceding 3 years, the TAC was still exceeded by about 25-30% in those years. This is of concern, given that some fisheries in the Regulatory Area are catching large quantities of juvenile American plaice. The current level of non-reported catch with no sampling makes the assessment of this stock difficult if not impossible to assess.

The indices of abundance indicated that the stock is currently at a relatively low level, although the research vessel surveys indicated some improved recruitment. STACFIS advises that the catch in 1992 should not exceed the current TAC of 25,800 tons. Continuation of catches above the TAC coupled with increased targetting of the fisheries in the Regulatory Area on young fish will reduce the potential benefits of improved recruitment.

10. Witch Flounder in Divisions 3N and 3O (SCR Doc. 91/56; SCS Doc. 91/15, 16)

a) Introduction

Reported catches in the period 1970-84 ranged from a low of about 2,400 tons in 1980 and 1981 to a high of about 9,200 tons in 1972 (Fig. 26). With increased effort, mainly by EEC-Spain and EEC-Portugal in 1985 and 1986, catches rose rapidly to 8,800 and 8,500 tons respectively. This increased effort was concentrated mainly in the Regulatory area of Div. 3N. Non-member countries such as South Korea, USA, Cayman Islands and Panama also contributed to increased catches.

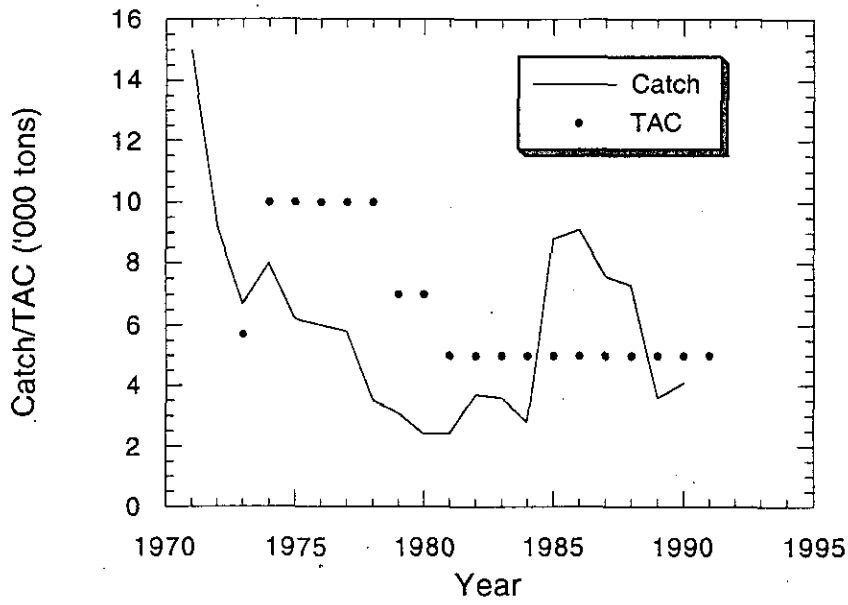

Fig. 26. Witch flounder in Div. 3NO: catches and TACs.

In 1987 and 1988, the total catch was about 7,500 tons, declining to about 4,000 tons in 1989 and 1990. Catches by Canada ranged from 1,200 tons to 3,000 tons in recent years (2,700 tons in 1990) and were mainly from Div. 3O. Catches by USSR vessels declined from between 1,000 and 2,000 tons in 1982-88 to less than 100 tons in 1989-90.

Catch statistics are not adequate for this stock, given that there are catches by non-member countries which are not reported to NAFO and are only estimated from surveillance reports. There are also catches which must be determined from breakdowns of unspecified flounder catches.

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	5	5	5	5	5	5	5	5	5	5	5
Catch	2	4	4	3	9	9	8	6	4[1]	4[1]	

[1] Provisional data.

b) Input Data

i) Commercial fishery data

Catch rate. STACFIS noted that no catch-rate data were presented for this stock. Although it is likely that no continuous series of adequate catch-rate data exists for any given fleet, it was observed that there were data for Canada and USSR in most years. STACFIS therefore recommended that *an analysis of available catch-rate data for witch flounder in Div. 3NO be presented at the June 1992 meeting.*

Catch-at-age. Data from the Canadian fishery in 1990 showed that most of the catch came from witch aged 9-12, which were mainly between 40 and 48 cm in length. This was similar to some of the Spanish catches in Div. 3N, although during some months the Spanish and Portuguese catches in Div. 3N contained fish mainly in the 34-42 cm range. Some of the data collected in the Portuguese fishery was from fishing sets as deep as 930 m. STACFIS recommended that *available data on catch-at-age and mean weights-at-age for witch flounder in Div. 3NO be prepared for the next assessment of this stock in June 1992.*

ii) Research vessel surveys (Fig. 27)

Annual estimates of biomass from Canadian surveys since 1971 in Div. 3N were below 1,000 tons, with the exception of the 1984,1985 and 1988 estimates of 1,200-1,700 tons. Because strata deeper than 366 m were not sampled, the biomass have been underestimated. The USSR surveys in 1987-90 showed that witch flounder are most abundant in strata deeper than 366 m, at least up to 731 m. These surveys in Div. 3N showed that both abundance and biomass indices were stable in the 1987-89 period but that the 1990 values were about half the mean of the previous years. The biomass estimates from the USSR surveys were higher than the Canadian estimates but still below the catch levels. Given the depths of the fishery and the magnitude of recent catches in Div. 3N, it was clear that the surveys are not adequate as indices of stock abundance.

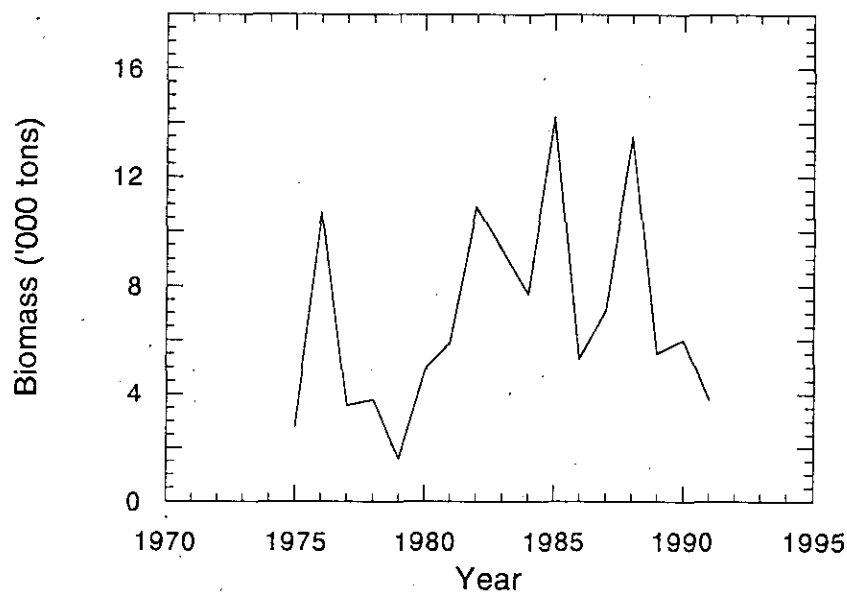

Fig. 27. Witch flounder in Div. 3NO: biomass estimates from research vessel data.

- Survey biomass estimates were much higher in Div. 3O, but showed a higher degree of variability. Both the Canadian and USSR surveys showed a continual decrease in stock size from 1988 to 1990. However, it was observed that variations in biomass estimates were sometimes related to differences in estimates for those strata near the southwestern slope of the Grand Bank. It was considered that the fluctuations in biomass in Div 3O may be largely a result of distributional changes as fish move in and out of the survey area near the continental slope. A fall survey in Div 3NO in 1990 also suggested seasonal differences in distribution with regard to the survey area.

c) Catch Projections

STACFIS noted that the present indices of abundance for this stock are not adequate to draw firm conclusions about the stock status. Although there are some signs to suggest that the stock may have declined, STACFIS had no basis to change its current advice and advises that the TAC for 1992 should remain at the 5,000 ton level.

d) Future Research

STACFIS reiterated its recommendation that *more information from the commercial fishery for witch flounder in Div. 3NO be made available so that precise locations and depths of the fishery, as well as age composition data, could be examined.* This is particularly important, given that current research vessel surveys clearly do not include some of the deep areas covered in the commercial fishery.

11. Yellowtail Flounder in Divisions 3L, 3N, and 3O (SCR Doc. 91/61, 80; SCS Doc. 91/5, 15, 16)

a) Introduction

Nominal catches increased rapidly from neglible levels in the early-1960s to a peak of over 39,000 tons in 1972 (Fig. 28). Canada and USSR were the major participants in the fishery up to 1975 with Canada taking almost all of the catch from 1976 to 1981. After 1981 several other countries entered the fishery, notably South Korea, EEC (Spain and Portugal), Panama, USA and Cayman Islands and catches by those fleets increased up to 1986. Catches of yellowtail flounder in the Regulatory Area declined in 1987 as effort was directed primarily to redfish, but increased again from 1988 to 1990. In 1990, the total catch was estimated to be 14,000 tons, an increase over the 10,000 tons caught in 1989. With the TAC of 5,000 tons restricting the fishery, the Canadian catches in 1989 and 1990 were the lowest since 1968. Except for 310 tons taken by Scottish seines, the remainder of the 1990 catch by Canada was taken by otter trawls.

The catch by EEC-Spain declined from 3,200 tons in 1988 to 1,100 tons in 1989, with only 119 tons being reported in 1990. The catch by South Korea was about 6,000 tons in 1990, the highest value in the nine years this country has been in the fishery. USA catches have declined steadily from 3,800 tons in 1985 to only 6 tons in 1990.

Catch statistics for this stock are not adequate, with as much as 25% of the catch in 1985-86 coming from surveillance estimates and breakdowns of unspecified flounder catches. In 1990, about 3,000 tons of catch was estimated for Contracting Parties, in addition to that which was reported and that which was estimated for non-reporting non-member countries. This means that 35-40% of the 1990 catch of 14,000 tons came from estimates rather than reported catches.

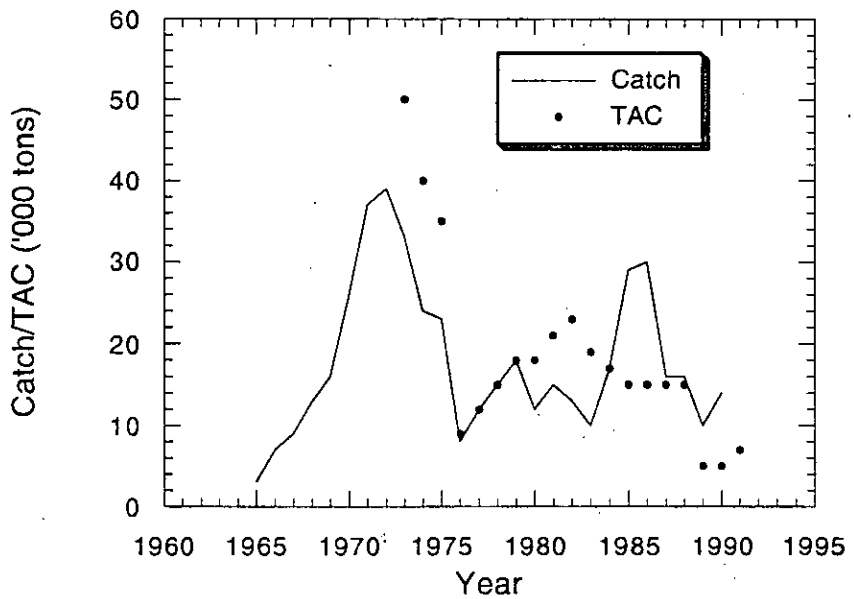

Fig. 28. Yellowtail flounder in Div. 3LNO: catches and TACs.

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	21	23	19	17	15	15	15	15	5	5	7
Catch	15	13[1]	10[1]	17[1,2]	29[1,2]	30[1,2]	16[1]	16[1,2]	10[1,2,3]	14[1,2,3,4]	

[1] Includes a percentage of the "flounder non-specified" catch reported to NAFO by South Korea.
[2] Includes estimates of catch based on surveillance reports.
[3] Provisional data.
[4] Includes estimated catches for non-members and Contracting Parties (5,200 tons).

b) Input Data

i) Commercial fishery data

Catch-rate data. A multiplicative model was used to analyse the catch and effort data as in recent assessments. Canada took almost all the catch from this stock from 1976 to 1983, providing the only source of catch-rate data for this stock. The catch rate declined steadily from 1965 to 1975, then increased slightly to a relatively stable period in 1983-85 (Fig. 29). The index declined sharply in 1986 and has remained at a relatively low level, although there was an increase of 15% from 1989-90. Recent catch-rate values are close to previously observed lows in the mid-1970s. Although this index did not cover the majority of the stock, it probably underestimated the recent decline in the stock as a whole, as the Canadian fleet rarely fished for yellowtail flounder in the Regulatory Area, where catches in 1987-89 were considerably lower than the high values in the 1985-86 period. No series of catch-rate data are available from the fisheries in the Regulatory Area.

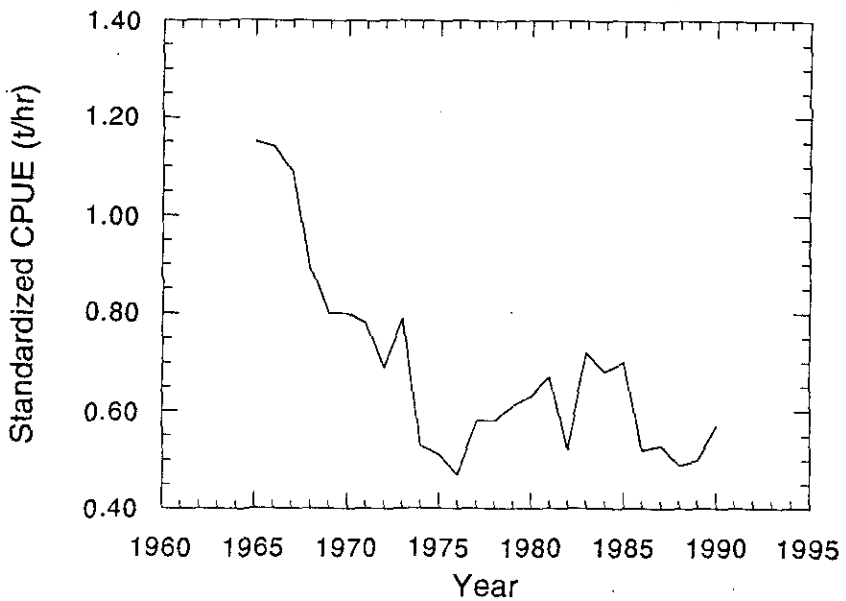

Fig. 29. Yellowtail flounder in Div. 3LNO: standardized catch rates.

Catch rates-at-age from the Canadian fleet for the period 1986-90 showed that ages 6-8 dominated. In 1990, the values at age 6 and 7 were higher than other years while at age 8 was about average. STACFIS noted that there is a much longer time series of these data available, and recommended that *the time series of catch rate-at-age data be analyzed and presented at the June 1992 meeting.*

Catch-at-age and mean weights-at-age. Catch-at-age was calculated from length frequencies of the Canadian and Spanish fisheries in 1990. Age-length keys from the Canadian 1990 fall research vessel survey were used to calculate numbers-at-age for the Spanish fishery. In the Canadian catch, ages 6-8 dominated in 1990, consistent with other years. The mean weights-at-age from the Canadian catch in 1990 were similar to recent values. In the Spanish fishery, ages 4 and 5 comprised 72% of the catch numbers with the dominant year-class being that of 1985. This was also the dominant year-class in the 1989 fishery by EEC-Spain, where it accounted for 53% of the catch numbers.

In the 1990 assessment it was demonstrated that large changes in the age composition of the catch could be generated by slight changes in how samples were applied to catches, given the considerable differences in the age composition of catches by different fleets. It was also noted that large

portions of the catch in some years (e.g.40-45% in 1986) had no sampling whatsoever. This also applied to the 1990 data, where the South Korean catch was estimated to be approximately 42% of the total catch, and for which no sampling data were available.

For these reasons no reliable catch-at-age or mean weights-at-age can be calculated for the total removals from this stock for many years since 1984. STACFIS again concluded that the calculated catch-at-age was not suitable for use in sequential population models.

ii) Research vessel surveys (Fig. 30)

Canadian stratified-random groundfish surveys. Surveys have been carried out by Canadian research vessels in Div. 3LNO each year from 1971 to 1991 with the exception of 1983. The surveys from 1984 to 1991 are comparable in terms of coverage and vessel/gear used. Most of the biomass of this stock is found in Div. 3N. In this Division, the biomass index declined from 65,000 tons in 1986 to approximately 34,000 tons in 1988-89 then increased slightly to around 40,000 tons in 1990 and 1991. The total biomass index for Div. 3LNO has been variable, ranging from 80,000 to 140,000 tons during the early-1980s. During the 1988-91 period the biomass was fairly stable but lower, averaging approximately 55,000 tons.

As was done in recent assessments, a multiplicative model was employed to obtain estimates of abundance for strata not surveyed in some years. The estimates for 1971-82 surveys were multiplied by 1.4, a vessel/gear conversion for that period, which make the data comparable to the data from 1984-91. The total abundance index of this stock remained relatively stable between 240 and 340 million fish from 1975 to 1984, after which time it declined steadily to about 100 million fish in 1988. From the surveys of 1989-91, estimates were 30-50% higher than the 1988 estimate, but were still among the lowest in the 21 year time series. The Canadian survey catches are usually dominated by ages 5-8 years. In 1991, the 1985 and 1986 year-classes, ages 6 and 5 years respectively, appeared to be larger than any year-classes at these ages in the most recent 5 or 6 years, but were still lower than those observed for this stock during the 1970s and early-1980s. The 1985 year-class also appeared to be large at age 4 in the 1989 survey. The 1984 year-class (age 7 in 1991) appeared to be on par with recent year-classes at the same age. The 1983 year-class, which appeared relatively strong at ages 6 and 7 in 1989 and 1990 respectively, is now estimated to be one of the lowest in the time series at age 8. The weak 1981 and 1982 year-classes have essentially passed through the population by 1991, as have ages 9+. Generally age 9+ fish comprise less than 5% of commercial and research vessel catches.

USSR stratified-random groundfish surveys (1972-90). The trends in stock size in the USSR surveys were identical to those in Canadian surveys, showing a sharp drop in abundance in 1985, a continued decline to 1988 and a small increase in 1989-90. As in the Canadian surveys, age 7 dominated the USSR survey catch, with few yellowtail flounder aged 1-3 present, suggesting similar selectivity between Canadian and USSR survey trawls. The 1985 year-class, which appeared strong at age 4 in the 1989 survey, appeared to be weak in 1990.

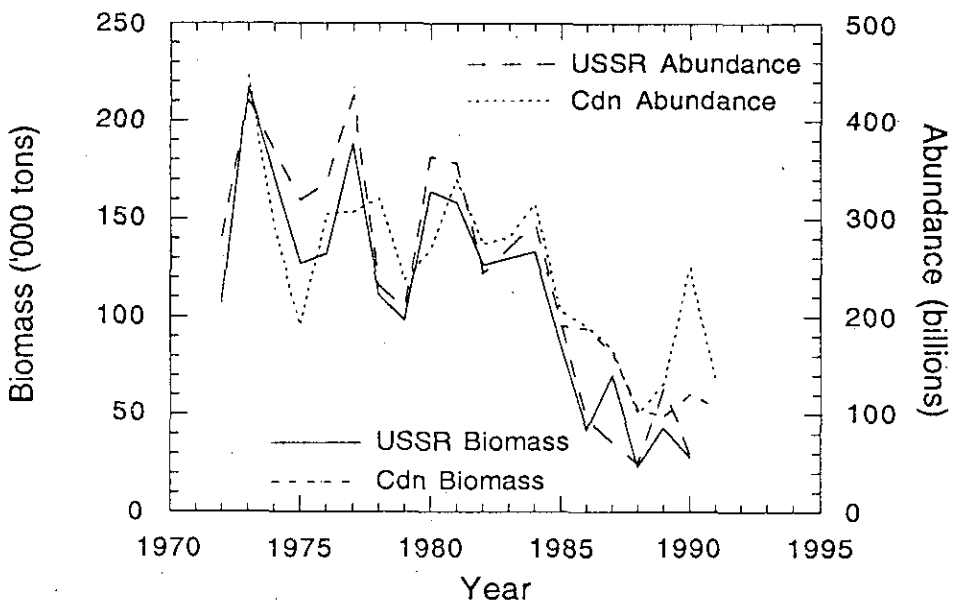

Fig. 30. Yellowtail flounder in Div. 3LNO: biomass and abundance estimates from research vessel data.

Canadian juvenile flounder surveys. From 1985 to 1990, annual fall stratified-random surveys have been conducted in Div.3LNO, directed at juvenile American plaice and yellowtail flounder. Most of the juvenile population of yellowtail flounder is located in the Regulatory Area. The biomass estimates for Div. 3NO have shown a steady increase since 1988, with the 1990 estimate being twice the low 1988 estimate.

Both the 1989 and 1990 surveys showed the 1984 and 1985 year-classes to be the largest in the series, with that of 1985 being dominant. As well, the 1986 year-class, which appeared to be moderate in the 1989 survey results, was the second largest in the time series at age 4 in 1990.

c) Assessment Results

The catch-at-age could not be used in a sequential population analysis based model for this stock, and the use of a yield-per-recruit model was also not possible, so it was again decided that the information contained in the indices of abundance (research vessel surveys and catch rate) would be evaluated to determine stock status.

All four indices (three research vessel and one catch rate) showed a slight increase in abundance from 1988 to 1990, with the 1991 Canadian groundfish survey showing a slight decrease from the 1990 level. However the indices still showed the population to be at a relatively low level compared to historic values.

The decline in stock size in the mid- to late-1980s was caused by poor recruitment from the year-classes of the early-1980s and a rapid increase in catches to about 30,000 tons in 1985-86 from 10,000 to 15,000 tons in 1980-83. The year-classes of 1984-86 are stronger than their immediate predecessors. Although they do not appear to be as strong as most of the 1970s year-classes at ages 4 and 5, comparisons are somewhat difficult, given that relatively large numbers of the recent year-classes have been caught at younger ages compared to earlier cohorts because of increased exploitation of younger fish in the Regulatory Area. Thus there is likely to be more of an influence from fishing mortality on the recent estimates of year-classes at these ages compared to years prior to the mid-1980s.

Both the Canadian groundfish survey and the catch-rate indices of abundance at ages 5-7 have increased in recent years (up to 1991 for research vessel and up to 1990 for catch rate) but are still at relatively low levels. The increase in catch from 1989 to 1990 was likely a measure of stronger recruitment, particularly of the 1985 and 1986 year-classes, although there was no information on the age composition of approximately 50% of the 1990 catch.

d) Catch Projections and Prognosis

STACFIS concluded that the stock is showing signs of a slight increase due to improved recruitment, but is still at a relatively low level. The abundance of the stock remains at about 50% of the abundance in the 1977-84 period, when an average catch of 14,100 tons did not result in trends in stock size. Thus it was concluded that a catch of 7,000 tons in 1992 would not be harmful to the stock and STACFIS advises that the TAC for 1992 be set at this level.

STACFIS again expressed concern about the catch of juvenile yellowtail flounder in the Regulatory Area, where it is apparent that the effective mesh size being used in some fisheries remains well below the legal minimum size. Although still impossible to quantify, continuation of the current exploitation pattern in these fisheries will likely result in a loss in yield-per-recruit and slow any stock rebuilding. This stock will continue to be very difficult to manage if unregulated catches by non-member countries increase again in future years, as they did in 1990.

12. Greenland Halibut in Subareas 0 and 1 (SCR Doc. 91/21, 35, 36, 38, 39, 45, 49, 50, 66; SCS Doc. 91/5)

a) Introduction

Description of fishery and nominal catches. Catches were rather stable in the period 1981-89 with an average annual catch of 9,000 tons (Fig. 31). From 1989 to 1990 catches increased to about 19,000 tons, due to an increased trawl fishery in Div. 0B by Canada, Faroe Islands and USSR (about 10,000 tons). In Subarea 1 catches reached about 9,000 tons in 1990, of which 88% were taken by Greenland in the fjords of West Greenland. The Greenland fishery is an inshore gillnet and longline fishery, with 91% of the total Greenland catch in 1990 taken in Div. 1A distributed between the areas Ilulissat, Uummannaq and Upernavik. An offshore trawl fishery carried out in Div. 1C-F amounted to about 1,000 tons, the main part taken by Japan (joint venture Greenland-Japan). Recent TACs and catches ('000 tons) are as follows:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	25	25	25	25	25	25	25	25	25	25	25
Catch	10	9	9	7	10	9	10	10	9[1]	19[1]	

[1] Provisional data.

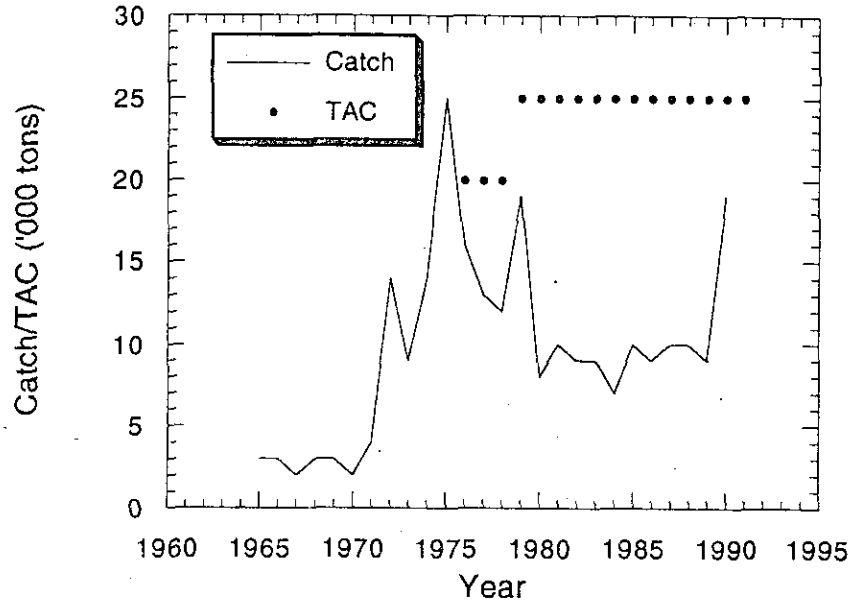

Fig. 31. Greenland halibut in Subareas 0 and 1: catches and TACs.

b) Input Data

i) Commercial fishery data

Length frequencies from the Canadian otter-trawl fishery for Greenland halibut on Subarea 0 in 1990 ranged between 32-96 cm, with a mode at about 52 cm and age 7.

Catch-at-age for the inshore fishery in Subarea 1 was estimated separately for the three main areas, Ilulissat, Uummannaq and Upernavik, for the years 1988-90, and seemed consistent in this period. Greenland halibut enter the fishery at age 8 and generally peak at age 11-12 in the catch numbers.

ii) Offshore trawl surveys

Bottom-trawl surveys have been conducted jointly by Japan and Greenland in Subarea 1 since 1987. In 1990 two surveys were carried out in Subarea 1, in May-June and in August-September, respectively. Both surveys covered the depth range 400-1,500 m. The biomass in Div. 1ABCD was estimated to be 61,500 tons during the first survey and in Div. 1BCD and 51,300 tons during the second survey. The surveys differed from year to year in areas and depths surveyed. The estimated survey biomass was constant in the period 1987-90. Within the period, the surveys have shown differences in distribution of the biomass, which may be due to within-year migrations, as the surveys were carried out at different times of the year.

A bottom-trawl survey was conducted by USSR in cooperation with EEC (ex GDR) in Div. 0B and 1BCD in October-November 1990, covering the depth range 200-1,500 m. In Div. 0B Greenland halibut occurred in hauls over the entire surveyed area. Both fish size and catch rate in weight increased with increasing depth, during the survey. The abundance in the trawl survey area in Div. 0B had remained at about the same level in the three preceding years: 83.8 million fish in 1988, 91.8 million fish in 1989 and 88.5 million fish in 1990 with biomasses of 64,200 tons, 83,700 tons and 78,900 tons, respectively. Most of the Greenland halibut in Div. 0B in 1990 were distributed at depths between 1,000 and 1,500 m.

The trawl survey in Div. 1BCD had the largest catches at depths between 1,000 and 1,500 m. The length of Greenland halibut were between 18-109 cm, with a modal group of 50-51 cm for both sexes. Total biomass, as estimated in the 1990 fall survey off West Greenland, was about 95,600 tons.

The differences in biomass estimates of Greenland halibut from the Japan/Greenland and USSR/EEC surveys were probably due to the differences between the surveys in time, area and depth coverage.

Catches of Greenland halibut during shrimp surveys off West Greenland in Div. 1ABCD from the 3-mile boundary to the 600 m depth contour in July-August 1988 and 1990 indicated a decrease in abundance from north to south, from shallow to deep water and from 1988 to 1990. Fish size increased with increasing depth. The total biomass and abundance estimates decreased from about 12,000 tons and 141 million in 1988 to about 4,600 tons and 36 million in 1990, respectively. The largest reduction was seen in the northern areas. The observed decrease in biomass and abundance were probably due to a deeper

distribution of Greenland halibut during the survey in 1990. The catches during the shrimp survey confirmed that major nursery grounds for Greenland halibut coincide with the distribution area for shrimp. Lengths ranged from 7 cm to 55 cm during the survey with modes at 12, 18 and 25 cm being most pronounced in the northern areas.

iii) Biological information

A pilot study of larval and 0-group fish off West Greenland carried out by EEC-FRG in summer and autumn 1989 and 1990 gave preliminary information about horizontal and vertical distributions of larvae in relation to temperature conditions. The larvae were caught exclusively in the upper 50 m at temperatures above 2°C.

Preliminary investigations of the feeding habits of Greenland halibut on the shrimp grounds off West Greenland indicated that shrimps and redfish are the most important prey items for Greenland halibut in the length range 15-54 cm.

During the bottom trawl survey in Div. 1BCD in October-November 1990 by USSR/EEC stomachs of Greenland halibut was examined. Mean stomach fullness was between 0.00-1.33 and 75% of the stomachs examined were empty. Most preferred prey for Greenland halibut were squids, shrimps and fishes (redfish).

iv) Other research results

Selectivity. By comparing catches in Div. 0B from bottom trawl and longline surveys, the USSR estimated the relative efficiency of longlines in comparison with bottom trawls to range from 0.02 for small Greenland halibut (36-41 cm) to 13.01 for large ones (90-95 cm). Investigations of the use of longline surveys will be continued.

A Greenland study on gear selection was carried out for longlines and gillnets in the West Greenland area. Estimating the long-term yield for an exploitation exclusively by one of the gears, showed that gillnets might provide greater catches of larger Greenland halibut compared to longlines.

c) Prognosis

The USSR/EEC and Japanese offshore surveys do not cover the whole area of distribution of Greenland halibut in Subareas 0+1, and the biomass in Div. 0A as well as in inshore areas of Subarea 1 is not known. STACFIS therefore had no basis upon which to advise a precise level of catch for 1992. However, based upon the available information, STACFIS advises that the present TAC level of 25,000 tons be maintained. Any expansion of the fishery should be directed towards the offshore areas.

13. Greenland Halibut in Subarea 2 and Divisions 3KL (SCR Doc. 91/56, 66, 88; SCS Doc. 91/5, 11, 15, 16)

a) Introduction

Catches increased from low levels in the early-1960s to over 36,000 tons in 1969, and ranged from 24,000 tons to 39,000 tons over the next 15 years (Fig. 32). From 1985 to 1989, catches exceeded 20,000 tons only in 1987. In 1990, an extensive fishery developed in the deep water (down to 1,400 m) in the Regulatory Area, around the boundary of Div. 3L and 3M, resulting in an increase in catch to about 47,000 tons. The major participants in this fishery were EEC-Spain and EEC-Portugal, as well as some non-member countries such as Panama. STACFIS considered that catches from Div. 3M were from the Subarea 2 and Div. 3KL stock and should therefore be included in the assessment of this resource. It was noted that approximately 18,000 tons of catch in 1990 came from estimates, rather than actual reported catches.

Canadian catches peaked in 1980 at just over 31,000 tons, while the largest non-Canadian catches before 1990 occurred in 1969-70. USSR, Denmark (Faroe Islands), Poland and GDR have taken catches from this stock in most years, but catches by the latter 2 countries were only a few tons in 1990. EEC-Portugal and Japan have taken catches from this stock each year since 1984. Canadian catches have been between 8,000 and 13,500 tons in each year from 1985-90.

In most years, the majority of the catch has come from Div. 3K and 3L, with catches from Div. 2G and 2H usually being relatively low. Canadian catches are taken mainly by gillnet, and have been around 7,000 to 10,000 tons in most recent years, down from a high of 28,000 tons in 1980. Canadian otter trawl catches peaked at about 8,000 tons in 1982, declined to less than 1,000 tons in 1988 and increased to about 3,100 tons in 1990, which was close to the highest level in the last 5 years. Recent TACs and catches ('000 tons) are as follows:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC[1]	55	55	55	55	75	100	100	100	100	50	50
Catch	31	26	28	25	19	16	31	19	19[2]	47[2,3]	

[1] TAC for Div. 2J+3KL only for 1977-84.
[2] Provisional data.
[3] Includes estimated catches of non-members and Contracting Parties.

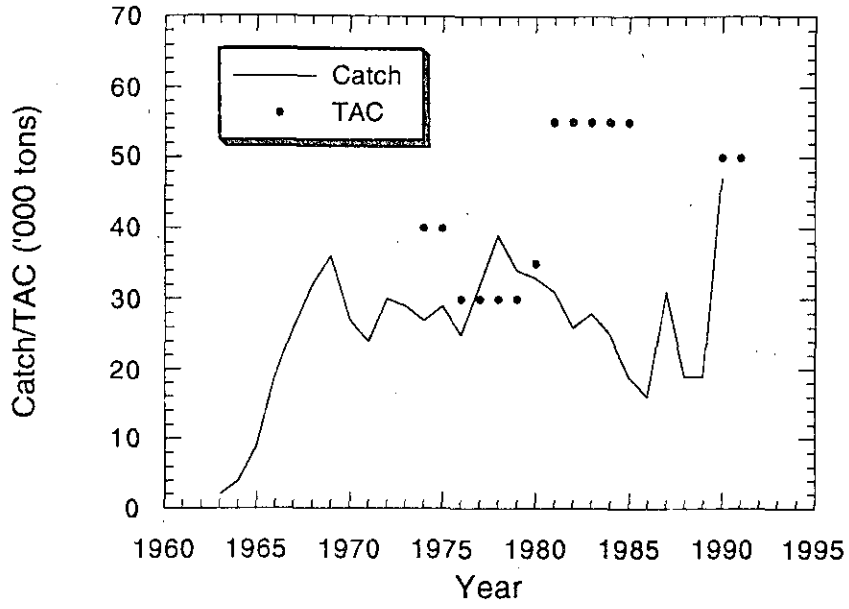

Fig. 32. Greenland halibut in Subarea 2 and Div. 3KL: catches and TACs.

b) Input Data

i) Commercial fishery data

Considering the nature of the fishery, the migratory behaviour of this species, as well as the low levels of directed catch, it was difficult to obtain catch-rate data which were representative of total stock size. In recent assessments of this stock it was noted that catch-per-unit-effort data were incomplete for some fisheries, areas and seasons. Canadian trawler catches have been relatively low in many years, particularly in the directed fishery for Greenland halibut, effort by many other nations has been variable over time, and hence there is no CPUE index for this stock. However, data from the Portuguese trawler fleet in Div. 3L showed declines in catch rate in 1990 compared to 1989. There were also seasonal trends observed in the catch rates of the Portuguese and Spanish fisheries being highest in spring and summer. It was noted that there should be catch-rate data from many years for several fleets, and STACFIS recommended that *an analysis of available catch-rate data be carried out and presented at the next assessment of the Greenland halibut stock in Subarea 2 and Div. 3KL.*

Age compositions were obtained from the Canadian fishery in 1990, and Portuguese length frequency data were converted to an age composition using Canadian fall survey data from Div. 3KL for 1990. Ages 6-8 years dominated in the catches of the Canadian inshore and offshore fisheries and as well as in catches of the Portugese fishery. Length frequency data from the Spanish fishery in Div. 3LM were comparable to the length frequencies in the Portuguese fishery, and the age compostion is expected to be the same.

In most years, age 7 was the peak age in the catch followed by age 8, however age 6 constituted a higher percentage of the catch numbers than age 8 in 1990. It was noted that smaller fish were taken in the Portuguese fishery in 1990 compared to 1989. The mean weights-at-age in the Canadian fishery in 1990 were very similar to those calculated for 1989.

Information from a Canadian vessel fishing in the deep-water(720-1,300 m) area of Div. 3LM in 1991 showed catches with somewhat larger fish than occurred in either the Portuguese or Spanish data at comparable depths in Div. 3L in 1990.

ii) Research vessel surveys (Fig. 33)

Canadian groundfish surveys. Estimates of biomass from Canadian autumn stratified-random groundfish surveys in Div. 2J (1977-90 down to 1,000 m), Div. 3K (1978-90 down to 1,000 m) and Div. 3L (1981-90 down to 366 m) were reviewed, with values for missing strata estimated using a multiplicative model. Div. 2GH was last surveyed by Canada in 1988. The biomass index showed a decline, particularly in Div. 2J and 3K, while the abundance had increased, with 1989 and 1990 being among the highest estimates in the 1981-90 period. This can be explained by the substantial drop in age 9+ abundance in the late-1980s, while at the same time an increase in the abundance of younger fish was occurring. The abundance of age 7-9 year old fish, which form the bulk of the fishery in most years, particularly the Canadian fishery, was at its lowest level in recent surveys. However, abundance at ages 4-6 was at its highest level in 1989 and 1990. The surveys

suggest that the 1984-86 year-classes are as large or larger at ages 4 and 5 (age 4 only for the 1986 year-class) than any others since the surveys began. In 1990 the majority of the abundance of the 1984-86 year-classes was found in the deep water channels in Div. 3K and in Hawke Channel in Div. 2J.

USSR spring/summer groundfish surveys. Data from USSR stratified-random groundfish surveys in Div. 3KL from 1987 to 1990 were presented. In Div. 3K, the estimates of abundance were variable, with the estimate for 1988 being about double the mean of the other 3 years. Areas of highest abundance in Div. 3K corresponded to those found in the Canadian fall surveys. The mean abundance from 1987-90 was similar to the mean from the Canadian surveys during this time.

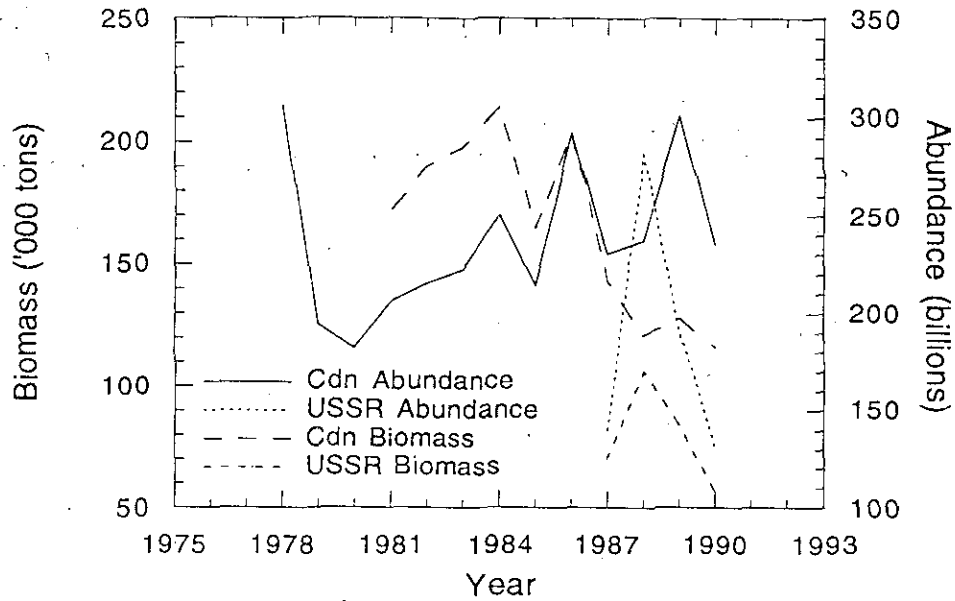

Fig. 33. Greenland halibut in Subarea 2 and Div. 3KL: biomass and abundance estimates from research vessel data.

In Div. 3L, the results showed considerable variability, with estimates in 1987 and 1989 being 2.5-3 times higher than the values in 1988 and 1990. This pattern was not seen in the Canadian surveys, where the indices were stable at a higher level than shown in the USSR data. This suggested some seasonal variability, given the difference in timing of the 2 survey series, and the fact that neither survey covers depths greater than 731 m in Div. 3L, where much of the developing fishery for this species occurs. A joint EEC(ex GDR)/USSR bottom trawl survey contained a few fishing sets in the northern section of Div. 2G and a USSR longlining experiment also contained some fishing sets in Subarea 2. These two surveys provided ancillary information.

Canadian summer shrimp surveys. Abundance estimates at age for Greenland halibut were available from Hopedale Channel in Div. 2H for 1984-88 and 1990, from Cartwright Channel in Div. 2J for 1984-88, and from Hawke Channel in Div. 2J for 1988-90. These surveys have consistently indicated that the 1985 and 1986 year-classes are relatively strong. In addition, the 1984 year-class appeared to be strong in the survey catches of Hawke Channel. The 1987-89 year-classes did not appear to be as strong as the 3 previous cohorts in any of the areas covered by the shrimp surveys.

c) Estimation of Parameters

STACFIS again noted that an analytical assessment of this stock would not be possible until migration factors could be quantified. Although the indices of abundance do not apply to the entire stock STACFIS decided to use them as the basis for evaluation of stock status.

d) Prognosis and Catch Projections

The large increase in catch in 1990 came as a result of a rapid expansion of the fishery in the deep water of the Regulatory Area in Div. 3LM. At present, almost nothing is known of the population of Greenland halibut in this area, particularly the abundance and its relation to the rest of the stock. The current assessment confirmed that the surveyed biomass was relatively stable at a lower level than in the mid-1980s, but that the abundance in recent years was higher relative to the earlier period. This increase was attributed to the recruitment of the 1984 to 1986 year-classes. The decrease in biomass in the recent period compared to the mid-1980s is caused by a decline in the number of older (age 9+) fish in the population, which could not be fully explained by the fishery and was still a cause for concern. It was noted that the catch in 1990 in the stock area excluding the deep water of Div. 3LM was at its lowest level since the early-1960s.

There was no way of evaluating the effect of a catch of 35,000 tons in Div. 3LM on the resource, given the lack of knowledge of this component of the population. Information suggested there has been a decline in catch rates in this fishery from 1989 to 1990. STACFIS noted that the previous advice has been for the entire stock area in Subarea 2 and Div. 3KL and the new fishery in the Regulatory Area is a portion of this stock. STACFIS concluded that the current TAC of 50,000 tons is appropriate for this stock in 1992, and that it should apply to the entire stock, including the part located in the Regulatory Area in Div. 3LM.

STACFIS noted that there was a request from Canada, with the concurrence of Denmark (Greenland), for an assessment of the Greenland halibut stock complex in all of Subareas 0-3. However, although there continues to be no biological reason to maintain separate assessments for Subareas 0+1 and 2+3, there are practical reasons why a combined assessment cannot be carried out. These include problems with surveys not covering portions of the stock exploited by the fishery, lack of complete knowledge of distribution and migrations, and incomplete data from some fisheries.

e) Future Research

STACFIS noted that there are tentative plans for some survey work in the deepwater areas not covered by present surveys and recommended that *such deepwater area survey data of Greenland halibut in Subarea 2 and Div. 3KL be presented to STACFIS when available.*

STACFIS recommended that *Greenland halibut maturity data from the commerical fisheries in the Regulatory Area be collected and presented at the 1992 meeting of STACFIS.*

14. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 91/8, 22, 50; SCS Doc. 91/5)

a) Introduction

A total catch of only 156 tons has been reported to date for 1990, compared with 49 tons reported for 1989. Catches since 1978 continue to be restricted to by-catches in the Greenland halibut fishery (Fig. 34).

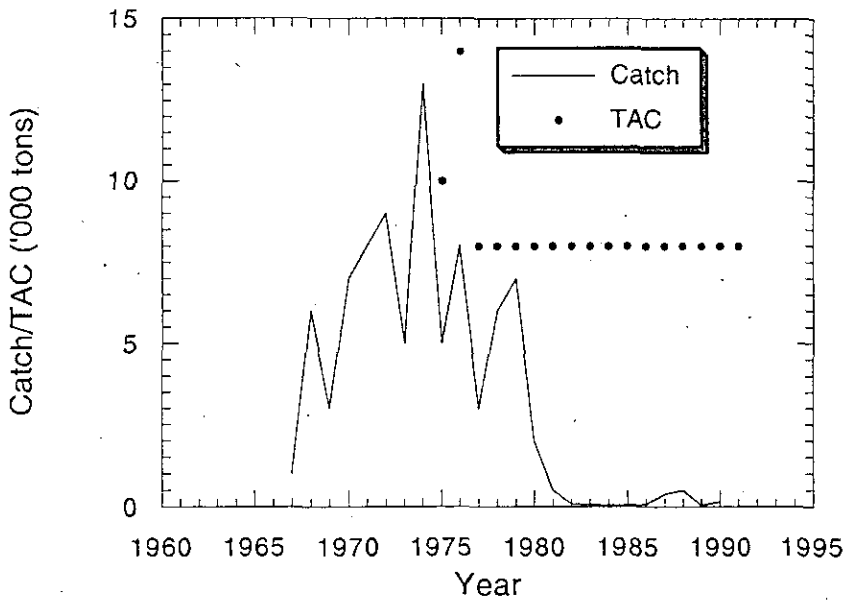

Fig. 34. Roundnose grenadier in Subareas 0 and 1: catches and TACs.

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Catch	0.5	0.1	0.1	0.1	0.1	0.1	0.4	0.5	0.05[1]	0.15[1]	

[1] Provisonal data.

b) Input Data

i) Commercial fishery data

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

ii) Research data

The results of two research surveys in Subarea 1 in 1990 by Japan in cooperation with Greenland were presented. Based on bottom trawling, the total biomass in Div. 1CD was estimated to be 7,000 tons during the first survey (May/June) and 20,300 tons during the second survey in August/September. When comparing the biomass estimates from the last three years, there were indications of an immigration into the survey area during early summer and an emigration during the winter. Only a few roundnose grenadier were taken at depths less than 600 m. The largest catches were taken at depths between 1,000-1,500 m. The size of the fish increased with depth and in the direction from north to south. During the two bottom trawl surveys, sample pelagic trawl hauls yielded only small catches which however gave some indications of a vertical feeding migration.

A bottom trawl survey carried out in Div. 1BCD at depths between 200-1,500 m in October 1990 by USSR/EEC(ex-GDR) gave small catches at depths less than 1,000 m. The largest catches were taken at 1,140 m in Div. 1D. The size of the fish increased with depth. The same bottom trawl survey which was carried out in Div. 0B at depths between 230-1,330 m in October-November 1990 did not catch roundnose grenadier at depths less than 720 m. Below 720 m the catches were only small, the best catches were taken deeper than 1,300 m. The size of fish increased with depth.

c) Prognosis

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, but is almost 20% of the biomass estimates from the 1987 and 1988 Japanese surveys (NAFO Sci. Coun. Rep., 1989, page 96). Although the 1989 and 1990 biomass estimates are about 10 fold less than those of 1987 and 1988, this is not considered to be realistic. STACFIS advises that the 1992 TAC should remain at the 1991 level of 8,000 tons.

15. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 91/8, 22; SCS Doc. 91/5, 12, 15, 16)

a) Introduction

The provisional 1990 catch of about 4,000 tons was down by about 1,000 tons from the reported catch in 1989 (Fig. 35). This was similar to the decline from 1988 to 1989. There was no fishing effort by the GDR in 1990, whereas they reported catches of 2,352 tons in 1989. The catch by EEC-Portugal increased from about 300 tons in 1989 to about 3,200 tons in 1990. This increase occurred in the Div. 3LM area and was associated with the increased catches of Greenland halibut. Grenadiers are a by-catch in this fishery. Catches by the USSR declined from 2,552 tons to only 500 tons for the same period. Nominal catches remain low compared to those prior to 1979.

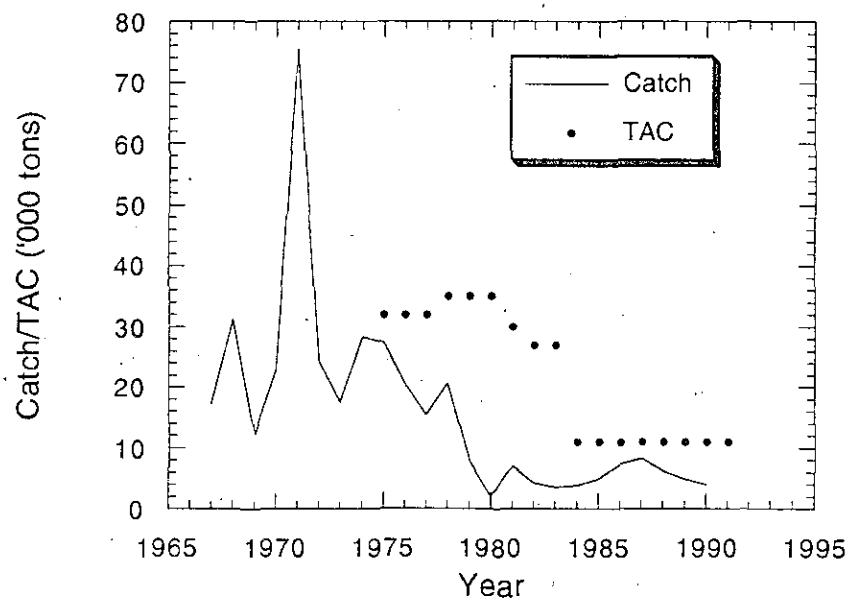

Fig. 35. Roundnose grenadier in Subareas 2 and 3: catches and TACs.

Catches and TACs ('000 tons) for the recent period are as follows:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	27	27	11	11	11	11	11	11	11	11	11
Catch	7	4	4	4	5	7	8	6	5[1]	4[1]	

[1] Provisional data.

Prior to the increase in Portuguese catches, the traditional fishery took place primarily in Div. 3K during the second half of the year. In 1990, the majority of catches were taken in Div. 3LM and landings were reported over the entire year with about 50% of the total being taken during the March to May period.

b) Input Data

i) Commercial fishery data

Catch and effort data were available from ICNAF/NAFO for the period 1967-89, and from the Canadian Observer Program for 1978-89. The two data sets were analysed separately using a multiplicative model to derive two estimates of standardized catch rate (Fig. 36) and effort. The ICNAF/NAFO series indicated that catch rates were highest in the early-1970s, but have gradually declined since then. Catch rates remained fairly constant from 1981 to 1986, but appeared to have declined somewhat since then. The series derived from the Observer Program also appeared stable from 1978 to 1986 although there was considerable inter-annual variability. Catch rates from this series have also declined somewhat since then.

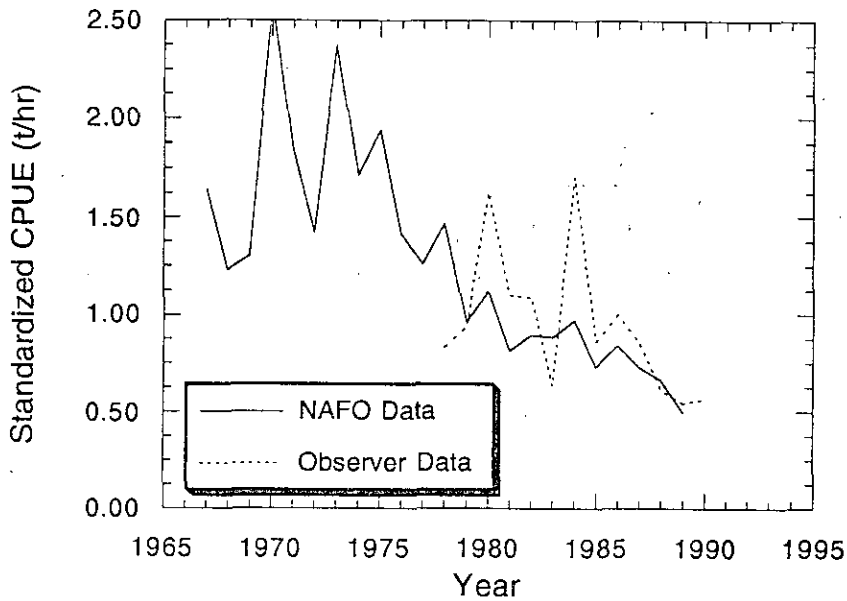

Fig. 36. Roundnose grenadier in Subareas 2 and 3: standardized catches rates.

STACFIS noted that it was unclear whether the observed decline in catch rates in recent years was an indicator of stock status, or availability to the fishery. It was noted that the USSR fishery encountered problems because of the deep distribution of the fish in 1990. Further evidence was also presented that the fish may have been distributed deeper in recent years, and were less available to the fishery resulting in lower catches and catch rates in recent years. Therefore, questions remain concerning the use of these as indicators of stock status.

ii) Catch-at-age data

No length frequency data from the 1990 fisheries were available.

iii) Research data

The results of a research survey to Div. 2G by the USSR/EEC(FRG) in 1990 were presented. Fishing was carried out in depths of 550-1380 m, but no roundnose grenadier were caught in depths <920 m. They dominated the catches in depths >1,200 m. Larger fish were caught in deeper waters, and the mean overall total length was about 48 cm.

A survey was also conducted in depths between 550 and 1,450 m in Div. 3K in 1990. None were found at depths <700 m, and the largest catches were taken

in depths >1,400 m. As in Div. 2G, mean length increased with increasing depth, and the overall mean length was 53.9 cm.

c) Prognosis

In 1990, STACFIS concluded (NAFO Sci. Coun. Rep., 1990, page 94) that Sequential Population Analysis was not an appropriate tool for the assessment of roundnose grenadier in SA 2+3 because the distribution of this species extended beyond the depths where the commercial fishery was prosecuted. Potential calibration indices such as survey data and commercial catch rates are of limited value because they do not cover all inhabited depths, and the proportion of roundnose grenadier in deeper waters in unknown. It is also possible that this proportion changes between years. If there is a trend in recent years for roundnose grenadier to be distributed deeper, then the recent decline in catch rates may be reflecting this re-distribution rather than stock status.

Given the above, STACFIS concluded that there are insufficient data upon which to base an assessment, and until such data are forthcoming it will not be possible to assess the status of this stock. STACFIS therefore advises that the precautionary TAC level of 11,000 tons should remain in place until further data, suitable for use in assessing this stock, become available. STACFIS does not anticipate that the pre-requisite data will be available in the foreseeable future.

16. Capelin in Division 3L (SCR Doc. 91/9, 10, 37, 43)

In recent years, projections for this stock have relied on the results of Canadian acoustic surveys conducted during May, just prior to the assessment meeting. Only preliminary results were available from the May 1991 survey. Ice covered a portion of the planned survey area north of 48°N and as a result, only about 60% of the area could be surveyed. Ice has not been a problem during this May survey since it was initiated in 1985. In four of the six previous years, greater than 50% of the biomass occurred in the survey area north of 48°N while in the other two years, about 40% and 10% of the total biomass occurred there. A preliminary analysis provided a biomass estimate for 1991 of 116,000 tons, an extremely low biomass considering the next lowest biomass in the comparable area was the 1986 estimate of about 1.7 million tons. STACFIS was unable to determine whether the Canadian survey results were representative of stock status or whether the capelin distribution was abnormal because of the extensive ice cover. STACFIS noted that some capelin surveys near Iceland have produced low biomass estimates when there was extensive ice coverage in the area, and scientists have speculated that the capelin were under the ice and inaccessible to survey gear. When the surveys were repeated after the ice had receded, the capelin abundance estimates were much higher.

STACFIS noted that Canada was planning to repeat the survey during late June to mid-July and the results would be available for the September meeting. The USSR was also planning to conduct a survey of the area. As a result, STACFIS deferred further discussion of this stock until the September 1991 meeting.

17. Capelin in Divisions 3N and 3O (SCR Doc. 91/9, 10, 34; SCS Doc. 91/5)

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 (Fig. 37).

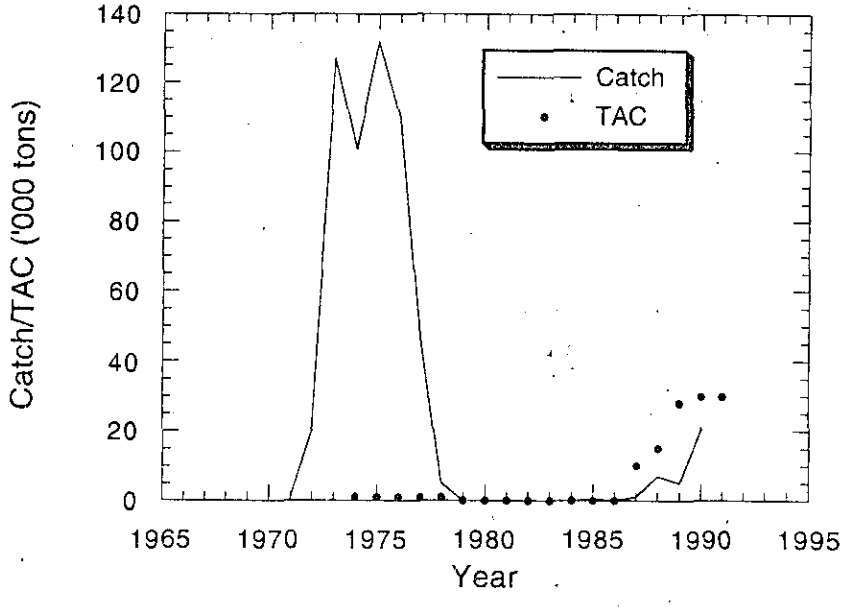

Fig. 37. Capelin in Div. 3NO: catches and TACs.

During that period, most of the catch was taken by USSR trawlers and Norwegian purse seiners. The fishery was closed during 1979-86 but was re-opened under quota regulation in 1987. The provisional catch in 1990 was 20,673 tons. The USSR reported catches of 2,451 tons of prespawning capelin in Div. 3O but the remainder (USSR, 11,625 tons; Norway 8,395 tons; Japan 2,054 tons; EEC-Portugal and Cuba, less than 100 tons each) occurred on the capelin spawning grounds in the Regulatory Area. Recent TACs and catches ('000 tons) are as follows:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Advised TAC	0	-[1]	0	0	0	0	10	10	28	30	30
TAC	0	0	0	0	0	0	10	15	28	30	30
Catch	0	0	0	+	0	1	7	5[2]	21[2]		

[1] No STACFIS advice.
[2] Provisional data.

b) Input Data

i) Commercial fishery data

The catch rates in the USSR midwater trawl fishery in Div 3O during May 1990, as reported by Canadian observers, was 4.8 tons/hr and 46.5 tons/day. These were higher than the 1989 and 1988 values of 3.5 tons/hr and 36.5 tons/day and 2.8 tons/hr and 33.0 tons/day respectively. The 1987 (50%) and 1986 (40%) year-classes predominated in the catches during 1990.

STACFIS could not determine whether the increase in catch rates represented an increase in biomass. Although a fishery occurred in this area during the mid-1970s, the present fishery has different vessels and captains. Thus, it can be considered to be a new fishery and STACFIS concluded that learning is a possibility.

A Japanese midwater trawl fishery reported catch rates of 4.95 tons/hr in the Regulatory Area in 1990. This catch rate was the second highest during the period 1987-90 and higher than catch rates (0.23-4.75) between 1975 and 1978 when the fishery operated over a wider area. The age-compositions in the catch of the only sampled trawler were dominated by the 1987 (66%) and 1986 (23%) year-classes.

STACFIS noted that its recommendation from last year concerning increased sampling of catches had been acted upon and urged that such sampling be continued.

ii) Research data

External tags were applied by Canadian scientists to maturing capelin in the area of operation of the USSR fishery in the northwestern corner of Div. 3O during May 1988 and 1990. One 1988 tag was recovered by the USSR fishery in the same area in 1988 and similarly in 1990, one 1990 tag was recovered by the USSR fishery in the same area. No tags were recovered from other areas in 1988. However, in 1990, 10 tags were recovered near the inshore spawning grounds at Newfoundland, from Conception Bay to Notre Dame Bay. No other tags from the 1990 tagging were recovered.

STACFIS noted the value of the tagging experiments and recommended that *Contracting Parties contact fishing fleets soliciting the return of capelin tags.*

The USSR conducted an acoustic survey in Div. 3LNO during 15-29 May 1990. The selection of survey tracks, stratification, computation of biomass and standard deviation due to survey design, were based on Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) recommendations. One stratum and most of another stratum occurred in Div. 3O and the biomass computed for these two strata was 991,000 tons. These two strata were dominated by the 1987 (46%) and 1986 (43%) year-classes, most of which were mature. As described above, the tagging data indicated that some capelin from this area moved inshore to Div. 3KL to spawn. STACFIS was unable to quantify the proportions of fish that would move into Div. 3L and therefore, could not calculate a spawning biomass for Div. 3NO.

Because of the problem of stock mixing prior to spawning, STACFIS recommended that *acoustic surveys in Div. 3NO be conducted during the capelin spawning period.* In this regard, it was noted that the USSR survey during 1991 will occur later than in 1990 and is timed to coincide with the usual time of spawning.

An 0-group capelin survey was conducted in Div. 3LNO by the USSR during 22-25 November and 1-11 December 1990. The continuation of this annual survey (started in 1983, no survey in 1985), was recommended by STACFIS last year. The time series of data was re-analyzed based on the observation that indices of abundance of 0-group fish from the southern portion of the survey were significantly correlated with USSR acoustic estimates of age 2 capelin (1983-88 year-classes). Although confidence intervals are wide, there is no indication that there has been any decline in the 0-group index and in fact, recent year-classes were abundant as 0-group and similar to the large 1983

year-class.

The indices of abundance and confidence intervals are as follows:

Year-class	Index of abundance	Confidence interval
1983	5.85	4.56-7.26
1984	2.98	2.52-3.46
1986	3.48	2.28-4.91
1987	5.58	4.60-6.54
1988	6.88	4.04-8.28
1989	6.87	5.27-8.68
1990	6.21	5.05-7.37

c) Catch Projections

No stock projections were made for capelin in Div. 3NO because estimates of abundance of the 1988 and 1989 year-classes were not available for this stock. However, given the relationship between the 0-group index and age 2 capelin and the high 0-group indices, STACFIS concluded that this stock will probably not decline during 1992. Based on these considerations, STACFIS has no basis on which to change its previous year's advice of a TAC of 30,000 tons.

18. Squid in Subareas 3 and 4 (SCR Doc. 91/28, 55)

a) Introduction

Catches increased rapidly during the 1970s, reaching 162,000 tons in 1979, and then decreased to 111 tons in 1986 (Fig. 38). Research activities on squid ceased at the same time as the drop in the squid catch. In recent years, there has been no advice on squid due to little information on the stock status. Catches increased in 1989 and 1990. Recent TACs and catches ('000 tons) are as follows:

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TAC	150	150	150	150	150	150	150	150	150	150	150
Catch	33	13	+	1	1	+	2	1	7[1]	11[1]	

[1] Provisional data.

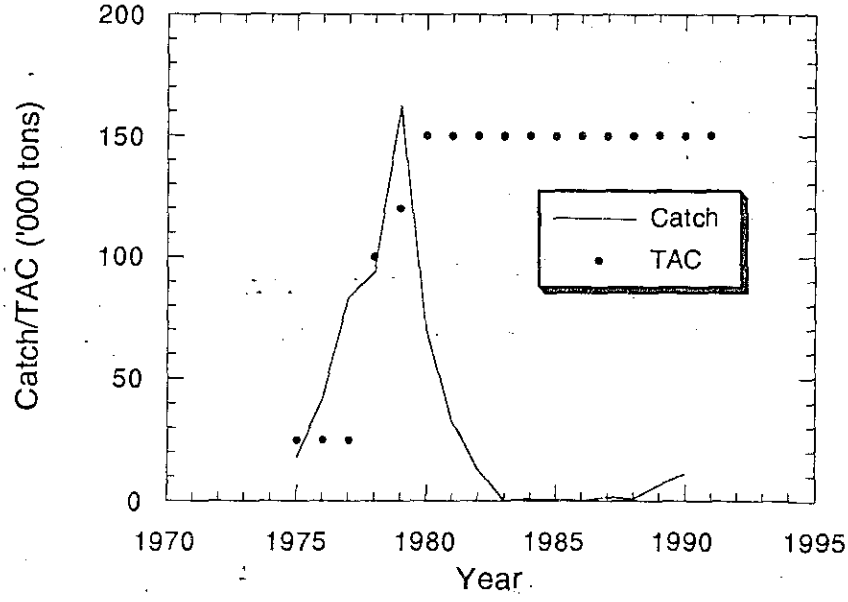

Fig. 38. Squid in Subareas 3 and 4: catches and TACs.

The most important characteristic of this stock is that there is only a single age group present at any time. Although the relationship between spawning biomass and recruitment is believed to be most important for current management, this relationship is poorly known. Furthermore it is impossible to estimate the recruitment a few months in advance of the start of the fishery without a juvenile survey. The basis for management was discussed extensively by ICNAF and was changed after 1973, when it was concluded that fishing levels were having no harmful effect on subsequent recruitment. In 1979, from a theoretical point of view, effort regulation was considered to allow more effective management, but some practical difficulties hampered its enforcement. In 1980, it was concluded that a TAC of 150,000 tons in conjunction with effort constraints remained the most satisfactory means of preventing over-exploitation in years of moderate or high abundance. In years of low abundance, the fishery would be self-regulated.

b) Prognosis

Presently, there is still a small-scale directed fishery for squid and, if the gradual increase in abundance indices in Subareas 5 and 6 during recent years continues, increased catches may be expected in Subareas 3 and 4 in the near future. Without up-to-date information on the squid stock, especially for recruitment, STACFIS is not able to provide more precise advice and this situation will remain if current research effort on this stock is not increased.

19. Shrimp in Subareas 0 and 1 (SCR Doc. 91/33, 40, 41, 47, 48, 49, 57, 69, 70, 71, 74).

a) Introduction

The nominal catch of shrimp in the offshore areas of Subarea 1 south of 71°N and the adjacent part of Subarea 0 (Div. 0A) increased from less than 1,000 tons before 1972 to almost 43,000 tons in 1976, fluctuated thereafter, but has been at a level about 44,000 tons during 1985-88. Preliminary statistics for 1989 and 1990 indicate total catches of about 51,000 and 52,000 tons, respectively. The fishery has been regulated by TAC since 1977 (Table 2A and Fig. 39).

Table 2A. Shrimp in Div. 0A and Subarea 1: nominal catches and TAC (tons) included in TAC advice.

		1980	1981	1982	1983	1984	1985	1986	1987[1]	1988[1]	1989[1]	1990[1]	1991
Div. 0A	Canada	59	1,590	858	2,030	448	233	126	3,252	6,087	7,235	6,177	
	Denmark	-	1,923	946	2,627	526	916	1,208	529	-	-	-	
	France	-	-	-	-	436	-	-	-	-	-	-	
	Faroe Islands	-	1,686	-	756	730	142	530	2,359	-	-	-	
	Greenland	815	85	8	-	2	1,349	1,131	-	-	-	-	
	Total	874	5,284	1,812	5,413	2,142	2,640	2,995	6,140	6,087	7,235	6,177	
SA 1 Offshore, South of 71°N													
	Canada	590	-	-	-	-	-	-	-	-	-	-	
	Denmark	872	995	959	451	397	417	572	502	312	391	353	
	France	247	535	672	408	404	416	535	596	423	420	400	
	Faroe Islands	3,554	1,234	530	1,583	360	471	481	474	421	476	223	
	Greenland	27,501	28,197	32,016	30,929	32,129	37,788	39,537	37,998	35,947	42,164	45,284	
	Norway	3,014	1,055	838	483	451	455	464	450	459	448	-	
	Total	35,778	32,016	35,015	33,854	33,741	39,547	41,589	40,020	37,562	43,899	46,260	
0+1 offshore catch[2]		36,652	37,300	36,827	39,267	35,883	42,187	44,584	46,160	43,649	51,134	52,437	
0+1 advised TAC[2]		29,500	29,500	29,500	29,500	29,500	36,000	36,000	36,000	36,000	44,000	50,000	50,000
0+1 effective TAC[2]		29,500	35,000[3]	34,800[3]	34,625[3]	34,925[3]	42,120[4]	42,120[4]	40,120[4]	40,120[4]	40,120[5]	44,975[5]	46,225[6]

[1] Preliminary data.
[2] South of 71°N.
[3] Including TAC of 5,000 tons in SA 0.
[4] Including TAC of 6,120 tons in SA 0.
[5] Including TAC of 7,520 tons in Div. 0A.
[6] Including TAC of 8,500 tons in Div. 0A.

During the history of this fishery, the fishing grounds in Div. 1B have been the most important. Since 1987, however, there has been increasing catches in Div. 1C and 1D. In 1990 the nominal catches by larger vessels in Div. 1B and 1C were almost equal.

The fishery in Div. 0A usually takes place from July till November. In Subarea 1 the fishery occurs in all months of the year, however, early in the year it is often confined to the southern fishing grounds in Div. 1C and 1D due to ice coverage in Div. 1A and 1B. This was the case in 1990.

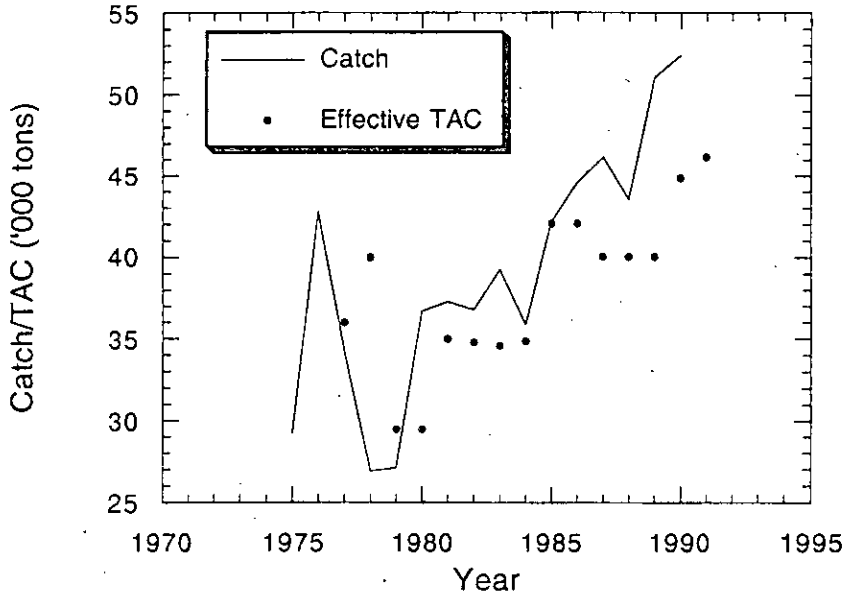

Fig. 39. Shrimp in Subareas 0 and 1: catches and TACs in offshore Subarea 1 (south of 71°N) and adjacent areas in Subarea 0 (Div. 0A). Effective TACs from 1977 to 1980 for Subarea 1 only.

An offshore fishery north of 71°N, outside the fishing areas in Subareas 0 and 1 for which TACs have been advised, began in 1985 and yielded about 4,300 tons that year. In 1986 and 1987 catches increased to about 11,000 tons, and thereafter decreased to about 2,100 tons in 1990. This fishery normally occurs from June to November.

The West Greenland inshore shrimp fishery was relatively stable from 1972 to 1987 with estimated catches of 7,000-8,000 tons annually (except for 10,000 tons in 1974). Preliminary statistics indicate increasing catches in recent years, namely 9,900 tons in 1988, 14,400 tons in 1989, and 15,000 tons in 1990.

Total catches (tons) for all Subarea 1 are shown in Table 2B.

Table 2B. Shrimp in Subarea 1: total nominal catches.

	1980	1981	1982	1983	1984	1985	1986	1987	1988[1]	1989[1]	1990[1]
SA 1 offshore (south of 71°N)	35,778	32,016	35,015	33,854	33,741	39,547	41,589	40,020	37,562	43,899	46,260
Greenland (N of 71°N)	-	-	-	-	-	4,349	11,045	10,700	6,660	2,522	2,121
Greenland (Inshore[2])	7,500	7,500	7,500	7,500	7,500	7,500	7,500	6,921	10,233	14,428	15,050
SA1 Total	43,278	39,516	42,515	41,354	41,241	51,396	60,134	57,641	54,455	60,849	63,431

[1] Preliminary.
[2] Inside 3 miles. Inshore component of total catch 1980-86 was estimated.

b) Input Data

i) Commercial fishery

Catch rates (Fig. 40). Catch and effort data from the shrimp fishery in 1990 were available from Canadian vessel logs for Div. 0A and from French and Greenland logbooks for Subarea 1.

Based on Canadian vessel logs from Division 0A from 1981 to 1990 an unstandardized, weighted yearly catch rate was calculated. Because of seasonality in the catch rates and changes in the fleet over time, the same data were analyzed using a multiplicative model without interactions to produce standardized yearly catch rates. Both series showed fluctuating catch rates but the standardized rate revealed an overall declining trend over the ten year period. From 1987 to 1989 there was a decline in CPUE followed by stabilization between 1989 and 1990.

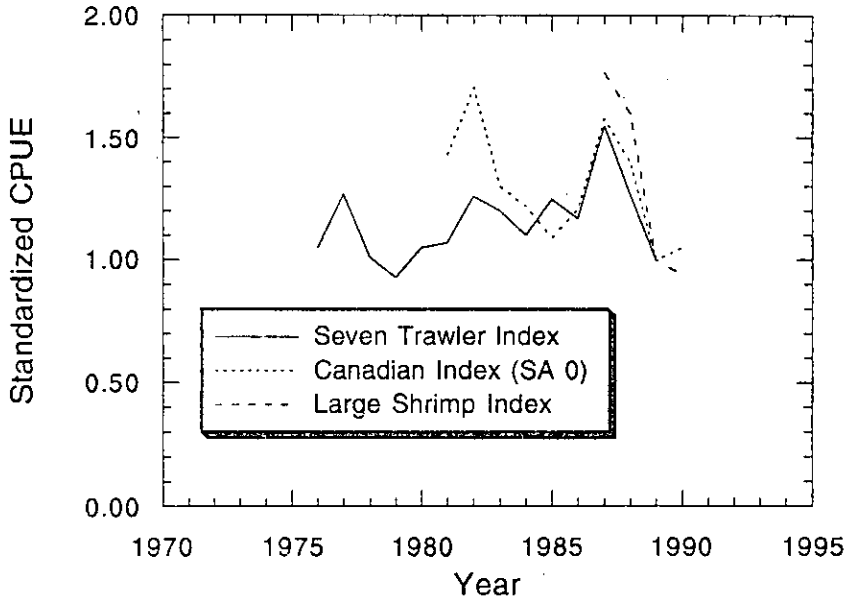

Fig. 40. Shrimp in Subareas 0 and 1: standardized catch-rate indices from Div. 0A and Div. 1B.

Logbook data from 22 Greenland sea processing trawlers, which enter the catch by shrimp size category in the logbook, were used in a multiplicative model to establish a CPUE-index for large shrimp >8.5 g (considered to be females), for which discard is unlikely or at least negligible. Hereby the uncertainty in interpretation of catch rates caused by possible changes in discarding procedures in recent years should be minimized. The index, covering the period from 1987 to 1990, decreased from 1987 to 1989 by about 50% and remained relatively stable from 1989 to 1990.

A standardized index for seven Greenland trawlers for Div. 1B showed an increasing trend from 1979 to 1987, followed by a decline from 1987 to 1989.

The increased catch in the south in recent years continued in 1990, and the catch rate indices are therefore now based on a smaller proportion of the total fishery than in the earlier years. STACFIS therefore recommends that *for future assessments of shrimp in Subareas 0 and 1, catch rate indices also be determined for the more southern Divisions.*

Length and age composition. The annual mean carapace length (CL) data for the Canadian fishery in Div. 0A showed an overall decrease from 24.8 mm in 1981 to 22.6 mm in 1990. The length-frequencies in 1990 consisted primarily of males at 20 mm CL (likely the 1985 year-class), which accounted for about 35% of the total catch numbers. The size distributions from the adjacent Subarea 1 fishery in 1990 were very similar to those from Div. 0A with strong representation of male shrimp about 20 mm CL. Farther north (Div. 1A), larger females (27 mm CL) dominated but the mode of males about 20 mm CL was also evident.

The catch-at-length data from the Canadian fishery in Div. 0A from 1981 to 1990 were separated into age groups by modal analysis based on the results of previous ageing studies. Estimated proportions of female shrimp (ages 7+) declined from over 80% in 1981 to about 50% from 1984 to 1989 and to 36% in 1990. Catch rates (numbers caught per hour) for ages 4, 5 and 6 (males) showed a generally increasing trend over the time series indicating the relative importance of these ages in the Canadian fishery. The data suggested that one or more strong year-classes were produced in the early-1980s and began to recruit to the fishery in 1984. This could explain the increase in catch rates which peaked in 1987 and the subsequent decline as their numbers were reduced through fishing and natural mortality.

The 1988 and, more importantly, the 1990 data indicated that the 1985 year-class is strong. Although animals of this size appear to be fully selected by the fishing gear, they were not fully recruited in 1990 and should contribute further in 1991 as males and in 1992 as females.

The estimation of catch-at-age from commercial length frequency data has potential for providing insight into events occurring within the population. Despite the likelihood of imprecise ageing (i.e. overlapping components), it appeared that periods of good recruitment could be identified and followed through the fishery. The separation of females by modal analysis might not be valid and needs to be checked with biological data before firm conclusions can be made regarding mortality and partial recruitment. However, since the fishery in Div. 0A usually represents less than 15% of the annual nominal

catches, STACFIS was not able to apply these results in the overall assessment of the Subareas 0 and 1 resource.

Shrimp discards. In Div. 0A, discard rates estimated by observers were at the same level as in preceding years. Since 1980 the observed average discard rate has fluctuated between 2 and 5%.

An observer program to estimate shrimp discarding in Subarea 1 was initiated in 1990. Two types of discard were distinguished, namely quality discard (shrimp of low quality, due to e.g. soft or broken shell) and size discard (small shrimp, the market value of which is down to one tenth of that of the largest shrimp). The observed quality discard varied between 0 and 19%, with a general level of 6 to 7%. Size discard varied between 9 and 36% of the catch, averaging about 24%. The estimated discard was about 100 times higher than reported in the logbooks. Based on these results an estimate of the total discard in 1990 for this component of the fishery was about 6,000 tons in Div. 1B and about 5,000 tons in Div. 1A, C and D.

STACFIS noted that last year's recommendation requesting direct observations on discard in the shrimp fishery had been carried out. Given that discard procedures may change from year to year for various reasons STACFIS is pleased that sampling will also be conducted in 1991.

By-catches. Observer data from the Canadian fishery in Div. 0A from July to November 1990 showed that the percentage by-catch by weight ranged from 12% to 23% of the total catch weight of all species. By-catch species composition was similar to that observed in 1989. Redfish was the most abundant fish species, accounting for approximately 6 to 15% of the total observed catch. Greenland halibut comprised 2.5% or less of the catch in each month. As usual, the incidence of Greenland shark increased in November from less then 1.2% of the catch in previous months to 7.5%.

No other data on by-catch were available.

ii) Research vessel surveys

Abundance estimates. In July-August 1990, a stratified-random trawl survey was carried out by two trawlers working simultaneously in Div. 0A and 1A-D. The area covered was extended to the south compared to surveys in 1988 and 1989 due to the change in distribution of commercial effort observed in 1989. The trawlable biomass estimates (tons) obtained by the swept area method are as follows:

	1988	1989	1990
South of 71°N	138,000	185,000	142,000
North of 71°N	24,500	11,725	10,228

The number of male shrimp increased significantly from 1988 to 1989, when a new male group entered the fishery, and decreased again in 1990 to the level of 1988. The number of females decreased from 1988 to 1989 and increased slightly in 1990. During the same years, the number of multiparous females decreased, and the increase of the female group in 1990 was due entirely to primiparous females. The data showed a higher abundance in the southern areas in 1989, where the newly recruited males were found in shallower water. In 1990 there were indications of movement towards the northern slopes of Store Hellefiske Bank and to deeper water. North of 69°30'N the abundance decreased for all sizes of shrimp over the three years except for a minor increase in the male group between 1989 and 1990 north of 71°N.

Selectivity studies. A selectivity study comparing 18 and 43 mm mesh codends was performed by Greenland in September 1990. Results showed that catch was proportional to the towing time. The average selection factor was estimated at 0.356, corresponding to an L_{50} of 15.5 mm CL for the mesh size of 43 mm.

Based on these results STACFIS noted that a smaller mesh size in the research trawl (about 24 mm) would be useful in the early detection of forthcoming recruitment.

Biological data. Preliminary studies on stomach content of fish species in the by-catch during the trawl survey in July 1990 were carried out to evaluate predation on shrimp, especially by redfish and Greenland halibut. Store Hellefiske Bank, which contains some of the most important fishing grounds for shrimp, is at the same time the most important nursery ground for these two fish species. Introduction of devices to reduce the by-catch of fish in the trawl might lead to higher survival of small fish, which again might have a negative effect on the shrimp stock by higher predation. These studies indicated that redfish may be a more important predator than Greenland halibut.

STACFIS noted that these studies will be continuing and will include the sorting of redfish by species. Also, studies on predation by seals were continuing.

c) Estimation of Parameters

Sequential population analysis. The catch-at-age matrix from the Canadian fishery for shrimp in Div. 0A from 1981 to 1990 was used in a cohort analysis to obtain estimates of abundance and fishing mortality. The analysis was performed and calibrated by age using the Adaptive framework. The number caught per hour at age was the index used for the calibration. Instantaneous natural mortality was assumed to be 0.5 and the fishing mortalities for the two oldest ages (7 and 8+) were assumed to be equal.

The results of the cohort analysis showed potential for application and should be explored further. The diagnostics indicated that the model fit the data well and the resulting trends in the population estimates corresponded to those interpreted from the fishery and survey data. For example, the 1985 year-class was shown to be the strongest at age 5 since 1981 and the estimates of population numbers and biomass from the mid-1980s onward were in good agreement with the CPUE data. However, since the data used in the analysis represented less than 15% of the total annual landings in Subareas 0 and 1 and since it was not yet clear that the modal analysis of length frequency data was properly separating the female ages, results could not be directly used in the present assessment. Nevertheless, STACFIS found it encouraging that the ageing of the commercial samples from the Canadian fishery in Div. 0A had been performed and that the previous age interpretation appears reliable. STACFIS was further encouraged that the sequential population analysis ran successfully on this set of data and therefore recommends that *these techniques should be applied for the total stock of shrimp in Subareas 0 and 1.*

d) Assessment Results

All catch-rate indices showed a decrease from 1987 to 1989, and the Canadian index and the large shrimp index showed a stabilization between 1989 and 1990.

Biomass estimates from trawl surveys indicated the same abundance in 1988 and 1990 south of 69°30'N, while the estimate in 1989 was about 30% higher. The high figure in 1989 may be explained by the substantial recruitment that year of the new group of male shrimp (1985 year-class).

Results from selection studies indicated that the 20 mm CL mode should have been fully selected to the commercial gear in 1989, but comparison of commercial and survey size distribution showed that this size group was not fully recruited to the fishery. All commercial fishery and research survey data available for 1990 showed the occurrence of this mode throughout the area south of 69°30'N, except in some southern locations.

e) Prognosis

The Canadian standardized CPUE series and the Greenland trawler large-shrimp index showed the same trend, a decline from 1987 to 1989 and some levelling off between 1989 and 1990. The available commercial fisheries and research data showed a potential for improved recruitment to the fishery in 1991 and 1992 depending on the actual strength of the 1985 year-class. However, the significance on recruitment in future years of the higher catch levels in the range of 45,000 to 52,000 tons from 1986 can not yet be evaluated. Therefore, STACFIS advises that catches in 1992 should not exceed recent levels, i.e. about 50,000 tons.

The reported catches in recent years have exceeded both the advised and the implemented TACs. Discarding has contributed further to removals from the stock. Observed discards in 1990 consisted mainly of the recruiting size group, and therefore STACFIS recommends that *shrimp discarding in the shrimp fishery should be closely monitored.*

f) The Greenland Shrimp Fishery North of 71°N

Data suggest that the resource has declined continuously since the beginning of this fishery. Considering that reproduction is assumed to be lower than in southern areas, and that survey results show that the abundance is decreasing for all sizes of shrimp from 1988 to 1990 except for a minor increase in the male group between 1989 and 1990, a cautious approach should be taken in the exploitation of this resource.

g) Future Research

It was acknowledged that a substantial data base exists for the shrimp stock in Subareas 0 and 1. However, the information is fragmentary and STACFIS therefore recommends that *a concentrated effort to synthesize the information for a more complete understanding of the status of the shrimp stock in Subareas 0 and 1.* This information should then be applied in the assessment process and the provision of advice.

h) Effects of Increasing Mesh Size in the Shrimp Fishery

The selectivity study by Greenland indicated that an increase in mesh size above the commercially used 43 mm would reduce catches of smaller size groups of shrimp. Considering that these results differ from previous selectivity results, STACFIS finds it premature to advise a change in the current regulation. To further evaluate the possibility of reducing discards, STACFIS recommends that *studies on selectivity using a 60 mm mesh be carried out.*

20. Shrimp in Denmark Strait (SCR Doc. 91/20, 40, 52, 53, 58, 72, 96)

a) Introduction

The fishery was initiated in 1978 and increased during the following years to around 12,500 tons in 1988 (Fig. 41). In 1989 the nominal catch of the Danish, Faroese, French, Greenlandic, Icelandic and Norwegian vessels decreased to about 10,700 tons. In 1990 the total nominal catch of the aforementioned nations amounted to about 10,300 tons. Reported catches and TACs ('000 tons) throughout the history of the fishery are as follows:

Nation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990[3]	1991
Denmark	-	-	702	581	740	204	443	353	500	555	444	366	390	
Faroe Islands	-	-	4,233	713	737	443	668	674	727	595	679	595	843	
France	-	-	50	353	414	291	500	642	780	1,030	494	381	51	
Greenland	-	-	200	1,004	1,115	1,467	2,250	2,596	5,781	6,627	7,456	5,981	6,210	
Iceland	363	485	759	125	-	43	742	1,794	1,150	1,330	1,424	1,326	281	
Norway	-	800	2,461	2,016	1,896	1,727	2,128	2,051	2,026	2,041	2,052	2,098	2,500	
Total	363	1,285	8,405	4,792	4,902	4,175	6,731	8,110	10,964	12,178	12,549	10,747	10,275	
Total catch eastern side	363	485	759	125	0	43	742	1,794	1,150	1,330	1,424	1,326	281	
Total catch western side	0	800	7,646	4,667	4,902	4,132	5,989	6,316	9,814	10,848	11,125	9,421	9,896	
Advised TAC	-	-	-	-	4,200	4,200	4,200	5,000	...	...	...	10,000[1]	10,000[1]	10,000[1]
Effective TAC western side	-	-	-	8,000	4,500	5,725	5,245	6,090	7,525[2]	7,725[2]	8,725[2]	9,025[2]	14,100	14,500

[1] Advised for a few years as a precautionary measure.
[2] Not including Greenland fishery north of 60°30'N.
[3] Preliminary.

Total catches increased rapidly from 1978 to 1980, decreased and remained stable from 1981 to 1983, increased steadily from 1983 to 1988 and then decreased again in 1989 and 1990.

The fishery takes place primarily in the area of Strede Bank and Dohrn Bank as well as on the slopes of Storfjord Deep. The available fishing ground at a given time depends heavily on the ice conditions. The main fishing area extends from approximately 65°20'N to 67°30'N and between 27°W and 33°W. In 1990, fishing for shrimp was allowed for the first time inside the "redfish box" (NAFO Res. Doc. 91/53) (Fig. 1), so the fishery was extended somewhat to the west. During the last 5 years about 60 vessels participated in the fishery each year on the western side of the midline, and about 30 vessels on the eastern side of the midline.

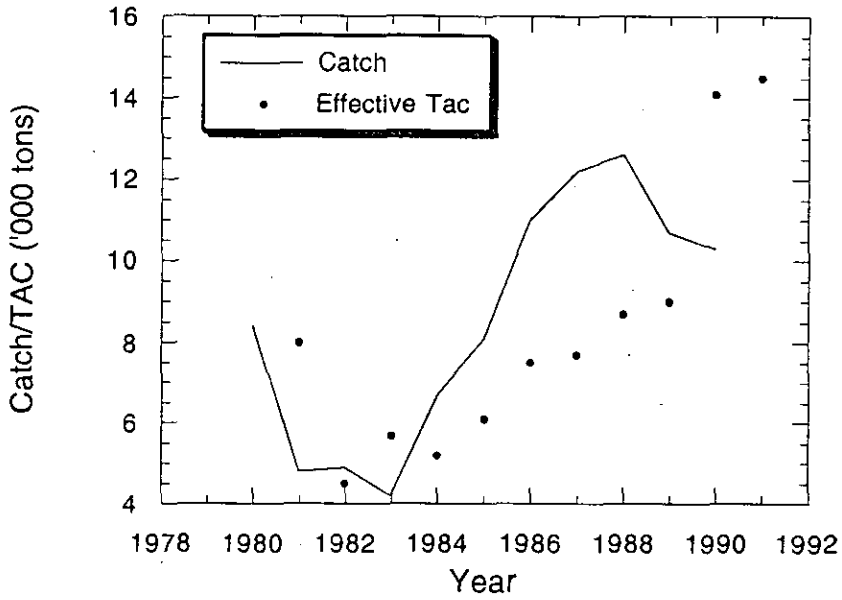

Fig. 41. Shrimp in Denmark Strait: catches and TACs.

b) Input Data

i) Commercial fishery data

Trends in effort. Catch data were available from log books for the six nations fishing shrimp in Denmark Strait while effort data were obtained for only four (Greenland, Norway, Iceland and France) from 1980 to 1990. Catches and corresponding effort were compiled by month and by fleet. CPUEs were calculated by month and the mean weighted CPUE of two periods of the year (January to June and July to December) was then applied to the total catch of the period to calculate the total effort.

Total effort values showed the same pattern as catch. From 1980 to 1990, effort increased from about 35,000 hours to more than 100,000 hours. Effort for the two periods of the year also showed an overall increase from the beginning of the 1980s to 1990. However, the autumn fishery (July-December) became more important at the end of the 1980s, accounting for approximately 50% of the total annual effort.

For the most recent years, more than 85% of the shrimp in Denmark Strait were caught by three nations, Greenland, Norway and Iceland. Effort values corresponding to the activity of the three fleets indicated a variable pattern. The Greenlandic data showed an increase in effort over the years for the two periods of the year, while the Norwegian effort was fairly stable during the spring fishery (January-June) and increased substantially since 1986 during the autumn fishery. Although the overall pattern over the years was quite variable for the Icelandic fishery, the autumn fishery has become more important since the mid-1980s.

Trends in catch rates. A declining trend was seen in the spring catch-rate series. The catch rates decreased from 1980 to 1990 although those from 1981 to 1987 showed a more variable pattern. Autumn catch rates were relatively stable from 1983 to 1988 and then decreased in 1989 and 1990. For both series, the 1990 catch rate was at about the same level as that of 1989. In general, autumn catch rates were lower than those of the spring fishery and were about 30 to 50% of the spring rates for the last four years.

Annual Norwegian and Greenland catch rates showed a decline over the years for both spring and autumn fisheries. Catch rates for the Icelandic fleet were variable during the spring fishery but indicated a decline over the years for the autumn fishery. The performances of these three major fleets in Denmark Strait was different over the years. Greenland catch rates in spring were usually higher than those of the two other fleets. Norwegian catch rates were higher than the Icelandic ones during the spring fishery up to 1987. During the autumn fishery, catch rates for both fleets were similar. The combined annual catch rates showed an overall declining trend from 1980 to 1990. The 1990 value was at about 50% of the 1980 value. The 1978 and 1979 values corresponded to very low effort and therefore, were less reliable.

Because the relative contribution of the fleets and of the spring and autumn fisheries to the annual catch rate has changed over the years, it is difficult to interpret the data as an index of abundance over the period. Therefore, all available catch and effort data from 1980 to 1990 were analyzed using multiple regression procedures to account for the seasonality (January to December) of the fishery and the relative contributions of the different fleets (Greenland, Norway, Iceland and France). Both series indicated the same overall decrease between 1980 and 1990 (Fig. 42).

Commercial biological data. The Norwegian observer samples were usually obtained during February-April. The length frequencies from 1981 to 1990 were pooled to obtain a mean carapace length (CL) distribution. Deviations from the mean distribution were calculated for each year. The 1990 samples showed positive deviations between 18 and 27 mm CL which also occurred in 1981 and 1984. This reflected the higher proportion of smaller animals present in those years (e.g. 37% in 1984 and 44% in 1990 compared to 10% in 1985). The Greenlandic observer data for 1990 and 1991 were also compared with the Norwegian average length distribution, and the deviations resembled those of the Norwegian data in 1990. The Icelandic observer samples showed the same trend as in the Norwegian and Greenlandic samples in that the proportion of males was higher in 1990 (50%) than in the previous years (about 30% in 1987 and 1988). Also, there was an indication that males changed sex earlier in 1990, as indicated by a smaller component of females with a mean length around 26 mm CL. This might reflect a response to fishing or a movement of shrimp from Icelandic waters where males change sex at smaller sizes than in Denmark Strait.

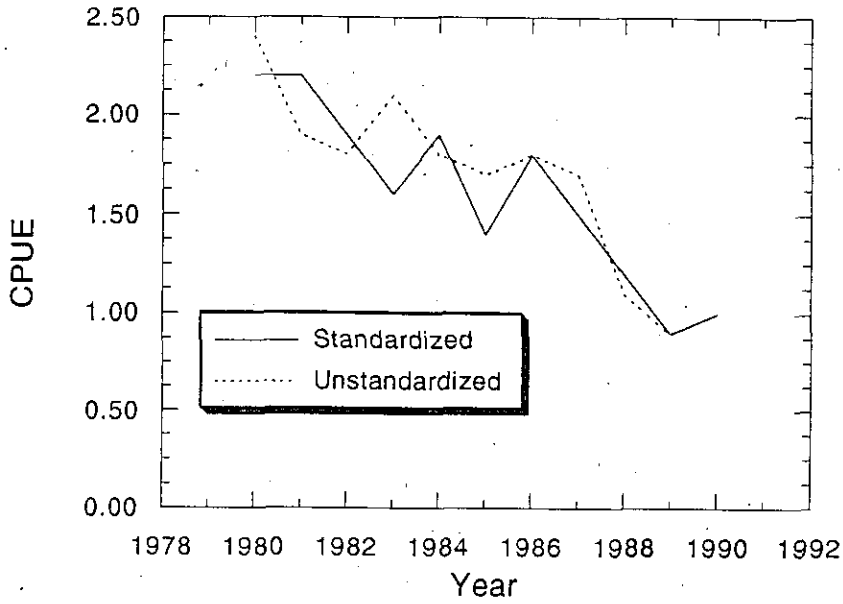

Fig. 42. Shrimp in Denmark Strait: catch rates.

Discards in the shrimp fishery. Norwegian observer data indicated a mean discard rate of 2 % from 1982 to 1990. However, these values corresponded to only one vessel fishing in a limited location for a short period of time. This may not have been representative of the activities of all fleets in the whole season.

Observer samples from 8 (Norwegian and Greenlandic) trawlers and logbooks of the Greenlandic fleet were used to produce an estimate of shrimp discard in the Denmark Strait. For 1990, the discard of shrimp for the Greenlandic fleet was estimated at a minimum of 1,000 tons, or approximately 10 % of the landings.

Fish by-catches in the shrimp fishery. Norwegian observer data from 1981 to 1990 indicated a mean by-catch rate of 0.44 fish caught per kilo of shrimp. Redfish was the most abundant species in the by-catch.

ii) Research survey data

Availability of shrimp and finfish in the 1990 Greenlandic survey was very low. Comparing this estimate with the commercial catches in 1990 and in the beginning of 1991, the Greenlandic survey was not considered to give a reliable estimate of shrimp stock biomass. No Norwegian survey was carried out in Denmark Strait in 1990.

Data from the Norwegian surveys from 1985 to 1989 as well as data from the 1989 and 1990 Greenlandic surveys were examined for biological detail.

In general in the Norwegian series, the proportion of males was higher in 1987, 1988 and 1989 than in 1985 and 1986 for the whole area. There was no change in the mean length of the largest female component over the years. In the 1990 Greenlandic survey, the proportion of males in the western part was 61%, the same level as in the 1989 Norwegian survey. The length frequency distributions of some samples collected in the eastern area in 1989 and 1990 showed females occurring at smaller sizes in 1990. In the 1990 samples, compared to 1989, there was a stronger component of males at 22 mm CL, a new component of small females at 25-26 mm CL and a similar component of females at 31 mm CL.

iii) Hydrographic data

The mean size at sex reversal has been shown to be inversely related to temperature. Hydrographic data from one station in the eastern part of the Denmark Strait from 1981 to 1990 suggested that the temperature was anomalously high in 1990. The hydrography is complex with three different water masses influencing the area and therefore this station may not be a good indicator for the shrimp stock.

c) Assessment Results

i) Production model

A general production model using moving averages of 2- and 3-years estimated the maximum sustainable yield (MSY) to be about 10,000 tons. It was noted that there were few observations at or beyond the MSY estimate, which suggested that the estimates were not very precise. Also, the fishery was not distributed over the entire stock area, which violates the assumptions underlying the use of such models. STACFIS noted further that annual updates of the model are not necessary but that the data series should be continued and periodically reviewed.

d) Prognosis

The decline of catch rates suggested that shrimp abundance from 1988 to 1990 was substantially lower than in previous years. This might be due to the fishery, given that the overall decline in catch rates was coincidental with the increased effort. The apparent decrease in the size at sex reversal in 1990, and the increased proportion of males in the commercial catches and in the Norwegian survey estimates, may also indicate a response due to either fishing pressure or to changes in environmental conditions.

STACFIS concluded that the biomass has been at a lower level in the last three years, without signs of improvement. It was also concluded that the total catches from Denmark Strait should be reduced in 1992. STACFIS does not have sufficient information to determine a more appropriate lower level and therefore advises an arbitrary reduction from 10,000 tons to 8,000 tons.

Given the apparent depressed condition of the resource and the uncertainty whether this has resulted from the fishery or due to changes in the environment, STACFIS recommends that *all historical data (commercial sampling, research survey, etc.) be thoroughly analyzed in relation to hydrographic data and results made available for future assessments.*

21. Other Finfishes in Subarea 1 (SCR Doc. 91/36; SCS Doc. 91/13)

Based on long-term biological and environmental investigations (1982-90) in the area of the continental shelf and slope off West Greenland (Div. 1B-F) in a depth range up to 600 m, provisional results concerning the changes in the structures of the ichthyofauna were presented.

In contrast to the increase in abundance and in biomass of starry skate (*Raja radiata*), the species long rough dab (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*) and spotted wolffish (*Anarhichas minor*) showed decreases in abundance and in biomass indices during that time. The observed variability in the structure of the fish community coincided with changes in temperature and fishing effort.

Comparing the nominal catches taken by Greenland vessels in 1989 and 1990 the same effect of relative changes in the species dominance seemed apparent. In 1990 the percentage proportion of the relative stenotherm species such as grenadiers (*Macrouridae* sp.), Greenland halibut (*Reinhardtius hippoglossoides*) and Arctic char (*Salvelinus alpinus*) in the catches were considerably larger than in 1989.

III. RESPONSES TO FISHERIES COMMISSION REQUESTS

The following are the responses to questions by the Fisheries Commission:

1. Cod in Divisions 2J, 3K and 3L (SCR Doc. 91/51; SCS Doc. 91/15, 16)

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

After reviewing a detailed study on stock discrimination in 1986 (NAFO Sci. Coun., Rep. 1986, pages 121-124), STACFIS concluded that it was appropriate to assess cod in Div. 2J, 3K and 3L as a single stock complex. At present, this conclusion remains unchanged, however, studies on stock structure in this area are ongoing. The potential of including mixing rates in assessment models is also being evaluated.

Estimates of the proportion of the cod biomass in Div. 3L in the Regulatory Area were updated to include the 1990 Canadian spring and autumn research vessel (RV) surveys. These results are similar to those presented previously and are as follows:

Season RV survey conducted	Years RV survey conducted	Range of proportions of biomass occurring in the Regulatory Area (1990 value in brackets)	Average proportion (%)
Winter	1985-86	23.8-26.8	25.3
Spring	1977-90	0.4-6.1 (5.6)	2.9
Autumn	1981-90	0.5-7.7 (2.9)	3.0

Results of the autumn survey conducted in all three Divisions (2J, 3K and 3L) by Canada since 1981, continued to show that the proportion of the cod in the Regulatory Area at that time of year was less than 1%, on average of the total Div. 2J+3KL biomass. The average breakdown of biomass by Division is as follows:

Division	Relative proportion of biomass (%)
2J	38
3K	33
3L	29

By assuming that the relative distribution observed between divisions during autumn was similar to that at other times of the year, it has been previously concluded that "the proportion of the entire Div. 2J+3KL cod biomass estimated to occur in the Regulatory Area is less than 10% in winter and less than 5% on average throughout the year" (NAFO Sci. Coun. Rep., 1990, p. 103). Updating these data leaves this conclusion unchanged and because the proportions of cod in the Regulatory Area in Div. 3L exhibit no annual trends, the proportions expected to occur in this area in the future would be about the same as those observed.

Age compositions derived from Canadian RV surveys in areas inside and outside 200 miles were also updated. The results continued to indicate that proportionately larger numbers of young cod occur in the Regulatory Area than inside 200 miles, however, during 1990 this pattern was less clear. The proportion at age inside and outside 200 miles were more similar in 1990 than previously observed because of the presence of the strong 1986 and 1987 year-classes, ages 3 and 4 in 1990 (Fig. 1). The 1989 results representing a more typical year are also included in Fig. 1.

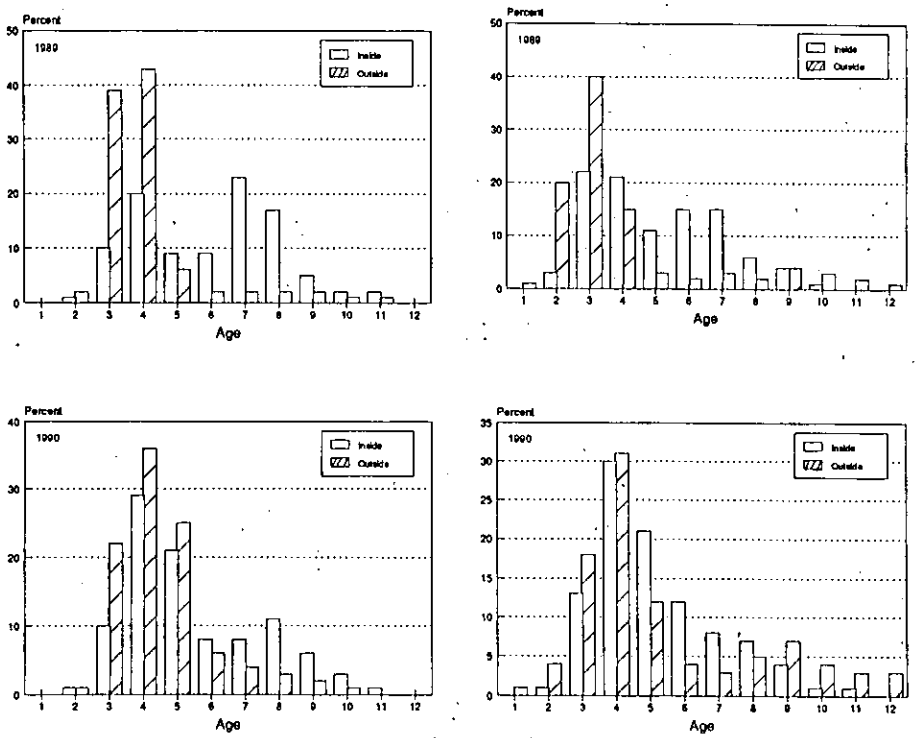

Fig. 1. Cod in Div. 2J and 3KL: spring and autumn catch-at-age for Canadian research vessels surveys.

Age compositions for Spanish pair-trawl and Portuguese otter-trawl fisheries in 1990 were similar to those observed for the Canadian RV data for corresponding months (Fig. 2).

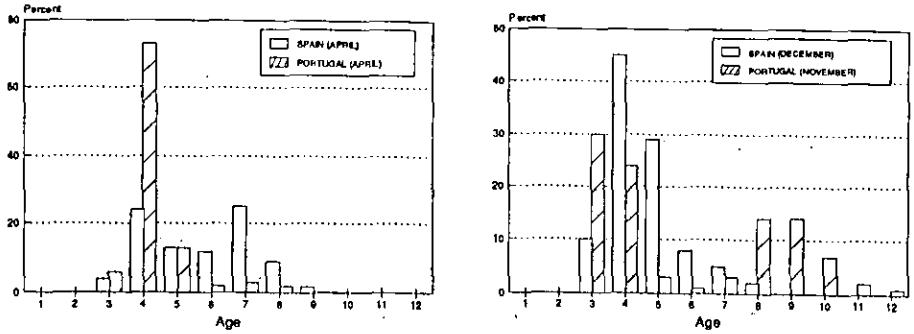

Fig. 2. Cod in Div. 2J and 3KL: spring and autumn catch-at-age for EEC-Spain and EEC-Portugal fisheries.

2. Flounders in Divisions 3LNO

With respect to flounders in Div.3LNO, the Scientific Council is requested to: *provide advice on management options that would reduce the extent to which the fisheries reduce the potential yield due to harvest of small fish.*

STACFIS again noted that large numbers of juvenile flatfish were caught in the Regulatory Area in Div. 3N, although there was more uncertainty with the catch-at-age in 1990 for yellowtail flounder and American plaice because a higher proportion of the catch was comprised of estimates for which there were no sampling data. It was concluded that the effective mesh size for some fisheries in the Regulatory Area was still likely to be much smaller than the NAFO regulation mesh size, and may have been as low as 60 mm again in 1990.

STACFIS once again emphasized that the obvious way to reduce the loss in potential yield due to the harvest of small fish is to enforce the minimum mesh size regulations in the Regulatory Area. Until this is done, it is not practical to advise on measures such as closed areas or seasons. In any case, the information required to develop advice on such measures, as requested by Scientific Council in 1989, has not been provided to date.

3. Witch Flounder in Divisions 3NO

With respect to witch flounder in Div. 3NO, the Scientific Council is asked to: *provide an analysis of the effect on stock status of the lowering of the TAC to 5,000 tons for 1991 and the maintenance of that TAC level in subsequent years.*

STACFIS noted that catches have averaged about 5,000 tons since the TAC was placed at that level, but the TAC had been exceeded in each year from 1985 to 1988. The indices of abundance for this stock are not adequate as measures of total stock size, as surveys do not extend into the deeper areas covered by the fisheries and catch-rate data are not complete or continuous for many fleets. There was nothing in the survey data to suggest that the stock had increased, in fact there were indications to the contrary. STACFIS concluded that until the indices of abundance for this stock are improved, it will be very difficult to evaluate the effect of management strategies on stock status. It was noted that the report of the assessment of this stock contained a number of recommendations dealing with the indices of abundance.

4. Squid in Subareas 3 and 4

With respect to squid in SA 3 and 4, the Scientific Council is asked *to examine all data available to it and if possible to present options for the management of the stock that are based on the NAFO principles of optimum utilization and conservation.*

STACFIS noted that there were no new research results available at this meeting and that no research is presently being conducted on squid. Until such time as new research is initiated and results made available for evaluation by STACFIS, it will not be possible to contemplate the provision of advice on this species.

5. Capelin in Divisions 3NO

The Scientific Council is requested to: *advise at its June 1991 Meeting on the most rational level of management of capelin in Divisions 3NO, on the basis of the main principles of NAFO: optimum utilization and conservation of stocks. The Council should evaluate the importance of capelin at different stages of their life history to the marine ecosystem and in particular, given the mass mortality following spawning, the significance of a management option that refers to harvesting during the period immediately prior to spawning. Other management options such as maintaining minimum spawning biomass should be evaluated in terms of both maintaining stock size and the impact on the ecosystem.*

Management, catches and TACs

TACs on capelin in Div. 3LNO were first applied in 1974. The stocks occurring in Div. 3LNO and Subdiv. 3Ps were originally managed as a stock complex because of the mixing of these stocks during the prespawning portion of their life history. National allocations were provided for Div. 3L, 3NO and Subdiv. 3Ps but because of the migration routes of capelin and the pattern of fishing, countries with specific allocations could add to their 3NO allocations any part of their Subdiv. 3Ps and Div. 3L allocations not taken in the latter two areas (see e.g. p. 15, 1975 ICNAF Redbook). All capelin stocks in the Northwest Atlantic declined during the late-1970s but it appeared that the Div. 3NO capelin stock had declined at a faster rate (p. 37, 1979 ICNAF Redbook). In 1979, for the first time, advice was provided separately for capelin in Div. 3NO advising a closure of this fishery. This advice was followed and no fishery in Div. 3NO occurred during 1979-86 inclusive. During the 1986 meeting, STACFIS determined that this stock had recovered enough to permit a small fishery and advised that a 10,000 ton catch would probably not be detrimental to the stock and would represent approximately 5% of the average biomass observed since 1981. This precautionary TAC advice stayed in effect until the 1988 meeting when STACFIS advised that an exploitation rate be applied to the average biomass.

TACs since then have been advised based on 10% of the average biomass from acoustic surveys during the 1980s. A summary of the TACs and catches ('000 tons) since 1970 is given below.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Advised TAC	-	-	-	-	[1]	[1]	[1]	1	1	0	0
TAC	-	-	-	-	[1]	[1]	[1]	1	1	0	0
Catch	0	1	21	127	101	132	110	47	5	0	0

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Advised TAC	0	0	0	0	0	0	10	10	28	30	30
TAC	0	0	0	0	0	0	10	15	28	30	30
Catch	0	0	0	0	+	0	1	7	5	21	

[1] Part of TAC for Div. 3LNO and Subdiv. 3Ps.
[2] Provisional.

Stock Structure

Capelin spawn on the bottom at depths approximately 50-60 m on the Southeast Shoal (Div. 3N) during June and July. This spawning time is coincidental with spawning of capelin on beaches in Newfoundland and this observation has been the basis for stock discrimination studies.

Morphometric and meristic studies have separated this spawning group from inshore spawners. However, more recent genetic studies have not shown a difference between Southeast Shoal fish and those spawning inshore in Newfoundland. An alternate hypothesis is that capelin spawning on the Southeast Shoal do so in greater numbers when the abundance is high over the entire range in the Northwest Atlantic and therefore, this is not a separate spawning stock.

Juvenile and pre-spawning capelin from the Div. 3NO stock are believed to use the Grand Bank as a nursery area and as a result, mix with juveniles from the Div. 3L stock. It is clear from recent tagging studies that maturing capelin destined to spawn on inshore beaches occur in Div. 3O prior to spawning. As a result of these observations, it is probable that an offshore fishery in Div. 3L and 3O (and possibly 3N) could operate on mixed stocks of Div. 3L and Div. 3NO capelin.

Biomass estimates

Acoustic estimates of abundance of mature capelin measured on the spawning grounds are available since the 1970s. The 1972 estimate was derived from a Norwegian survey but the others were from USSR and Canadian surveys. Only two estimates in the 1980s exceeded 500,000 tons. In contrast, the 1972 Norwegian estimate (or range of estimates) is lower than most estimates during the 1980s and the three USSR estimates during 1975-77 are higher than other estimates. A summary of these estimates ('000 tons) is given below (top row is Norwegian/USSR and bottom row is Canadian).

1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
125-170			1050	687	1000	*	**	**	109	-	269	***	***	559	315	***	***
									223	419	219	88	212	495	230	560	28

* No mature capelin found by USSR and Canadian surveys.

** No mature capelin found by USSR; mature capelin found in Canadian survey but biomass estimates considered unreliable.

*** Biomass estimate for Div. 3NO could not be separated from total Div. 3LNO estimate.

Stock and recruitment

No stock-recruit relationship has been demonstrated for capelin in Div. 3NO. The time-series of estimates is short and the data exhibit considerable scatter.

A stock-recruit relationship has been shown for Barents Sea capelin using data from the 1970s. This relationship was used as a basis for defining a target spawning stock biomass and for several years, catch levels were based on conservation of this spawning stock biomass. However, during the latter part of the 1980s, this relationship has deteriorated. For example, in 1984 and 1985, recruitment failed completely even though spawning stocks of comparable abundance had produced much higher recruitment during 5 other years. In contrast, the strong 1988 year-class was produced from a small spawning stock. While the exact cause for the change in the stock recruit relationship has not been determined, one possible explanation is the increase in the herring stock in the Barents Sea in the 1980s which may be having negative effects on capelin recruitment. As a result of this observation, the relevant ICES Working Group recommended that the spawning biomass of capelin during 1991 should be higher than the previously established target, based on the likelihood of poor survival of the 1991 year-class of capelin.

In the Northwest Atlantic, the environment has been shown to be an important regulator of larval survival and subsequent recruitment in beach-spawning capelin. An analogous environmental effect has been hypothesized for Div. 3NO capelin and data from one year support this hypothesis. However, more years of study are needed to fully test the hypothesis.

Capelin as prey

Capelin is an important prey species for seabirds, marine mammals and many commercial species of fish, especially cod. Because feeding data for cod are more extensive than for other predators and because of the relevance of cod in a management context, STACFIS focused most of its discussion on cod feeding.

Capelin stocks are believed to mix in Div. 3L and 3NO and as a result, cod in both areas may be affected by capelin abundance and distribution.

Cod on the northern slopes of the Grand Banks feed on capelin in winter. Cod also feed on capelin in various parts of the Avalon Channel and the northern, western and central Grand Banks in spring and summer. Predation on capelin also occurs in autumn but there has been less study during that season. The spatial pattern of cod predation on capelin varies annually within the same season.

Predation by cod on capelin in Div. 3NO appears to occur primarily in spring and summer, although this may reflect a low level of study in autumn and winter. Prior to the decline of haddock on the Grand Bank, they were reported to have fed heavily on capelin spawn.

There is a lack of data on physiological parameters (e.g. digestion rate) of cod for the Northwest Atlantic and this taken with the lack of detailed feeding data especially for Div. 3NO prohibits the quantification of predator-prey interactions. STACFIS noted that this has been done in the Barents Sea and has been incorporated into scientific advice for capelin in this area. In spite of the inability to quantify these cod-capelin interactions, STACFIS concluded that capelin is an important prey for many species and this should be borne in mind when providing advice for catch levels for capelin.

Conclusions

The recommendation for a 10% exploitation rate was first advised by ICNAF in 1979. At that time, recruitment was poor and capelin stocks were low. STACREC concluded that during periods of poor recruitment, the exploitation rate should be low to protect the spawning stock. A conservative exploitation rate of 10% was used and applied to the capelin in Div. 3LNO with the recommendation that the TAC be applied to Div. 3L only and the fishery in Div. 3NO be closed.

This 10% exploitation rate has been maintained for the Div. 3L stock since 1979 and as noted above, was applied to the Div. 3NO stock in 1988. Recruitment in the capelin stocks has been higher during the 1980s but the advice for a 10% exploitation rate has been maintained based on other considerations. These other considerations have been the importance of capelin for cod, possible imprecise acoustic estimates and the fact that projections of mature biomass are dependent on the estimates of the age-specific proportion of mature capelin and age-specific mortalities, both of which probably exhibit annual variation. While these considerations are not cited each year, they have been the reasons for recommending a conservative exploitation rate of 10% for capelin.

STACFIS noted that the recommendation of a 10% exploitation rate was not based on an analytical analysis nor was one performed for this meeting. However, STACFIS continues to recommend *a conservative exploitation rate for capelin based on the reasons outlined above.* STACFIS was especially concerned about possible deleterious effects on predators that might occur due to a decline in capelin precipitated by overexploitation. The decline of capelin in the Barents Sea, and the negative effects on predator stocks due to this decline have been severe. The complex predator-prey interactions and several aspects of capelin biology including stock structure and factors affecting survival and recruitment are poorly understood in the Northwest Atlantic.

STACFIS noted that a modelling study has been initiated using the Div. 3L database. This model is a risk analysis and will examine the current methods of projecting Div. 3L biomass from acoustic surveys. Although the database for Div. 3NO capelin is not as extensive, the principles of management should be applicable to both stocks. The results of the study are expected to be available by the end of 1991 but some preliminary results might be available by the September 1991 Meeting.

Recommendations

STACFIS recommends that *research be conducted in the following areas:*

a) Research on stock structure and mixing should be continued.

b) More research should be directed towards predator-prey interactions with the aim of incorporating the results in the advice for capelin.

c) Studies on reproduction capacity estimation on different stocks of capelin should be initiated. This information would be useful in determining minimum spawning stock biomass.

The possibilities of alternate management strategies should be considered. Capelin are schooling fish and bottom spawners and they spawn in a predictable area on the Southeast Shoal.

The egg beds and spawning behaviour may be disrupted by commercial fishing and alternate management techniques such as closed fishing areas and/or closed fishing seasons, alone or in conjunction with quotas, may be effective conservation measures.

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The tenth meeting of the Subcommittee on Environmental Research was held on 11 June 1991 with M. Stein (EEC) as Chairman. Annex 1 contains the detailed report of the meeting.

2. Review of Environmental Studies in 1990

A total of 10 documents dealing specifically with environmental issues and another 5 papers which used environmental data for analysis were reviewed. Thus, only 15 documents referred to environmental conditions in Subareas 0-6 during 1990.

Colder than normal surface temperatures were in evidence in more northerly regions of the NAFO Subareas. In the southerly regions, Subareas 4 to 6, significant warm surface temperature anomalies appeared in mid-summer and lasted for a few months. A warmer anomaly was present throughout most of the year in the offshore parts of Subarea 6.

STACFIS noted the absence of USA observers and reiterated the recommendation that, as in previous years, reports on the variation in the shelf water front position between Georges Bank and Cape Hatteras and on anticyclonic warm-core Gulf Stream rings should be submitted by USA observers.

3. Overview of Environmental Conditions (SCR Doc. 91/87)

A review paper was presented based on several long-term oceanographic and meteorological data sets, as well as summarized results from available research documents. This paper was the ninth in a series of annual overviews that began in 1982. Negative mean annual air temperature anomalies were found in all NAFO Subareas, except the Scotian Shelf and southwards. Generally, there was a trend of increasing negative anomaly to the northeastern part of the NAFO area. Sea-surface pressure anomalies showed an intensification of the Iceland low, especially in winter, which resulted in strong northerly winds over the Labrador Sea, along the Labrador coast and across Newfoundland.

4. Report on the Second World Climate Conference in Geneva, 29 October to 7 November 1990 (SCR Doc. 91/89)

In a summary presentation, the Environmental Subcommittee was informed on interactions between ocean and atmosphere concerning the Greenhouse gas problem, and on possible impacts on the fishery and mariculture.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Report on Methods of Ageing Silver Hake Otoliths

STACFIS was pleased to note that ageing discrepancies between Canadian and USSR age readers has been minimized to a point where Canadian and USSR age length keys can be combined in future assessments. STACFIS recognized that a Canada-USSR experiment to validate age readings using radio-nucleotides is ongoing and encourages its completion. STACFIS also noted the lack of a composite document on ageing methods as recommended last year. Although these techniques are documented in various publications, it is still desirable to create one summary document which incorporates new information from recent exchanges and other investigations. STACFIS recommends that *upon completion of the radio-nucleotide studies, one*

comprehensive document on silver hake ageing methods be prepared by Canadian and USSR authors.

2. Reports on the Otoliths Exchanges

a) American Plaice (Div. 3LM) (SCR Doc. 91/68)

STACFIS noted that there was no progress in 1991 in the exchange of otoliths of American plaice from Div. 3LM. It was apparent that difficulties still remain for some readers in the interpretation of ages for this species. A study proposed a method to help in the age determination of this species in Div. 3M. This method focused on a new way of preparing and polishing the otoliths, as it was thought that the degree of polishing may have an effect on the interpretation of the age. It was also stated that an otolith validation study, which is not currently available for American plaice in Div. 3M, may be useful in improving age determinations for this area.

b) Greenland Halibut

At the June 1990 NAFO meeting, STACFIS recommended that an exchange of Greenland halibut otoliths and scales, accompanied by photograph showing criteria used in the interpretation of rings be conducted. This inter-reader program involved Canada, USSR, Greenland, EEC (ex-GDR), EEC-Portugal and EEC-Spain.

This age reading exchange has been delayed.

c) Age-reading Workshop

It is proposed to hold an age-reading workshop in St. John's, Newfoundland in early December 1991. Experts from all Contracting Parties should be invited.

The workshop will consider ageing of American plaice and Greenland halibut. B. Brodie (Canada) and P. Ernst (EEC) have offered to serve as co-conveners.

VI. GEAR AND SELECTIVITY STUDIES

1. Effect of Tow Duration on Gear Selectivity (SCR Doc. 91/84)

The results of the experiment to study the effect of tow duration (5, 15 and 30 minutes) on gear selectivity was discussed in terms of catch-per-unit-effort and length composition. There were no significant differences in CPUE, expressed as catch-per-minute, in comparison of 15 and 30 minute tows. Average length of each species did not change with reduction in tow duration from 30 minutes to 15 minutes.

Using 15 minute tows could result in less subsampling, gear wear and damage. The number of trawl stations could be increased possibly leading to an increase in precision of survey estimates. In the case where sampling is being done in the outer fringes of the boundary distribution of a species longer tows would still be recommended to gather sufficient data for estimations of biological parameters. However, in areas of known concentrations of a species 15 minute tows may provide sufficient information.

VII. REVIEW OF SCIENTIFIC PAPERS

STACFIS reviewed 9 research documents not reviewed elsewhere. The reviews are given below.

1. Length-weight Relationships of Roundnose Grenadiers (*Coryphaenoides rupestris* Gunn.) in Different Areas of the Northwest Atlantic (SCR Doc. 91/59)

Length-weight relationships for roundnose grenadiers from off West Greenland and Baffin Island (SA 0+1), off northern Labrador (Div. 2G) and off Northeast Newfoundland (Div. 3K) were derived based on research data collected between 1968 and 1980. Comparisons by area and sex indicated some variability, possibly caused, at least in part, by varying habitat conditions. Relationships derived from this study for grenadiers in Subarea 2 and Div. 3K were very similar to relationships derived in other studies based on collections from the same area. Comparisons of results from different studies using fish from SA 0+1 showed considerable variation in results perhaps due to greater variability in condition factor of the fish at different time periods. It was concluded that it may not be appropriate to utilize growth rate differences as indicators of different stocks without first considering fish condition at the time of sampling.

2. Shrimp at Flemish Cap (Division 3M) (SCR Doc. 91/28, 29)

A groundfish research survey was conducted by the EEC on Flemish Cap during July-August 1990, the third in a series started in 1988. Catches of shrimp retained in the 35 mm codend were low throughout the area, averaging only 2.74 kg per tow. The biomass estimate of 2,140 tons, was similar to those obtained in the previous two years (2,164 tons in 1988 and 1,865 tons in 1989). Length distributions contained several modal size groups, presumed to represent year-classes, and differences in sex and maturity stages within the modal structure were observed between years. A fecundity/length relationship was also calculated.

It was noted that the surveys were directed for groundfish and, as such, the trawl was not ideally suited to estimate shrimp abundance.

3. Contribution to the Assessment of the Cod Stock in Subdivision 3Ps (SCR Doc. 91/23)

Data were presented on nominal catches, biological parameters and survey data. Nominal catches from 1959 to 1989 ranged from a high of 84,000 tons in 1961 to a low of 27,000 tons in 1978.

Since 1977 landings have been only by Canada and France and since 1987 to 1990 the Canadian catches have been quite stable while the French catches have decreased. Sampling data including average length and weights-at-age were presented. Catches by the French fleet in 1989 were mainly from ages 4 and 5. The results from French stratified-random surveys conducted each year since 1977 indicated, for the reference area which does not include all strata of the Laurentian Channel, a decrease in cod biomass and abundance since the mid-1980s and a decrease in the mean size of cod in the stock.

4. Yearly Distribution of American plaice (*Hippoglossoides platessoides*) in Late Winter in Subdivision 3Ps for the Period 1978-90 (SCR Doc. 91/26)

The yearly distribution of American plaice in late winter in Subdivision 3Ps for the period 1978-90 was analyzed. Data used were biomass estimates (per 30 minutes) obtained during the French groundfish surveys which have been conducted annually in late winter (February-March), and water temperatures from surface to bottom were recorded at the end of each trawling operation by means of XBT casts.

Largest temperature fluctuations occurring in the two upper depth ranges (0-99, 100-199 m) were due to the great influence of the Labrador Current. Generally, American plaice was well represented in Halibut Channel. During cold winters (1982, 1985-87, 1989, 1990), highest concentrations were observed on the Southwest slope of Saint Pierre Bank, and this could be related to the movement of cold Labrador current.

5. Feeding Behaviour of the American Plaice (*Hippoqloissoides platessoides*) on the Southern Grand Bank of Newfoundland (SCR Doc. 91/30)

This study found that the diet of American plaice from the Southern Grand Bank, at sizes between 40 and 55 cm, was mainly *Ammodytes dubius* and brittle stars, with *Mallotus villosus* being third in importance.

The daily feeding intensity varied in relation with the kind of prey. *A. dubius* was consumed in larger amounts during later periods of the day (18-24 hours), *M. villosus* was preyed upon more between 12 and 18 hours and on Brittle stars there was no definite feeding pattern.

The annual feeding cycle showed the greatest activity in April, with a summer period of relatively high values, followed by autumn and winter periods of low feeding intensity.

American plaice showed variability in feeding behaviour, permitting them to consume prey when they are most accessible. This variable accessibility may be the possible cause of the observed daily and annual feeding cycle.

6. The Feeding of Cod (*Gadus morhua*) on Flemish Cap in 1989-90 (SCR Doc. 91/31)

A feeding study on Flemish Cap cod done with 1989 and 1990 data confirmed the strong year-to-year change in cannibalism rate, which was observed to have been higher in 1990 in comparison with previously reported values. Redfish remained the most important prey for adult cod whereas amphipods were most important for juveniles. A significant relationship was found between cod length and length of redfish preyed upon.

7. Feeding Habits of Mesopelagic Species of Fish and Quantitative Estimation of Plankton Grazed in the Northwest Atlantic (SCR Doc. 91/3)

The investigation was based on the midwater trawl samples collected in the Northwest Atlantic off the Canadian 200-mile zone on board of R/V "Akademik Knipovich" at the depths of 60-400 m in July-October 1983. A total of 344 stomachs of 11 species were examined. The food of myctophods was mainly copepods, euphausiids and hyperids. The most favourable feeding conditions were assumed to be in the North Atlantic water masses and this was supported by high values of the feeding index and a narrow spectrum of food items in the stomachs of myctophids. The daily ration uptake was estimated to be 0.3-1.5% of the body weight and the grazing rate varied from 0.1 to 30.1% of estimated biomass.

8. Determination of the Growth Curve Parameters of the American plaice (*Hippoglossoides platessoides*) in the NAFO Subdivision 3Ps (SCR Doc. 91/27)

The age length keys constructed from an otolith sample (235 males, 305 females) taken during a research survey in the late winter of 1990 were presented.

The parameters of the Von Bertalanffy growth equation were determined using the arithmetic mean of the observed length as the central value for each age and by the classic least square method of fitting.

In general, the otoliths were rated as being hard or very hard to read as opacity and double rings were common. Taking only the clear otoliths (90% confidence or more) the histograms of the length-at-age were widely spread, as if different growth rates could be related to the areas where samples were collected. These same results have been noted in samples from the Canadian surveys and commercial fishery.

As commonly observed in flatfishes, males and females had different growth rates. From comparisons with different values of the growth parameters estimated by different authors, the 1990 values were closer to those of 1978, which were calculated from age readings done by the same person.

9. Reproduction and Formation of Silver Hake Year-class Strengths at Early Ontogenesis on Scotian Shelf (SCR Doc. 91/19)

Various stages of the silver hake life cycle in relation to its reproduction and year-class formation at early ontogenesis were studied, including features of year-to-year variability in the silver hake maturation and spawning on the Scotian Shelf in 1977-89. Relationships between spatial and temporal distributions of eggs and larvae relative to the various environmental factors were found. Significant correlations were obtained between the mean weights of the silver hake larvae and the mean densities of their main prey concentrations. There was some evidence that year-class strength development continues during the next winter after 0-group stage.

VIII. OTHER MATTERS

1. Review of Arrangements of Stock Assessments

STACFIS deferred this item for consideration at the September 1991 Meeting.

2. Symposium in 1991

A progress report on contributions for the 4-6 September 1991 symposium on "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes" were presented to STACFIS by the convenor, H. Hovgård (Denmark-Greenland). The deadline for potential contributions has been extended to 30 June. At present, 20 submissions have been announced and the meeting arrangements are well underway.

3. Co-conveners Report for the 1992 Special Session

The September 1992 Special Session titled "State-of-the-Art in Fish Stock Assessment: a Tutorial/Workshop on Calibration Methods and Their Practical Use" was discussed. The co-conveners are R. K. Mohn (Canada) and R. Cook (EEC-UK). The format and content of the workshop have yet to be finalized to date as the conveners consider that there should be active input to this from all potential participants. For example, North American scientists may be interested in learning more about techniques used in Europe (e.g. ICES) while European scientists may be interested in methods employed in Canada (e.g. CAFSAC). A number of possibilities were discussed, as were options for the length of the session. It was decided that the computer system should be MS-DOS although other systems may be available.

In order to assist the conveners in their preparations, it was decided to circulate a "pre-registration" form for completion by participants prior to departure on June 19. The completed forms, containing information regarding the potential number of participants, their areas of interest, the availability of computers and the possibility of Contracting Parties providing tutors, will be collated by the conveners during the summer, and a more detailed outline of the format and content of the Session will be presented at the September 1991 meeting.

In order to improve the possibility of success, STACFIS agreed it would be necessary to place an upper limit on the number of participants. Since it could not be determined how many participants there may be, further discussion of this was deferred to September.

STACFIS considered a request by ICES that this Special Session be co-sponsored by NAFO and ICES. Although it was agreed that the idea had considerable merit in principle, it was felt that since this will be NAFO's first venture into this area, it would be better to proceed slowly and on a small scale. If this session is successful, then the possibility of jointly sponsored tutorials/workshops could be pursued in the future. It was noted that one of the co-convenors is from EEC and is an active participant in ICES as are many of the participants from the Contracting Parties. As such, ICES will be well represented at the Session.

4. Theme for Special Session in 1993

STACFIS deferred this item for discussion at the September 1991 Meeting.

5. Adjournment

There being no further items on the agenda, the Chairman thanked the participants for their contributions, in particular those who were Designated Experts. A special note of gratitude was extended to the Executive Secretary, Assistant Executive Secretary and all of the Secretariat staff for their dedicated hard work during the meeting. The meeting was then adjourned.

ANNEX 1

REPORT OF THE SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH

Chairman: M. Stein

Rapporteur: F. Koester

The Subcommittee met at the NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada, on 11 June, 1991, to consider environmental-related topics and report on various matters referred to it by STACFIS. Scientists attended from Canada, Denmark (Faroe Islands/Greenland), EEC, Iceland, Japan, and USSR.

The Subcommittee reviewed the following documents: SCR Doc. 91/1, 4, 8, 10, 11, 17, 24, 35, 36, 79, 85, 86, 87, 89, 91, 92, 94 and 90/92; SCS Doc. 91/5, 6 and 8.

1. Chairman's Report

The Chairman began the meeting by noting the absence of observers from the USA, although the Research Report for 1990 was available and two papers dealing with environmental studies had been announced. These papers arrived at the Secretariat in the afternoon on 11 June 1991 by telefax. Information derived from these papers is given below.

2. Marine Environmental Data Service (MEDS) Report for 1990 (SCR Doc. 91/85)

MEDS is in progress of rebuilding their data handling system. This has not affected their real-time data acquisition. A substantial amount of the recent data sent to MEDS has not yet been processed, but is currently being worked on.

a) Data Collected in 1989

Data from 3,610 oceanographic stations collected in the NAFO area were sent directly to MEDS in 1990. Additionally data from a same number of stations were received through IGOSS (Integrated Global Ocean Service System).

The number of stations received by MEDS approximately doubled compared to the last year.

The number of stations which had been occupied but whose data have not been sent to MEDS is about the same number as reported last year, i.e. approximately 2,200.

b) Historical Data Holdings

Data from 3,160 historical hydrographic stations were received by MEDS in 1990, although the software systems to process these data were still not complete.

c) Drift-buoy Data

A total of 86 drift-buoy tracks were received by MEDS during 1990 representing 153 buoy months. This was the same number of buoy tracks followed, but was an increase of 7% in buoy months compared to last year. This trend is expected to continue with the commencement of the surface velocity program within World Ocean Circulation Experiment (WOCE).

d) Current-meter Data

Current-meter data collected in 1990 had been reduced by a factor of ten from 1989 to 1990 which is expected to be the normal state of affairs after the high activity in 1989. The data in 1990 included 9 sites, 23 instruments and a total of 1,322 meter days.

e) Wave Data

The number of wave spectra collected, significantly increased from 1989 to 1990. This was mainly due to an increased reporting rate of the buoys deployed by the US reporting wave spectra every hour.

f) Environmental Conditions

A review of monthly sea-surface temperature anomalies in 1990 for each of the NAFO Subareas was presented. The review was based on monthly reports of the Bedford Institute of Oceanography and National Oceanic and Atmospheric Adminstration (NOAA).

Colder than normal surface temperatures were in evidence in the more northerly NAFO Subareas. In the southerly regions, Subareas 4 to 6, significant warm surface temperature anomalies appeared in mid-summer and lasted for a few months. A warmer anomaly was present throughout most of the year in the offshore parts of Subarea 6.

3. Review of Environmental Studies in 1990

a) Subareas 0 and 1 (SCR Doc. 91/17, 35, 36, 79, 94; SCS Doc. 91/6)

Data from three neighbouring NAFO standard sections off southwest Greenland (Cape Farewell, Cape Desolation and Frederikshaab sections) showed remarkable differences in temperature and salinity anomalies during the 1980s (SCR Doc. 91/94). The influences of water front movements on the interpretation of CTD data from standard stations covered in regular yearly intervals were discussed. Due to the extreme environmental conditions, i.e. high current velocities and ice coverage, mooring of instruments seems to be rather difficult. Alternative strategies of interpreting whole sections, i.e. integrating available data were discussed. However, the trend in temperature and salinity values integrated over the upper 200 m of station 4 on the Fyllas Bank section seems to be consistent with other information available during the 1980s.

The use of an expert system (AUTOKLAS) for analyzing hydrographic data was proposed (SCR Doc. 91/79). Temperature data available from Fyllas Bank for the period 1964-90 was used as an example, although the system is able to include all other available information, such as meteorological and biological data sets. An international coordinated project on the use of expert systems in hydrographic research related to fisheries was proposed by the authors. The predictive strength of the method was discussed, but was not evaluated by the Subcommittee.

Greenhouse induced changes in the Northwest Atlantic and their potential impact on West Greenland cod stocks were discussed (SCR Doc. 91/17). The predicted warming of the surface layer on Fyllas Bank and related year-class strength derived from a linear relationship of ln transformed year-class strength (age 3) and surface layer temperature during the period 1953-79, resulted in unrealistic sizes of cod year classes for the period 1980-2050. In the discussion it was pointed out, that high year-class strengths of cod off West Greenland can be related to relatively high surface layer temperatures, however, below average year-classes have been observed during periods of both high and low surface layer temperatures. It was also noted that other factors, not incorporated in the model, can influence the success of recruitment. Due to this complex situation and with the data base available, a reliable prediction of stock development during a period of warming seems not to be possible at present.

The distribution of larvae and 0-group fish west off Greenland in summer and autumn 1989 and 1990 was described (SCR Doc. 91/35). In both years, larvae and 0-group cod as well as redfish larvae were nearly absent in the samples taken with a Multiple Opening Closing Net (MOCNESS) and an Isaac Kidd Midwater Trawl. 0-group redfish, caught in autumn off southwest Greenland, were most abundant close to the coast in water temperatures below 3°C indicating a drift from East Greenland. In the northern region high densities were observed predominantly at the outermost stations, reflecting the drift to the nursery areas in the Davis Strait.

Changes in structure of the fish community inhabiting the continental slope off West Greenland presented (SCR Doc. 90/36) coincide with variations in the hydrographic regime.

Termination of a three year current-meter mooring program in the Davis Strait was reported in the Canadian Research Report (SCS Doc. 91/6).

b) Subareas 2 and 3 (SCR Doc. 91/1, 4, 8, 10, 11, 24, 86, 92; SCS Doc. 91/5, 6)

SCR Doc. 91/11 summarized observations on water temperature and salinity in NAFO Subareas 0,1,2 and 3 from surveys conducted by the USSR in 1990 and compared the data with meteorological observations made by National Hydrometeorlogical Centres. Due to deep cyclonic depressions over Iceland during the winter of 1989-90 and resulting strong north winds over the Northwest Atlantic, the monthly mean air temperature showed high negative anomalies. These anomalies resulted in strong water cooling and intense ice formation in the Davis Strait and Labrador Sea. In autumn 1990 the near surface temperature in Subarea 0, was on average, 1.3°C lower than in 1989. The Labrador current water in the Hamilton Bank area was 0.3-0.6°C below the norm throughout the whole water column. In spring, the mean near bottom temperature was 1.6°C and 0.7°C below the norm in Div. 3NO and Div. 3KL respectively. Only at the end of 1990, compared to 1989 a slightly higher near bottom temperature was observed in Div. 3NO and deep waters of Div. 3K. The Subcommittee agreed that the presented document contained very valuable information and encouraged a summarizing publication of the available data on the hydrographic situation in the Northwest Atlantic during the 1980s.

A review of hydrographic conditions in Subarea 2, 3 and 4 in 1990 was presented on the basis of sea surface temperatures issued by the USSR Hydrometeorlogical Centres as well as the sea surface boundary location for the shelf and slope waters and mean temperatures measured in different depths on the Scotian Shelf (SCR Doc. 91/4). At least in the first half of the year, sea surface temperatures showed negative anomalies for all Subareas relative to the mean for the last five years. During spring, the strong influence of the Labrador Current resulted in a southward displacement of cold surface waters which in turn caused the negative anomalies observed on the Scotian Shelf.

From temperature measurements carried out on a standard section in Subdiv. 3Ps covering the northwestern slope of Saint-Pierre Bank to the north of Green Bank in February/March 1978-90, it was concluded, that since 1985 all winters, except 1988, can be classified as colder than normal. Largest temperature fluctuations occurred in the 100-200 m depth range which was strongly influenced by the Labrador current (SCR Doc. 91/24).

In SCR Doc. 90/92 the distribution of cod on the Flemish Cap in July 1989 was found not to be influenced by the temperature and salinity regime. This can be explained by the narrow range of temperature and salinity observed in the survey area..

Temperature and salinity variability on a decadal time scale on the Scotian Shelf and in the Gulf of Maine was described in SCR Doc. 91/86.

In the *Emerald Basin a large* component of the subsurface temperature variability occurred over very long time periods, up to 20 years, and had vertical scales comparable to the basin depth. Analysis of temperature frequency revealed, that higher variability plays a greater role at the surface than at depths, where longer period changes dominate. Similar long period variability was evident from sea surface temperature measurements carried out at different sites of the Scotian Shelf and the Gulf of Maine. These results indicated a broad scale, coherent ocean climate fluctuation in spite of differences in water mass characteristics. The variations appeared to be stronger in those water masses originated over the slopes.

Extensive hydrographic work was reported throughout the area including the occupation of the standard transects. Between south Greenland (Cape Desolation) and Labrador (Wolf Island) 24 standard CTD stations within the WOCE have been covered. Concerning the sea ice environment, the Labrador Ice Margin Experiment Program (LIMEX) was continued. The Canadian Research Report (SCS Doc. 91/6) noted further, that the current meter mooring program on Hamilton Bank was also continued in 1990.

As a part of the Northern Cod Science Program (NCSP) a major oceanographic program was launched, whereby current meter/thermistor chain moorings were deployed on the northeastern Newfoundland shelf and comprehensive CTD/current mapping was carried out (SCS Doc. 91/6).

c) Subareas 4, 5 and 6 (SCR Doc. 91/91, 92; SCS Doc. 91/6, 8)

According to the Canadian Research Report (SCS Doc. 91/6) several projects concerning the relationship between hydrographic features and fish distribution continued in Subarea 4. For example, further information about the Georges Bank Frontal Study, which entered the data analysis and synthesis phase, was presented.

An extensive number of temperature profiles were collected during groundfish cruises in the Gulf of St. Lawrence (SCS Doc. 91/6).

Information about the continuation of hydrographic measurements in Subarea 5 and 6 in connection with a study on the recovery of the herring stock on Georges Bank was available from the USA Research Report (SCS Doc. 91/8). Two additional studies were conducted to examine the spatial and temporal variability in water column stratification over southern Georges Bank.

Further ongoing activities mentioned in the USA Research Report (SCS Doc. 91/8) were a continuation of hydrographic measurements during the spring and autumn bottom trawl research surveys within four regions between Nova Scotia and Cape Hatteras.

A monthly monitoring of surface and water column temperature, and surface salinity across the Gulf of Maine and the Middle Atlantic Bight has been conducted for 14 and 15 years respectively (SCR Doc. 91/91). In both areas, sea surface temperatures in 1990 were generally cooler than the 10-year (1978-87) means at the beginning of the year, and warmer than average from late summer to the end of the year. Surface salinities in the Gulf of Maine were generally above average and, in the Middle Atlantic Bight, were near average for the year.

Phytoplankton abundances were significantly above the 1961-87 average during much of 1990 over Massachusetts Bay and Wilkinson Basin, and on the Scotian Shelf from June through August (SCR Doc. 91/92). The Subcommittee recommended that, *as in previous years, reports on the variation in the shelf water front position between Georges Bank and Cape Hatteras and on anticyclonic warm-core Gulf Stream rings should be submitted by USA observers.*

4. Overview of Environmental Conditions in 1990 (SCR Doc. 91/87)

A review paper was presented based on several long-term oceanographic and meteorological data sets as well as summarized results from available research documents. Highlights not covered in Section 2 are listed below.

a) Annual coastal sea temperatures at Halifax and St. Andrews were below, and at Boothbay Harbor above, their 1951-80 means.

b) Offshore surface temperature data showed negative anomalies in all NAFO areas in the beginning of the year, but throughout the year negative anomalies were found only in the Labrador Sea, the offshore branch of the Labrador Current, Flemish Cap, the outer

edge of the Scotian Shelf and the western Slope water. Near normal sea surface temperatures were found south of Newfoundland and in the Gulf of St. Lawrence.

c) Near-bottom temperatures at Station 27 off St. John's, Newfoundland, were colder than normal for the last eight years.

d) The number of icebergs crossing 48° was three times higher than during the last four iceberg seasons.

e) In most areas of the Gulf of St. Lawrence and in the offshore waters off Newfoundland, ice remained longer than normal.

f) Negative mean annual air temperature anomalies were found in all NAFO Subareas, except the Scotian Shelf and southwards. Generally, there was a trend of increasing negative anomaly to the northeastern part of the NAFO area.

g) Sea-surface pressure anomalies showed an intensification of the Icelandic low, especially in winter, which resulted in strong northerly winds over the Labrador Sea, along the Labrador coast and across Newfoundland.

Some members of the Subcommittee pointed out, that more precise maps of weather conditions including upper atmospheric level charts may contribute to a better understanding of the meteorological situation in the NAFO area.

5. National Representatives

Changes in the national representatives responsible for submitting oceanographic data to MEDS were reported as follows:

F. Nast replaces Ch. Brockmann (Federal Republic of Germany) and W. Thiele (former German Democratic Republic). The representatives from the other countries remained unchanged: R. Keeley (Canada), R. Dominguez (Cuba), E. Buch (Denmark), Francois (France), Y. Uozumi (Japan), R. Leinebo (Norway), A.J. Paciorkowski (Poland), G. Withee (USA), G.I. Luka (USSR) and a representative from BODC has replaced P. Edwards upon his recent retirement (United Kingdom).

The Chairman requested the representative from France to either validate the given name for the French national representative or submit an alternate to the Secretariat as early as possible.

6. Report on the Second World Climate Conference in Geneva, 29 October to 7 November 1990 (SCR Doc. 91/89)

In a summary presentation, the Chairman reported on major scientific results presented during the Second World Climate Conference, held in Geneva, 29 October-7 November 1990. The Environmental Subcommittee was informed on interactions between the ocean and atmosphere concerning the Greenhouse gas problem, and on possible impacts on the fishery and mariculture. Transcriptions of the transparencies were collated in SCR Doc. 91/89.

A summarizing video presentation dealing with the Second World Climate Conference was made by the Chairman on 12 June, and the video was presented to the Secretariat library.

7. Acknowledgements

The Chairman closed the meeting by thanking the participants for their contributions and cooperations.

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

Chairman: W. B. Brodie Rapporteur: E. F. Murphy

The Committee met at NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada on June 12 and 14, 1991. Representatives from Canada, Denmark (Faroe Island/Greenland), EEC, Iceland, Japan and USSR were present.

1. Fisheries Statistics

a) Progress Report on Secretariat Activities 1990/91

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

STACREC once again expressed concerns about the delays in submission of STATLANT 21A and 21B reports. To date the STATLANT 21B reports for 1989, due June 30 1990, were still outstanding from seven (7) countries. The deadline for submission for STATLANT 21B reports for 1990 is June 30 1991 and to date only five countries had reported.

ii) Publication of statistical information

In February 1991 NAFO Statistical Bulletin (Vol 38) was finally published, after a delay of eighteen (18) months, caused solely by the late submission of the 1988 STATLANT 21B reports which were due in June 1989. The preparation of the 1990 provisional report for use in the assessments at the June 1990 meeting was pending the reception of STATLANT 21A reports from EEC-France (M) and France (SP). The Committee decided to release the report with a note indicating the French data were missing and an addendum would be issued to the SCS Document when the data become available.

iii) Updating of fishery statistics database

STACREC was informed by the Assistant Executive Secretary that the updating of the catch and effort database had been completed back to 1960. As noted in last year's report, extending this exercise back further in time would not yield any useable data. These data are available to Contracting Parties on diskettes. It was noted that for the period 1983-85 for EEC-France(M) and France(SP), only aggregated catches have been received. STACREC agreed that a 30-year time series summary report be prepared but could not proceed without the disaggregated French data. When these data become available, a section on the 30 year time series will be appended to the Statistical Bulletin.

The representative from EEC-Portugal informed STACREC that data were not available to convert reported Portuguese fishing effort from days to hours previous to 1989 but effort data since then were being reported in hours. However, the gillnet effort was being reported in 50 m rather than the standard 100 m lengths. This means that Portuguese gillnet effort data has to be divided by 2 to standardize the units.

It was brought to STACREC's attention that there was some concern that catches of grenadier were not broken out by species. It was felt that reporting countries should be advised to report such catches by species.

In 1990 it was noted that a previous check of NAFO data from EEC member states had been made against the EEC(EUROSTAT) and FAO databases to identify and eliminate any discrepancies. It was felt that in light of recent conversions and updates to the NAFO database, this exercise on the whole NAFO database would be worth repeating. The initial work on identifying the discrepancies was to be done by EUROSTAT. To date the Secretariat had not had any communication from EUROSTAT identifying any database problems.

STACREC recommended that *EEC-Germany be requested to continue reporting the catches of the former GDR and FRG fleets as separate components, as this will maintain a valuable time series of catch and effort data used in many stock assessments.*

b) Review of Reporting Requirements for Submission of STATLANT 21A and 21B Statistics

The continued delays in reporting of STATLANT 21A and 21B statistics led to a lengthy discussion on the problems associated with this practice. One of the major problems is that without STATLANT 21B statistics, many of the assessments cannot be completed until similar data in a provisional form are provided in the national research reports. Even though the deadline for STATLANT 21B reports is June 30, in many cases these data are not made available until much later. It was felt that changes in reporting deadlines would not have any effect on having the data reported for the annual June Scientific Council Meeting. Representatives felt that the current *ad hoc* process of Designated Experts contacting scientists from Contracting Parties to obtain appropriate portions of the national research report was probably the only way of receiving the needed data before the June meeting. In addition, there are other

facets of NAFO business which require timely provision of catch data. STACREC recommended that *Scientific Council take action to ensure that Contracting Parties impress upon their statistical offices the importance of timely submission of STATLANT 21A and 21B forms.*

A request from FAO in 1990 that NAFO Scientific Council look into the possibility of keeping separate statistics for the Regulatory Area generated much discussion. It was felt that the means of providing a separate breakdown could already exist in the databases of some Coastal States. Much of the Canadian logbook and Observer data has this information, and in recent years many other countries have been restricted to the Regulatory Area. For some areas, the distinction maybe difficult because of disputed boundaries, however where defined boundaries exist there should be no problem.

In general, STACREC saw no problem in adopting this measure. To implement the reporting catches and effort inside and outside the Regulatory Area, STACREC stated that the statistics offices of all components for each reporting party should be contacted and requested to provide this information where possible under a separate cover with STATLANT 21B statistics due to be submitted by June 30 1992. STACREC felt this time frame would permit the statistics offices to implement procedures to collect these data and report them on revised STATLANT 21B forms to be provided for June 1993. STACREC recommended that *the issue of statistics from inside and outside the national EEZ's be raised at the upcoming CWP Meeting.* It was agreed that this should be only the first step in a process that should lead to NAFO statistics being collected on a finer geographic scale. It was felt that the problem of obtaining statistics for management of some stocks on a finer scale was becoming more and more of an issue.

c) Fifteenth Session of CWP, July 1992

The Assistant Executive Secretary informed STACREC that CWP had accepted the Scientific Council's invitation to hold the Fifteenth Session of CWP at NAFO Headquarters in Dartmouth, Nova Scotia, Canada from the 8 to 14 July,1992. In the past NAFO was represented at CWP by the Assistant Executive Secretary, the chairman of STACREC and a representative of a Contracting Party. STACREC saw no reason why more than one Contracting Party could not attend. Representatives were asked to express any interest in attending CWP. Only the USSR expressed interest at this time and STACREC therefore recommended that *a USSR delegate attend the CWP meeting in 1992.* As recommended at the June 1990 Meeting, the Assistant Executive Secretary is scheduled to attend the planning meeting in France proposed for 25-26 September 1991, to finalize the agenda and arrangements.

2. Biological Sampling

a) Progress Report on Activities in 1990/91

The Provisional List of Biological Sampling Data for 1989 was tabled (SCS Doc. 91/10). It was noted that Canada (G) and Canada (Q) had not provided sampling data for 1989. Representatives were encouraged to check this list and provide any changes or omissions for compilation of the final version of the 1985-89 list which is now due for publication.

b) Forms and Deadlines for Submission of Data

No changes to either the forms or deadlines for submitting biological data were suggested. STACREC discussed at length the importance of having catch and effort data, and any associated biological data from non-member countries fishing in the Regulatory Area. STACREC concluded that requests for catch and effort data from non-member countries which are being pursued through the appropriate channels, should also include requests for the submission of biological data. STACREC recommended that *Scientific Council raise issue that data requested from non-member countries should include biological data, so that the necessary action can be taken.*

The issue of whether Contracting Parties were to submit lists of sampling data or the actual data was raised. As the data are rarely used, STACREC agreed to review the requirements for submission of sampling data at its next meeting, in September, 1991.

3. Biological Surveys

a) Review of Survey Activities in 1990 (Table 1)

The Inventory of Biological Surveys conducted in 1990 was presented by the Secretariat. STACREC noted the preliminary listing had several omissions and representatives were requested to provide the information to facilitate printing of the revised list for the report of this meeting.

In 1990 it was suggested that the Inventory of Surveys should reflect the time series of annual surveys as well as the list of surveys applying to each stock reviewed by STACFIS. This led to the compiling of SCS Doc.90/22. STACREC discussed how this list was to be maintained. It was concluded that the best approach was to have the Designated Experts update this information annually and to have these series reviewed by STACFIS with the report for each stock assessment. These tables would then be used to prepare an updated SCS Document similar to SCS Doc. 90/22.

b) Surveys Plans for 1991 and Early 1992 (Table 2)

The inventory of surveys planned for 1991 and early 1992 was prepared by the Secretariat. STACREC noted that the preliminary list had omissions and representatives were requested to provide the information to facilitate printing of the revised list for the report of this meeting.

c) Review of Stratification Schemes

Nothing reported.

d) Coordination of Surveys in 1991-92

Nothing reported.

4. Other Matters

a) List of Fishing Vessels

This list was due to be published in 1990 but was being delayed by outstanding lists from 4 countries (Denmark-M, EEC-France (M), Poland and EEC-Spain). STACREC recommended that *representatives check with appropriate sources and have outstanding data forwarded to the Secretariat so that the list of fishing vessels can be published as soon as possible.*

b) Tagging Activities Reported for 1990

A review of tagging was presented by the Assistant Executive Secretary (SCS Doc 91/7) reporting the tagging activities by three countries (or components). STACREC agreed that any outstanding information should be made available to the Secretariat, so that a revised list can be produced if necessary.

c) Review of Relevant SCR and SCS Documents not Considered Above

No documents were reviewed.

5. Acknowledgements

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

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1990.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
			STRATIFIED-RANDOM SURVEYS		
0	B	SUN/FRG	10-11	G. halibut, grenadier temperature, *salinity*	66
0,1	B,ABCDE	GRL	7,8	Shrimp, bottom trawl, hydrography	273
1	A	GRL	9	Shrimp, bottom trawl	55
	A-D	JPN	8-9	Bottom trawl survey on G. halibut in 400-1500 m	88
	BCD	JPN	6	Bottom trawl survey on G. halibut in 400-1500 m	75
		SUN/FRG	10	G. halibut, grenadier, temperature, salnity	50
2	GHJ	SUN/FRG	10-11	Capelin, temperature, salinity	14
	J	CAN-N	11	Groundfish	83
2+3	HJK	CAN-N	7	Shrimp	126
	JK	CAN-N	11-12	Groundfish	146
3	K	CAN-N	12	Groundfish	117
	KLNO	SUN	4-6	Groundfish, temperature, salinity	393
	L	CAN-N	5-6	Groundfish	164
		CAN-N	8	Redfish	148
		CAN-N	10-11	Groundfish	201
	LNO	CAN-N	1	Redfish	85
		CAN-N	8-9	Juvenile flatfish	122
	LO	CAN-N	9	Juvenile flatfish	108
	M	SUN	6-7	Groundfish, temperature salinity	119
	NO	CAN-N	4	Groundfish	81
		CAN-N	5	Groundfish	92
		CAN-N	11	Groundfish	201
	Ps	FRA-SP	2-3	Groundfish	107
		CAN-N	4-5	Scallop	250
		CAN-N	8-9	Scallop	120
4	T	CAN-G	6-8	Bottom trawl survey for crab biomass estimation (NB, NS, Gaspé peninsula and PEI	235
		CAN-G	6,11	Groundfish migration and distribution	70+ 83
		CAN-G	8	Juvenile cod	34
		CAN-G	9	Groundfish abundance	154
	TVn	CAN-G	10-11	Herring accoustic	18
	VsW	CAN-SF	3	Groundfish	77
	VWX	SUN	10-11	Juvenile silver hake	108
	X	USA	4	Spring bottom trawl	24
		USA	10	Autumn bottom trawl	20
4+t	VWXZe	CAN-SF	6	Groundfish	234
	WXZe	CAN-SF	5	Scallop	137
	XZe	CAN-SF	8	Scallop, *juvenile* study	150
5	YZ	USA	3,4	Spring bottom trawl	163
		USA	8	Sea scallop	247
		USA	9,10	Autumn bottom trawl	168
	Ze	CAN-SF	2,3	Groundfish	140
6	ABC	USA	3	Spring bottom trawl	135
		USA	7,8	Sea scallop	222
		USA	9	Autumn bottom trawl	154
			OTHER SURVEYS		
1	A	GRL	2,4,5,10	White whale, sampling	-
		GRL	8,9	Harp seal, sampling	-
		GRL	10	Fin whale photo-id, biopsy sampling	-
	AB	GRL	4	White whale, aerial survey	-
	ABCDE	GRL	6	Hydrography	33
	ABCDEF	GRL	8,9	Minke, fin whale - aerial survey	-
	BDF	GRL	7	Young cod-gillnet	171
	CD	JPN	9	G. halibut, midwater trawl	35
	CDE	GRL	7	Large cetacean photo-id, biopsy sampling	-
	D	JPN	6	Midwater trawl on G. halibut	24
		GRL	7	Hydrography	5
	DEF	GRL	5,6	Harp seal, sampling	-
2	J	CAN-N	7-8	Cod sampling	-
2+3	JK	CAN-N	2	Cod (acoustic)	37
		CAN-N	10	Capelin (acoustic)	31
		SUN	11	Capelin, temperature, salinity	14
	JKL	CAN-N	5-10	Hydrography	-
		CAN-N	7	Oceanography	-
3	K	SUN	9	Grenadier, G. halibut, temperature, salinity	47
	KL	CAN-N	6	Capelin tagging	17
		CAN-N	6	Cod (acoustic)	23
		CAN-N	6,10-11	Oceanography	-
		CAN-N	10-11	Herring (acoustic)	17
	KLNO	CAN-N	2-3	Cod tagging	32
	L	CAN-N	3	Cod tagging	20
		CAN-N	4,6,9	Acoustic trials	-
		CAN-N	5	Capelin (acoustic)	25
		CAN-N	5,6,8	Crab	162
		CAN-N	9	Oceanography	-
	LN	CAN-N	3	Gear trials	76
	LNO	SUN	5	Capelin, temperature, salinity	22
		CAN-N	6	Flounder tagging	59
		SUN	11-12	Capelin larvae, temperature, salinity	55
	LO	CAN-N	5	Capelin tagging	28
	LPs	CAN-N	1-2	Herring (acoustic)	6
		CAN-N	6	Capelin tagging	10
	M	SUN	6-7	Eggs, larvae, temperature, salinity	43
	Ps	CAN-N	7-8	Redfish (acoustic)	47
4	R	CAN-G	5-8	Trap	139
				Diving (Scuba)	16
				Trawl crab survey (Bonne Bay, NF)	26
	RST	CAN-Q	6	*Gear intercalibration*	91
		CAN-Q	9	Redfish	230
	S	CAN-Q	6	Scallops	79
		CAN-Q	8	Acoustics	10
	T	CAN-G	1-12	Phytoplankton, east PEI	5 sites week/ biomonthly
		CAN-G	2	Bottom-set gillnets for juvenile herring near Bathurst, NB	2
		CAN-G	2	Sampling of juvenile herring bycatch in commercial smelt fishery in Restigouche River channel	3
		CAN-G	4	Flounder drag sets in Chaleur Bay to monitor juvenile herring on bottom	12
		CAN-G	4-6	Crab sea sampling aboard commercial fishery vessels (NB, Quebec, PEI)	90 trips
		CAN-Q	5	Crab	-
		CAN-G	5,11-12	Bivalve parasite/pathology	6 sites month/ biomonthly
		CAN-G	5-6	Lobster monitoring of biological characteristics (growth, movement)(tagging)	63 days
		CAN-G	5-6,8-10	Commercial sea sampling (lobster)	148
		CAN-G	5-9	Fyke nets set near shore near Bathurst to monitor in/off shore movements of juvenile hake	6d
		CAN-G	5-12	Monthly trawl survey on snow crab population characteristics (Baie des Chaleurs)	6/ month
		CAN-G	6	Crab trap survey for catchability and selectivity study (Baie des Chaleurs)	35x 8d 8d
		CAN-Q	6	Mackerel larvae	65
		CAN-Q	6	Genetics	-
		CAN-G	7	Underwater 3-D photography of scallop bed, scallop dredging	
		CAN-G	7	Scallop, plankton sampling	2d
		CAN-Q	7	Genetics	-
		CAN-Q	7	Scallops	68
		CAN-G	7,12	Juvenile herring	26+36
		CAN-G	7-8	Lobster monitoring of biological characteristics by trawling	8d 56 sets
		CAN-G	7-10	Crab sea-sampling aboard commercial fishing vessels (NS)	25 trips
		CAN-G	8-9	Distribution and aggregative response of winter flounder relative to herring spawn	48
		CAN-G	8-9	Herring spawning bed	-
		CAN-G	8-9	Herring spawning wave study	140
		CAN-G	9	Tagging ripe herring for stock identification studies	1
		CAN-Q	9	Crab	-
		CAN-Q	10	Snow crab	176
	VnW	CAN-SF	1	Herring acoustics	20
	VW	CAN-SF	8	Seaworm	49
	VWX	CAN-SF	2	Seaworm	95
		SUN	5-7	Adult silver hake (trawl & oceanography)	346
	WX	SUN	6	Mackerel (trawl & oceanography)	67
		CAN-SF	7,8	Gear trials	70
		CAN-SF	10	Gear trials	33
		CAN-SF	3,4	Observer training	23
		CAN-SF	4	Lobster tagging	31
		CAN-SF	6	Juvenile haddock	-
		CAN-SF	9	livefish ICP training	24
4+5	XZe	CAN-SF	10	Larval herring resurgence	112
		CAN-SF	10,11	Larval herring	154
5	YZe	CAN-SF	12	Pollock tagging	38
	YZ	USA	2	Ichthyoplankton - herring/sand lance	73
			10	" "	75
			11	" "	123
			12	" "	130
	Ze	CAN-SF	4	Larval cod/haddock	103
		USA	4,5	Mackerel predation	198
		CAN-SF	4,5	Juvenile lobster study	N/g
		CAN-SF	9	Swordfish study	5
		CAN-SF	10	Groundfish and herring acoustics	32
5+6	YZA	USA	3	Ichthyoplankton - herring/sand lance	65
	ZAB	USA	1-8	To determine prevalence to shell disease (chitinoclasia) in lobsters	4000
6	A	USA	8	Epibenthic/megafauna-collections for analyses 1) organic contaminant 2) heavy metals	26
		USA	10	Ecological recovery of former sewage sludge dumpsite	9

Table 2. Biological surveys planned for the NAFO Area in 1991 and early 1992.

Country	Area	Type of Survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1991	
CAN-G	4T	Groundfish migration and distribution	Apr
		Bottom trawl survey for crab biomass estimation (NB, NS, and PEI)	Jun-Aug
		Juvenile cod	Jul
		Groundfish abundance	Sep
		Juvenile herring	Dec
	4TVn	Herring acoustic	Oct
CAN-N	2GH	Groundfish	12-28 Nov
	2HJ+3A3	Shrimp	06-31 Jul
	2J+3KL	Groundfish	30 Oct-19 Dec
	3L	Groundfish	18 Oct-10 Nov
	3LNO	Groundfish	17 Apr-30 May
		Redfish	04-21 Aug
		Juvenile flatfish	23 Aug-25 Sep
	3NO	Groundfish	12 Nov-01 Dec
	3Ps	Groundfish	05-25 Feb
		Scallop	18-29 Apr
		Scallop	22 Aug-03 Sep
CAN-Q	3Pn+4RST	Groundfish survey	10-30 Jan
	4RST	Redfish - shrimp	20 Aug-10 Sep
CAN-SF	4VsW	Groundfish	04-19 Mar
	4VWX	Scallop survey	13-24 May
	4VWX+5Ze	Groundfish	02-30 Jul
	5Ze	Groundfish	12 Feb-01 Mar
		Scallop survey	06-23 Aug
GRL	0B+1ABCDE	Shrimp, bottom trawl, hydrography	Jul-Aug
	1B	Bottom shrimp trawl selection studies & underwater TV - observations	Jul
	1DEF	Bottom trawl, fish	Oct
E/FRG	1BCDEF	Groundfish	19 Oct-29 Nov
FRA-SP	3P	Groundfish	18 Feb-26 Mar
JPN	1A-D	Bottom trawl survey on G. halibut	Aug
SUN	0B	G. halibut, temperature	Sep-Oct
	1BCD	G. halibut, grenadier, temperature, salinity	Oct
	3KLNO	Groundfish, temperature, salinity	Jun
	4VWX	Juvenile silver hake	Oct-Nov
USA	4X+5YZ +6ABC	Spring bottom trawl	04-22 Mar 25 Mar-05 Apr 08-19 Apr
	4X+5YZ +6ABC	Autumn bottom trawl	09-27 Sep 30 Sep-11 Oct 14-25 Oct
	5Y	Summer bottom trawl	22 Jul-02 Aug
	5Z+6ABC	Sea scallop	25 Jul-03 Aug 06-20 Aug
		OTHER SURVEYS - 1991	
CAN-G	4R	Crab trap, diving (SCUBA) and trawl survey (Bonne Bay, Nfld.)	Apr-Sep
	4T	Sampling of juvenile herring by-catch in commercial smelt fishery in Restigouche River Channel	Jan-Mar
		Flounder drag sets in Chaleur to monitor juvenile herring on bottom	Apr
		Crab trap survey for catchability and selectivity study (Baie des Chaleurs)	Apr-Jun
		Crab sea sampling aboard commercial fishing vessels (NB, Quebec, PEI)	Apr-Jun
		Crab sea sampling aboard commercial fishing vessels (NS)	Apr-Jun Aug-Oct
		Monthly trawl survey on snow crab population characteristics (Baie des Chaleurs)	Apr-Nov
		Sampling of bycatch in gaspereau fishery in Miramichi River	May-Jun
		Commercial sea sampling (lobster)	May-Jun, Aug-Oct
		Fyke nets set near shore near Bathurst to monitor in/off shore movements of hake	May-Sep
		Monthly sampling of juvenile herring in rearing areas (inshore)	May-Nov
		Bivalve parasite/pathology study	May-Dec
		Monthly research sampling in Miramichi estuary	May-Nov
		Phytoplankton dynamics, research surveys and inshore sampling (east PEI and Georges Bay)	Jun, Sep, Nov and monthly
		Lobster monitoring of biological characteristics by trawling	Jul
		Underwater 3-D photography of scallop bed, scallop dredging	Jul
		Scallop, plankton sampling	Jul
		Distribution and aggregative response of winter flounder relative to herring spawn	Aug-Sep
		Herring spawning bed survey	Aug-Sep
		Herring spawning wave study	Aug-Sep
		Snow crab tagging study	Sep
		Biweekly sampling of bycatch in commercial smelt fishery in Miramichi estuary	Nov-Mar '92
CAN-N	2J	Cod sampling	22 Jul-16 Aug
	2J+3K	Capelin tagging	25 Sep-07 Oct
	2J+3KL	Ecology	10-27 Apr
		Ecology	31 May-16 Jun
		Capelin (acoustics)	02-28 Oct
	2J+3KLMNOP	Oceanography	21 Jul-08 Aug
	SA2+3KL	Cod (acoustics)	28 May-20 Jun
	SA2+3	Hydrography	15 May-29 Jul
		Hydrography	09 Aug-08 Nov
		Salmon tagging	27 Sep-16 Oct
	3K	Ecology	29 Apr-10 May
		Ecology	18-29 Jun
	3KL	Oceanography	08-23 Oct
CAN-N	3KL	Groundfish (acoustics)	12-29 May
	3KLOPs	Oceanography	25 Oct-10 Nov
	3L	Cod tagging	14-28 Mar
		Crab studies	01-07 Apr
		Oceanography	02-06 Apr
		Oceanography	29 Apr-03 May
		Acoustic trials	01-06 May
		Crab survey	05-16 May
		Capelin (acoustics)	07-26 May
		Cod (video)	15-31 May
		Capelin tagging	17-23 May
		Oceanography	27-31 May
		Crab studies	03-17 Jun
		Oceanography	24-28 Jun
		Ecology	02-18 Jul
		Crab survey	05-20 Aug
		Crab survey	01-15 Sep
		Oceanography	16-20 Sep
		Acoustic calibration	27 Sep-01 Oct
		Capelin studies	08-23 Oct
		Crab survey	12-26 Oct
		Herring survey	14-25 Oct
		Oceanography	18-22 Nov
	3LNO	Gear trials	08-15 Apr
		Capelin tagging	21-28 Jun
	3LOPs	Capelin tagging	03-14 May
	3NO	Capelin acoustics	22 Jun-04 Jul
		Juvenile flatfish tagging	10-19 Jun
	3Ps	Capelin tagging	22 May-05 Jun
		Redfish (acoustics)	02-20 Aug
CAN-Q	4R	Groundfish	08-14 Apr
		Cod migration	09-30 May
		Plankton - cod	16-29 Jul
		Juvenile cod & herring acoustics	07-21 Oct
		Shrimp	15-26 Oct
		Herring acoustics	14-29 Nov
	4RST	Crab	22 May-04 Jun
	4S	Shrimp larvae	30 Apr-08 May
		Redfish - calanus	26 May-09 Jun
		Redfish - calanus	19-30 Jun
		Acoustics	08-26 Aug
		Shrimp	11-20 Aug
	4T	Crab	15 Apr-21 May
		Biological oceanography	24 Apr-01 May
		Mackerel acoustics	27 May-07 Jun
		Biological oceanography	10-18 Jun
		Mackerel eggs	17-28 Jun
		Crab	17 Jun-01 Jul
		Benthos	18-23 Jun
		Biological oceanography	01-15 Jul
		Plankton - larvae	08 Jul-05 Aug
		Scallops	25 Jul-02 Aug
		Crab	06-15 Aug
		Crab	16-31 Aug
		Plankton	23 Aug-01 Sep
		Biological oceanography	01-08 Sep
		Crab	16-23 Sep
		Biological oceanography	28 Sep-09 Oct
		Crab	28 Oct-11 Nov
		Biological oceanography	26-28 Oct
CAN-SF	4VW	Herring acoustics	03-29 Jan
		Herring acoustics	02-13 Dec
	4VWX	Gear trials	30 Apr-10 May
		Comparative fishing	02-16 Aug
		Ghostnet study	23 Sep-03 Oct
		Underfertilized species	29 Oct-06 Nov
	4X	Live fish	22-26 Apr
		Herring acoustics	25 Jul-02 Aug
		Herring acoustics	27 Aug-17 Sep
		Live fish	22-23 Oct
		Herring larvae	24 Oct-11 Nov
		Acoustics	07-16 Nov
	4X+5Ze	Swordfish study	23-Sep-03 Oct
	5Ze	Herring resurgence	25 Oct-05 Nov
GRL	1A	Harp seal, sampling	Aug-Sep
	1ABCDEF	Minke and fin whale aerial survey	Jul-Aug
	1BDF	Young - cod gillnet	Jul
	1CDE	Large cetacean photo-id and biopsy sampling	Jul-Aug
JPN	1A-D	Juvenile survey on G. halibut, redfish	Nov
SUN	2GH	Long-line survey	15 Aug-30 Nov
	2J+3K	Capelin	Nov
	3LNO	Capelin	May
		Larvae of capelin	May-Dec
USA	5YZ	Ichthyoplankton - herring/ sand lance	Jan
		Ichthyoplankton - herring/ sand lance	Oct
		Ichthyoplankton - herring/ sand lance	Nov
		Ichthyoplankton - herring/ sand lance	Dec
	5Z	Trawl door testing	23-31 Jan
		Trawl door testing	11-20 Nov
	5Y+6A	Ichthyoplankton - herring/ sand lance	Mar
	5YZ+6A	Ichthyoplankton - herring/ sand lance	Feb
	5Z+6AB	To determine prevalence of shell disease (chitinoclasia) in lobsters	Jan-Sep
	6A	Ecological - recovery of former sewage sludge dumpsite	Mar-Apr, Sep
		Epibenthic/Megafauna - Analyses for 1) Organic contaminant 2) heavy metals	Aug
		SURVEYS PLANNED FOR EARLY 1992	
CAN-N	SA2+3	Cod tagging	Jan
	3LPs	Herring survey	13 Jan-01 Mar
	3Ps	Groundfish (stratified)	05-25 Feb
CAN-Q	3Pn+4RST	Groundfish (stratified)	10-30 Jan
CAN-SF	4VW	Herring acoustics	03-15 Jan
		Observer training	10-15 Mar
		Groundfish (stratified)	10-21 Mar
	5Ze	Groundfish (stratified)	19 Feb-07 Mar
SUN	4VWX	Juvenile silver hake (stratified)	Jan

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

Chairman: V. P. Serebryakov Rapporteur: J. E. Carscadden

The Committee met at the NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada on 10 and 15 June, 1991. In attendance were V. P. Serebryakov (USSR) (Chairman), J. E. Carscadden (Canada), V. A. Rikhter (USSR), M. Stein (EEC), A. Vazquez (EEC), the Assistant Executive Secretary (T. Amaratunga) and the Executive Secretary (L. I. Chepel).

1. Review of STACPUB Membership

STACPUB welcomed the new Executive Secretary of NAFO, Dr. Chepel, to his first meeting of the Committee. STACPUB also acknowledged the conscientious work of W. R. Bowering in the Committee over the last 2 years and welcomed his replacement, J. E. Carscadden.

2. Review of Scientific Publications since June 1990

a) Journal of Northwest Atlantic Fishery Science

Volume 10 containing 1 paper (61 pages) titled "The Delimitation of Fishing Areas in the Northwest Atlantic" by R. Halliday and A. Pinhorn, 3 notices and 2 obituaries was published as planned with the publication date of December 1990. This special issue of the Journal contained the first invitational paper. It was also the first issue containing the new cover design. The authors dedicated their paper to the memory of L. Day and W. Templeman. STACPUB was pleased to note the rapid turn-around time for this publication.

Volume 11, which was the next regular issue of the Journal, containing 7 papers and 3 notices (79 pages) was published as planned with the publication date of February 1991.

The single issue of the Journal with respect to papers presented at the Special Session on "Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic over the Last 30 Years and Their Possible Causes" held in Brussels, September 6-8, 1989 with M. Fogarty as convener, was still in preparation. Editorial work undertaken by the convener was delayed due to other commitments, but the Assistant Executive Secretary has been informed that many papers were now ready for final processing at the Secretariat.

The next issue of the Journal had 5 papers which had been processed for galley preparation. The Assistant Executive Secretary was hopeful that publication would be possible by late 1991, when 2 or 3 more papers become available from the Associate Editors.

STACPUB considered the production of different numbers of issues of the Journal each year which had caused some question of how to number the issues. Noting that each volume also has its own year of issue for cross reference, STACPUB recommended that *each future issue of the Journal be given a separate Volume number.*

b) NAFO Scientific Council Studies

Studies Number 15 was in its final stages of printing. The publication containing 7 papers, was expected to be circulated in about one months time.

Papers presented at the Special Session titled "Management under uncertainties related to biology and assessment, with case studies on some North Atlantic fisheries" held 5-7 September 1990 were all (with the exception of two which were not submitted by the author) in the final stage of preparation for publication in Studies Number 16. Three papers were under review by the convener while galleys had been prepared for the others. Publication of this issue was expected to be completed in 2-3 months.

STACPUB noted the quick turn-around time for this unusually large issue (20 papers) and commended the Secretariat staff for the extra effort that made this possible.

c) NAFO Statistical Bulletin

After the late receipt of data from some countries (December 1990) *NAFO Statistical Bulletin* Vol. 38 was published in February 1991 just 1 month after all data became available. STACPUB noted that data compilation, final preparation and printing at the Secretariat was very rapid, while this publication was delayed by about 18 months due to late submission of data. STACPUB noted that turn-around time at the Secretariat for the last 2 issues was also very rapid.

Submission of STATLANT 21B reports for 1989 were still outstanding from 8 countries - the same 8 countries were outstanding in June 1990. The delay in the acquisition of final data will again have impact on the timely publication of *NAFO Statistical Bulletin* Vol. 39.

d) NAFO Scientific Council Reports

The volume (187 pages) containing reports of the 1990 meetings of the Scientific Council in June and September was published and distributed as planned in December 1990.

STACPUB noted that the Scientific Council had a proposal to produce a summary of the Scientific Council reports for use by the Fisheries Commission and General Council at the Annual Meeting. Noting the potential readership for this publication, STACPUB recommended that *the Scientific Council report being prepared from the June meeting be under separate cover and titled Executive Summary.*

e) List of Fishing Vessels

This triennial publication for 1989 was still delayed pending receipt of data from 3 countries.

f) Index and Lists of Titles

The provisional index and lists of titles of 115 research documents (SCR Doc.) and 25 summary documents (SCS Doc.) which were presented at the Scientific Council meetings during 1990 were compiled and presented in SCS Doc. 91/02 (24 pages).

The issue of *Index of Meeting Documents, 1985-89* was compiled and published in December 1990 as planned, from the provisional indexes of meeting documents prepared annually in SCS Doc. 86/7, 87/2, 88/9, 89/11 and 90/6.

g) STACPUB commended the NAFO Secretariat on the superior technical quality of all of the publications, especially the Journal and Studies.

3. 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 by the Committee. No significant departures from those of previous years were observed.

It was noted that the Journal Vol. 4 continued to attract interest. The sales since June 1990 had in fact increased substantially and STACPUB noted that it is possible that it may have to be reprinted in the future.

4. Promotion and Distribution of Scientific Publications

a) Publicity and Response Regarding the Journal

STACPUB noted that there has been a decline in the distribution of all publications of the Scientific Council. This occurred mainly during 1990-91 as a result of responses to letters sent out by the Secretariat to all recipients of free issues of the publications. The greatest decline in numbers occurred in the Canadian and GDR list. The subscription list remained similar except for a slight decrease in the Statistical Bulletin.

STACPUB was concerned that the Journal and Studies might be facing competition from new Journals. The Committee felt that high quality Journal papers with a quick turn-around time from submission to publication were very important factors in maintaining the position of NAFO publication. Furthermore, STACPUB was of the opinion that Studies, such as the special issue from the 1990 Special Session, was an especially useful avenue for publication because it allowed the presentation of useful new concepts or small databases which might not be adequate for primary publication in a short time-frame. STACPUB also noted that there were provisions for short papers and letters to the editor in the Journal to stimulate authors to bring new views to promote the Journal.

b) Invitational Papers for the Journal

The Assistant Executive Secretary noted that Vol. 10 containing the first invitational paper had been processed very quickly and had been well-received. In view of this success, STACPUB endorsed the continuation of contacting potential authors for publications as invited papers.

With respect to authors already contacted, STACPUB was informed that Sv. Aa. Horsted was still intending to prepare the invitational paper on cod in the Greenland area. However, he was cognisant of the possibility that members of the Greenland Fisheries Institute and other Institutes involved in research in the area were considering preparing a group of papers describing research activities and results in the Greenland area. The situation was that a single invitational paper by Sv. Aa. Horsted or a number of papers from the Institute would be submitted. STACPUB endorsed this arrangement and requested the Assistant Executive Secretary to continue communicating on this matter.

In the same vein, STACPUB considered the general theme of research activities by individual laboratories during the ICNAF/NAFO years. Based on this discussion, STACPUB requested the Assistant Executive Secretary to extend an invitation on its behalf to M. Grosslein (USA) to consider preparing a paper. Final details of the

topic were open for discussion between M. Grosslein and the Assistant Executive Secretary and he was encouraged to solicit the cooperation of other relevant US scientists.

The Assistant Executive Secretary reported that he had not had further correspondence with J. Messtorff but hoped to inquire soon. STACPUB confirmed its interest in a review paper by J. Messtorff.

c) New Cover of Journal

The new cover appeared on Vol. 10 and 11 of the Journal. STACPUB noted that many positive comments had been received.

5. Editorial Matters Regarding Scientific Publications

a) Editorial Activities

At its meetings since 1980, STACPUB had nominated a total of 347 research documents as potential for publication in the NAFO Journal or Studies.

Of the 8 papers nominated at the June 1990 Meeting, 4 papers had been submitted.

Of the 22 papers presented at the September 1990 Special Session, 20 were submitted on schedule (leaving only 2 with unknown status).

In addition, 6 papers from outside of the STACPUB nomination process were submitted since June 1990.

STACPUB noted a total of 40 papers were published or were in their final stages of preparation (13 in Journal, Volumes 10, 11, and the upcoming 12; and 27 in Studies, No. 15 and 16) since June 1990.

In addition, a total of 32 papers were currently in various stages of editorial review for the Journal. Of these, 10 papers from the 1989 Special Session submitted to date were being edited by M. Fogarty for a single issue of the Journal.

In addition, there was only one paper left at this time under review for Studies.

b) Progress Review: Journal Issue of 1989 Special Session

STACPUB noted progress had been slow but was encouraged that urgent attention was being given to the 10 papers now available. In view of the considerable delay to date and the commitments given to the authors, STACPUB hoped that this special Journal issue will be published by the end of 1991.

c) Review of General Editorial Process

STACPUB noted that the review process of Journal papers has been very slow for some papers. The Associate Editors have the sole responsibility for ensuring reviews were provided in a reasonable time frame, preferably 3-6 weeks. STACPUB felt that the workload of papers is not high for each Associate Editor and therefore, long delays for reviews should be rare. Consequently, STACPUB encouraged the Assistant Executive Secretary to make inquires from the Associate Editors at regular intervals on the progress of the reviews. As previously noted, STACPUB feels that a timely turn-around of papers for the Journal is essential to maintain the popularity of the Journal.

d) Review of Editorial Board

There were no changes in the Editorial Board since the last meeting.

6. Papers for Possible Publication

a) Review of Proposals Resulting from the 1990 Meeting

STACPUB was pleased that submissions during 1990 as a result of recommendations arising from the 1990 meetings, have been good.

J. E. Carscadden reported on the progress of the submission of papers from the USSR-Canada Bilateral Meeting on Capelin, held in St. John's, November 1990. There were 26 oral presentations and to date 8 have been submitted with 5 more expected. STACPUB noted the formal review process will be initiated shortly in preparation for a single issue of the Journal.

b) Review of Contributions to the 1991 Meeting

STACPUB had requested authors to indicate whether they wished to have their paper considered for publication and as a result, STACPUB had a better opportunity to pay more attention to review those papers. In total, 94 Research (SCR) Documents and 16 Summary (SCS) Documents presented to the Scientific Council were considered. STACPUB nominated SCR Doc. 91/3, 11, 18, 26, 30, 31, 32, 36, 39, 40, 59, 67, 86, 87, and also 91/1, 2, 16 combined and 91/47, 48, 49 combined. All of the selected papers were evaluated for their suitability for the Journal or Studies. Accordingly, the

Committee requested the Assistant Executive Secretary to invite authors of those documents to submit them in a suitable form for consideration for publication in the Journal or Studies, as decided by the Committee.

7. Microfiche Projects

a) Review of Requests for Microfiche of ICNAF Documents

No sets were sold during 1990 meaning that a total of 13 out of the 30 sets of ICNAF documents have been sold.

b) Question of Microfiching NAFO Documents

An estimate of the cost of microfiching the NAFO Research and Summary Documents (1979-90) was available.

STACPUB confirmed its earlier decision not to proceed with a request for funding for this project until the ICNAF project recovers its full costs. In addition, new technologies (see 7c) may preclude the production of NAFO Documents in microfiche form.

c) New Technology for Archiving Documents

STACPUB discussed the possibility of archiving NAFO Documents on optical storage discs (Cds). Some databases of abstracts were already available in this form and libraries were acquiring the technology to read them. STACPUB requested the Assistant Executive Secretary to obtain price quotations on converting NAFO Research and Summary Documents to this format. No decision on conversion of these documents to microfiches or Cds will be made, pending further investigation of costs and availability of the technology.

STACPUB endorsed the efforts of the Secretariat to solicit drafts of documents in machine readable (diskette) form. STACPUB recommended that *every effort be made by the Secretariat to develop the computer hardware and software necessary to meet the publication demands.*

8. Other Matters

It was noted that most laboratories had telefax equipment and any urgent matters could be dealt with by using them.

APPENDIX IV. AGENDA FOR SCIENTIFIC COUNCIL MEETING, JUNE 1991

I. Opening (Chairman: B. W. Jones)

1. Appointment of rapporteur
2. Adoption of agenda
3. Attendance of observers
4. Plan of work
5. Report of proxy votes (by Executive Secretary)

II. Fishery Science (STACFIS Chairman: D. B. Atkinson)

1. General review of catches and fishing activity in 1990

2. Stock assessments

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

- Cod (Div. 3NO; Div. 3M) *(also see App. III, Item 3)*
- Redfish (Div. 3LN; Div. 3M) *(also see App. III, Items 3, 4 and 5)*
- American plaice (Div. 3LNO; Div. 3M) *(also see App. III, Items 2, 3, 6 and 12)*
- Witch flounder (Div. 3NO) *(also see App. III, Items 3 and 7)*
- Yellowtail flounder (Div. 3LNO) *(also see App. III, Item 3)*
- Capelin (Div. 3NO) *(also see App. III, Item 8)*
- Squid (Subareas 3 and 4)
- [Note also Annex 1, Item 3 concerning cod in Div. 2J+3KL, Item 4 concerning flounders in Div. 3LNO, Item 5 concerning witch flounder in Div. 3NO, Item 6 concerning squid in SA 3 and 4 and Item 7 concerning capelin in Div. 3NO]

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

- Greenland halibut (Subarea 2 and Div. 3KL) *(also see App. III, Item 12)*
- Roundnose grenadier (Subareas 2 and 3)
- Silver hake (Div. 4VWX) *(also see App. III, Items 1 and 12)*
- 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):

- Cod (Subarea 1)
- Redfish (Subarea 1) (if possible, by species)
- Northern shrimp (East Greenland) *(also see App. III, Item 10)*
- 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) *(also see App. III, Item 12)*
- Roundnose grenadier (Subareas 0 and 1)
- Northern shrimp (Subareas 0 and 1) *(also see App. III, Item 9)*

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

a) Chairman's report
b) Marine Environmental Data Service (MEDS) Report for 1990
c) Review of environmental studies in 1990
d) Overview of environmental conditions in 1990
e) National representatives
f) Report on the Second World Climate Conference (Geneva, 29 October-7 November 1990)
g) Other matters

4. Ageing techniques and validation studies

a) Report on methods of ageing silver hake otoliths
b) Reports on the otolith exchanges of American plaice (Div. 3LM) and Greenland halibut
c) Other ageing and validation studies reported

5. Gear and selectivity studies

a) Reports on gear and selectivity studies
b) Proposals for gear and selectivity studies

6. Review of SCR and SCS documents not considered in items 1 to 5 above

7. Other matters

   a) Review of arrangements for conducting stock assessments and documentation of assessments (*see App. III, Item 17*)
   b) Progress report on contributions for the 4-6 September 1991 Symposium on "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes", hosted by the Scientific Council (H. Hovgård, Denmark, Convener)
   c) Reports from the co-conveners of the Special Session in 1992 and any other matters in relation to this meeting
   d) Theme for the 1993 Special Session
   e) Other business

III. Research Coordination (STACREC Chairman: W. B. Brodie)

1. Fishery Statistics

   a) Progress report on Secretariat activities in 1990/91

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

   b) Review of reporting requirements for submission of STATLANT 21A and 21B statistics

   c) Fifteenth Session of CWP, July 1992

2. Biological Sampling

   a) Progress report on activities in 1990/91
   b) Forms and deadlines for submission of data

3. Biological Surveys

   a) Review of survey activity in 1990 (*see App. III, Item 15*)
   b) Survey plans for 1991 and early 1992
   c) Review of stratification schemes
   d) Coordination of surveys in 1991-92 (if required)

4. Other Matters

   a) List of fishing vessels for 1989
   b) Tagging activities reported for 1990
   c) Review of relevant SCR and SCS documents not considered in items 1 to 3 above
   d) Other business

IV. Publications (STACPUB Chairman: V. P. Serebryakov)

1. Review of STACPUB membership

2. Review of scientific publications since June 1990

3. Production costs and revenues for Scientific Council publications

4. Promotion and distribution of scientific publications

   a) Publicity and response regarding the Journal
   b) Invitational papers for the Journal
   c) New cover of the Journal

5. Editorial matters regarding scientific publications

   a) Editorial activities
   b) Progress review: Journal issue of 1989 Special Session
   c) Review of general editorial process
   d) Review of Editorial Board

6. Papers for possible publication

   a) Review of proposals resulting from the 1990 meetings
   b) Review of contributions to the 1991 meeting

7. Microfiche projects

   a) Review of requests for microfiche of ICNAF documents
   b) Question of microfiching NAFO research documents

8. Other matters

V. Rules of Procedures

VI. Collaboration with other Organizations

1. Joint ICES/NAFO working group on harp and hooded seals
2. Fifteenth Session of CWP, July 1992

VII. Arrangements for Special Sessions

[See under Fishery Science, Section 7(b), 7(c), and 7(d)]

VIII. Future Scientific Council Meetings, 1991 and 1992

IX. Nomination and election of officers to the Scientific Council and its Standing Committees (except STACFIS)

X. Other Matters

XI. Adoption of Reports

1. Committee reports from this meeting (STACFIS, STACREC, STACPUB)
2. Scientific Council Report, June 1991 (receipt and adoption)

XII. Adjournment

ANNEX 1. FISHERIES COMMISSION REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1992 OF CERTAIN STOCKS IN SUBAREAS 3 AND 4

1. The Fisheries Commission with the concurrence of the Coastal State as regards the stocks below which occur within its jurisdiction, requests that the Scientific Council, at a meeting in advance of the 1991 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 1992:

   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_{1990} and Fmax in 1992 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 1992 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 stocks 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 1992 over a range of fishing mortality rates (F) at least from $F_{0.1}$ to Fmax.
         - a graph showing spawning stock biomass at 1.1.1993 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, Fmax and $F_{0.1}$ should be shown.

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

4. With respect to flounders in Div. 3LNO, the Scientific Council is requested to provide advice on management options that would reduce the extent to which the fisheries reduce the potential yield due to harvest of small fish.

5. With respect to witch flounder in Div. 3NO, the Scientific Council is asked to provide an analysis of the effect on stock status of the lowering of TAC to 5,000 tons for 1981 and the maintenance of that TAC level in sequent years.

6. With respect to squid in SA 3 and 4, the Scientific Council is asked to examine all data available to it and if possible to present options for the management of the stock that are based on the NAFO principles of optimum utilization and conservation.

7. The Scientific Council is requested to advise at its June 1991 Meeting on the most rational level of management of capelin in Divisions 3NO, on the basis of the main principles of NAFO: optimum utilization and conservation of stocks. The Council should evaluate the importance of capelin at different stages of their life history to the marine ecosystem and in particular, given the mass mortality following spawning, the significance of a management option that refers to harvesting during the period immediately prior to spawning. Other management options such as maintaining minimum spawning biomass should be evaluated in terms of both maintaining stock size and the impact on the ecosystem.

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1992 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1991 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1992:

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

It is also suggested that, subject to the concurrence of Denmark (Greenland), the Scientific Council, prior to the 1991 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1992 of the following stocks:

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

The Scientific Council noted in its 1990 report that there was no biological basis for making two separate assessments for the Greenland halibut throughout Subareas 0-3. The Council is therefore asked, subject to concurrence of Denmark (Greenland) as regards Subarea 1, to provide an overall assessment of the total stock and comment on its management.

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 the implications of continuing to fish at $F_{0.1}$ in 1992 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those to be expected at the $F_{0.1}$ level in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. All results should be expressed in terms of stock sizes, catch rates and TACs implied for 1992 and the long term.

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

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

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ANNEX 3. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT OF CERTAIN STOCKS IN 1992

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO in advance of the 1991 Annual Meeting to consider the following stocks occurring in Subarea 1:

   i) Atlantic cod
   ii) Redfish (by species, is possible)
   iii) Any other stock of invertebrates and finfish of commercial interest for which data allow a status report

   It is also suggested, subject to the concurrence of Canada, that the following stocks overlapping Subareas 0 and 1 be included in the considerations of the Scientific Council:

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

   Further, in cooperation with ICES, the Scientific Council is requested to analyse the following stock in the Denmark Strait and off East Greenland:

   i) Northern shrimp (*Pandalus borealis*)

   The Scientific Council is requested to provide advice on the status and on the biological basis for management in 1992 and as many years forward as the data allow for all stocks mentioned above.

2. In the analyses on which management advice will be based, the following should be included:

   For cod in Subarea 1 the catch projections should include the following options:

   a) F = F(0.1) from 1992 and onwards
   b) F = F-max from 1992 and onwards

   The TAC for 1991 is 90,000 tons. Taking into account the most recent observations on the stock the Scientific Council should evaluate whether such a catch level for 1991 is realistic and, if not so deemed, base its prognoses on what is considered a realistic range of catches in 1991. Furthermore,

   c) the possibility of maintaining such a catch level over the years 1992-94 should be evaluated, giving corresponding F-values.

   The expected development in length distribution of stock and catches (by gear) should be evaluated, in particular with respect to the proportion between size groups 40-55 cm and above 55 cm.

   The events which have led to the recent drastic decline in the stock should be analyzed both in terms of uncertainties and variability round basic data and observations as well as in terms of biologically induced events (growth, migration etc.).

   The Scientific Council should advise on the appropriateness in 1992 and subsequent years of managing the cod fisheries in Greenland waters by a combined (West and East Greenland) TAC.

   For Northern shrimp fisheries in Subarea 0+1

   a) The magnitude and size distribution of shrimp discard and the effect of the actual catch on the stock should be analyzed if data so allow;

   b) the short- and long-term effects on stocks, catch composition, catch rate and discards of an increase in mesh size over the interval from 40 to 60 mm should be analyzed if data so allow;

   c) the implications, if any, on the scientific advice of a change in the quota management year in Subarea 1 from the calendar year to the period 1 September to 31 August should be analyzed;

   d) the by-catch of small finfish (notably redfish and Greenland halibut) in the fisheries for shrimp should be evaluated quantitatively and qualitatively (e.g. length distribution), and the effect of the by-catch on these fish stocks should be analyzed if data so allow.

   For Northern shrimp fisheries in Denmark Strait

   a) as a) above;

   b) as d) above.

3. The Scientific Council should feel free to report on such other invertebrates and finfish stocks in Subarea 1 and on such other scientifically based management options for the above mentioned Subarea 1 stocks, as it feels applicable.

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APPENDIX V. LIST OF PARTICIPANTS

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APPENDIX VI. LIST OF RESEARCH AND SUMMARY DOCUMENTS, 1991

RESEARCH DOCUMENTS (SCR)

SCR #	Ser. #	
91/1	N1869	SHERSTYUKOV, A. I. Distribution and abundance of young silver hake of 1989 year-class on the Scotian Shelf in 1989-1990 fall-winter season.
91/2	N1870	SHERSTYUKOV, A. I., and V. I. VINOGRADOV. Studies on vertical distribution of Scotian young silver hake in fall-winter season 1989-1990.
91/3	N1873	PODRAZHANSKAYA, S. G. Feeding habits of mesopelagic species of fish and quantitative estimation of plankton grazed in the Northwest Atlantic.
91/4	N1876	SIGAEV, I. K. Review of hydrographic conditions in some areas of the Northwest Atlantic, 1990.
91/5	N1877	KUZMIN, S. A. Assessment of cod stock in NAFO Subarea 3 by the data from 1990 trawl-acoustic survey.
91/6	N1878	VASKOV, A. A., and I. A. OGANIN. Status of redfish stock in Divisions 3LN.
91/7	N1879	HUNT, J. J. Comparison of Canadian and USSR estimates of age for 1989 Observer Program otolith collections.
91/8	N1880	SAVVATIMSKY, P. I. Causes of decrease in total catch of roundnose grenadier (*Coryphaenoides rupestris* Gun.) in the Northwest Atlantic in 1979-1990.
91/9	N1881	BAKANEV, V. S., and V. I. ZUBOV. Acoustic assessment of capelin stock in NAFO Divisions 3LNO and 2J+3K in 1990.
91/10	N1882	BAKANEV, V. S. Trawl survey for the 1990 year-class of capelin stock assessment in Divisions 3LNO.
91/11	N1883	BOROVKOV, V. A., and I. I. TEVS. Oceanographic conditions in NAFO Subareas 0, 1, 2 and 3 in 1990.
91/12	N1884	MOROZOVA, G. N. Length-age characteristic and fluctuation of American plaice (*Hippoglossoides platessoides*) abundance in Division 3M from 1983 to 1990.
91/13	N1885	RIKHTER, V. A., V. F. TUROK, and N. K. ISTOMINA. Distribution of silver hake, other abundant fish species and short-finned squid on the Scotian Shelf slope in 1990 from data obtained by USSR observers.
91/14	N1886	RIKHTER, V. A. On age changes in natural mortality rates of silver hake on the Scotian Shelf.
91/15	N1887	RIKHTER, V. A. Comparative analysis of the biological state and CPUE of silver hake on the Scotian Shelf in the area of foreign fisheries 1989-1990.
91/16	N1888	SHERSTYUKOV, A. I. Distribution and abundance of the Scotian Shelf 0-group silver hake in October-November 1978-1989.
91/17	N1891	STEIN, M. Greenhouse induced changes in the North Atlantic - potential impact on West Greenland cod stocks.
91/18	N1892	MARKOV, Yu. A., and A. I. SHERSTYUKOV. Microstructure of otoliths, age readings and growth determinations of silver hake (*Merluccius bilinearis*) on early development stages on the Scotian Shelf.
91/19	N1893	SHERSTYUKOV, A. I. On reproduction and formation of silver hake (*Merluccius bilinearis* Mitchill) year-class strengths at early ontogenesis on the Scotian Shelf.
91/20	N1897	SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (*Pandalus borealis*) in East Greenland Waters in 1990.
91/21	N1900	ERNST, P., U. HOFFMANN, and A. A. VASKOV. Results on the Greenland halibut survey in Divisions 0B, 1B, 1C and 1D in 1990.
91/22	N1902	ATKINSON, D. B., and D. POWER. Roundnose grenadier (*Coryphaenoides rupestris*) of NAFO Subareas 2+3 with catch information from Subareas 0+1.
91/23	N1903	MOGUEDET, Ph. Contribution to the assessment of the cod stock in Subdivision 3Ps.
91/24	N1904	MOGUEDET, Ph., and J.-C. MAHÉ Yearly variations in water temperature in NAFO Subdivision 3Ps from 1978 to 1990.
91/25	N1905	REINERT, J. Results from the Faroese exploratory fishery with longline for cod on Flemish Cap in 1990.

91/26	N1906	MOGUEDET, Ph., and J.-C. MAHÉ. Yearly distribution of American plaice (*Hippoglossoides platessoides*) in late winter in Subdivision 3Ps in the period 1978-1990.
91/27	N1907	MAHÉ, J.-C., and Ph. MOGUEDET. Determination of the growth curve parameters of the American plaice (*Hippoglossoides platessoides*) in the NAFO Subdivision 3Ps.
91/28	N1908	VAZQUEZ, A. Results from bottom trawl survey on Flemish Cap in July-August 1990.
91/29	N1909	MENA, I. Northern prawn (*Pandalus borealis*) length distribution and fecundity in Flemish Cap.
91/30	N1910	ZAMARRO, J. Feeding behaviour of the American plaice (*Hippoglossoides platessoides*) on the southern Grand Bank of Newfoundland.
91/31	N1911	PAZ, F. J. J. M. CASAS, and G. PEREZ-GÁNDARAS. The feeding of cod (*Gadus morhua*) on Flemish Cap, 1989-90.
91/32	N1912	SABORIDO, F. Redfish distribution in Flemish Cap during the period 1988-1990.
91/33	N1913	PARSONS, D. G., and P. J. VEITCH. Canadian fishery for northern shrimp (*Pandalus borealis*) in Division 0A, 1990.
91/34	N1914	YOKAWA, K. Outline of Japanese capelin fishery in Div. 3NO and some biological data of capelin in 1990.
91/35	N1915	WIELAND, K. Distribution of larval and 0-group fish off West Greenland in summer and autumn 1989 and 1990.
91/36	N1916	RÄTZ, H. J. Notes of the structures and changes in the ichthyofauna off West Greenland.
91/37	N1917	MILLER, D. S. Estimates of biomass from an acoustic survey for capelin (*Mallotus villosus*) in Division 3L, May 1990.
91/38	N1918	BOJE, J., and S. A. PEDERSEN. An assessment of the Greenland halibut stock component in NAFO Subareas 0+1.
91/39	N1919	BOJE, J. A comparison of selectivity in longlines and gillnets in the fishery for Greenland halibut in West Greenland.
91/40	N1920	LEHMANN, K., and H. DEGEL. An estimate of shrimp discard from shrimp factory trawlers in Davis Strait and Denmark Strait.
91/41	N1921	DEGEL, H., H. LASSEN, and K. LEHMANN. Selectivity in shrimp trawl.
91/42	N1922	WALDRON, D. E., M. A. SHOWELL, and G. HARRISON. Status of the Scotian Shelf silver hake (Whiting) population in 1990.
91/43	N1923	NAKASHIMA, B. S., and. R. W. HARNUM. The inshore capelin fishery in NAFO Division 3L in 1990.
91/44	N1927	DE CÁRDENAS, E., and A. M. AVILA DE MELO. The effect of misreported catches in the assessment of the Flemish Cap cod stock: a simulation exercise.
91/45	N1928	KANNEWORFF, P., and S. A. PEDERSEN. Survey biomass of Greenland halibut (*Reinhardtius hippoglossoides*) off West Greenland (NAFO Subareas 0+1) July-August 1988, 1989 and 1990.
91/46	N1929	PEDERSEN, S. A., and P. KANNEWORFF. Survey biomass of redfish (*Sebastes* spp.) off West Greenland (NAFO Subareas 0+1) July-August 1988, 1989 and 1990.
91/47	N1930	PEDERSEN, S. A., and F. RIGET. Preliminary studies on feeding habits of demersal fish species in West Greenland waters with special emphasis on predation on shrimp.
91/48	N1931	PEDERSEN, S. A., and F. RIGET. Feeding habits of redfish, *Sebastes* spp., in West Greenland waters with special emphasis on predation on shrimp.
91/49	N1932	RIGET, F., and S. A. PEDERSEN. The feeding habits of Greenland halibut in West Greenland waters with special emphasis on predation on shrimp and juvenile redfish.
91/50	N1933	JØRGENSEN, O., and K. AKIMOTO. Results of two trawl surveys in NAFO Subarea 1 in 1990.
91/51	N1934	MURPHY, E. F., C. A. BISHOP, and J. W. BAIRD. Cod in Divisions 2J+3KL - estimates of biomass and age composition for the portion of the stock beyond the Canadian 200-mile fishery zone.
91/52	N1935	KANNEWORFF, P., and K. M. LEHMANN. Report on a stratified-random trawl survey for shrimp (*Pandalus borealis*) in ICES Division XIVb in 1990.

91/53	N1936	CARLSSON, D. M., and P. KANNEWORFF. The commercial shrimp fishery in Denmark Strait in 1990 and early 1991.
91/54	N1937	GASUIKOV, P. S. On sample selection when standardizing fishing effort with multiplicative model.
91/55	N1938	UOZUMI, Y., and S. KAWAHARA. On the management regime of the *Illex* fisheries in Subareas 3 and 4.
91/56	N1940	BRODIE, W. B., A. K. CHUMAKOV, and W. R. BOWERING. Update of abundance and biomass estimates of Witch flounder in Divisions 3NO and Greenland halibut in Divisions 3KL from USSR surveys in 1987-90.
91/57	N1941	CARLSSON, D. M., and H. LASSEN. A catch-rate index for large shrimp in the Greenland shrimp fishery in NAFO Division 1B.
91/58	N1942	SKÚLADÓTTIR, U. The catch statistics of the shrimp fishery (*Pandalus borealis*) in the Denmark Strait in the years 1980-1990.
91/59	N1943	SAVVATIMSKY, P. I., and D. B. ATKINSON. Length-weight relationships of roundnose grenadiers (*Coryphaenoides rupestris* Gunn.) in different areas of the Northwest Atlantic.
91/60	N1944	BRODIE, W. B., A. K. CHUMAKOV, J. W. BAIRD, and W. R. BOWERING. Results of American plaice from USSR surveys in Divisions 3KLMNO.
91/61	N1945	BRODIE, W. B., A. K. CHUMAKOV, J. W. BAIRD, and W. R. BOWERING. Results for yellowtail flounder from USSR surveys in Divisions 3LNO.
91/62	N1946	RIGET, F., and H. HOVGÅRD. Trends in catch and effort in the Greenland trawl fishery for cod.
91/63	N1947	HOVGÅRD, H., and F. RIGET. Preliminary results from cod tagging off West Greenland, 1989.
91/64	N1948	NYGAARD, K. H., and S. A. PEDERSEN. Young cod distribution and abundance in West Greenland inshore areas, 1990.
91/65	N1949	RIGET, F., and H. HOVGÅRD. Observation on discarding in the West Greenland fishery in 1990.
91/66	N1950	CHUMAKOV, A. K., and S. M. SOSHIN. Results of stratified-random bottom trawl and long-line survey on Greenland halibut in NAFO Div. 0B in 1990.
91/67	N1951	DE CARDENÁS, E., and A. AVILA DE MELO. Trends in the population of 3M cod and biological reference points: an approach using survey data.
91/68	N1952	GODINHO, M. L. A method to help age American plaice in Division 3M.
91/69	N1953	CARLSSON, D. M., and P. KANNEWORFF. The shrimp fishery in NAFO Subarea 1 in 1990.
91/70	N1954	CARLSSON, D. M., and P. KANNEWORFF. Report on stratified-random trawl survey for shrimp (*Pandalus borealis*) in NAFO Subareas 0+1 in July-August 1990, and a comparison with earlier surveys.
91/71	N1955	SAVARD, L., I. H. McQUINN, and D. G. PARSONS. Investigating the potential of sequential population analysis for Northern shrimp (*Pandalus borealis*) in Division 0A.
91/72	N1956	SKÚLADÓTTIR, U. The Icelandic shrimp fishery (*Pandalus borealis*) in the Denmark Strait in 1989 and 1990.
91/73	N1957	RÄTZ, H. J. NAFO Subarea 1 golden and beaked redfish: spatial distribution pattern, survey abundance and biomass estimates in 1982-90 and length frequency in 1990.
91/74	N1958	CARLSSON, D. M. Data and preliminary assessment of shrimp in Subareas 0+1.
91/75	N1959	POWER, D., and A. K. CHUMAKOV. Abundance and biomass estimates of redfish (*Sebastes mentella*) in Div. 3LN from USSR groundfish surveys during 1972-1990.
91/76	N1960	HOVGÅRD, H. Preliminary assessment of Subarea 1 cod.
91/77	N1961	GASUIKOV, P. S., and R. S. DOROVSKIKH. Redfish stock size in Division 3M in 1990 and estimated TAC for 1992.
91/78	N1962	VAZQUEZ, A. Cod catch sampling of pair-trawlers fishing in Flemish Cap, 1988-1990.
91/79	N1963	FUCHS, F., and M. STEIN. A new method for estimating a hydrographic situation.
91/80	N1964	BRODIE, W. B., S. J. WALSH, and J. W. BAIRD. An assessment of the yellowtail flounder stock in Divisions 3LNO.

91/81	N1965	WALSH, S. J. Juvenile American plaice on the Grand Banks, NAFO Divisions 3LNO.
91/82	N1966	ZAMARRO, J. The American plaice stock on the Flemish Cap (NAFO Divison 3M).
91/83	N1967	BAIRD, J. W., C. A. BISHOP, and E. F. MURPHY. An assessment of the cod stock in NAFO Div. 3NO.
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