Northwest Atlantic Fisheries Organization

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SCIENTIFIC COUNCIL MEETING - JUNE 1992

Report of Scientific Council, June 1992 Meeting

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REPORT OF SCIENTIFIC COUNCIL

3-17 June 1992 Meeting

Chairman: V. P. Serebryakov Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada, on 3-17 June 1992, to consider the various matters listed in its Agenda (Appendix IV). Representatives attended from Canada, Cuba, Denmark (in respect of the Faroe Islands and Greenland), European Economic Community (EEC), Iceland, Japan, Russian Federation and an observer from United States of America (USA). The Executive Secretary and Assistant Executive Secretary were in attendance.

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

The opening session of the Council was called to order at 1000 hr on 3 June 1992.

The Chairman welcomed everyone to Dartmouth, and to the June 1992 Meeting.

The provisional agenda was addressed and adopted. The Assistant Executive Secretary was appointed rapporteur as was the usual practise.

The Chairman noted a new request from the Fisheries Commission, resulting from the Special Meeting of the Fisheries Commission, 11-15 May 1992, had been received. In accordance with Rule 4.3 of the Rules of Procedure, the Council unanimously agreed that this request for advice could be addressed by the Council during the course of this meeting.

The Council reiterated its standing invitation to the representative from the USA, and welcomed the observer from the National Marine Fisheries Service, Woods Hole, MA. The Council was informed that a request had been received from a non-Governmental Organization to attend this meeting as observers. The Council unanimously agreed not to extend an invitation at this time.

The Chairman informed the Council that there were some matters still outstanding from the 1-2 June 1992 Special Meeting of the Scientific Council on cod in Div. 2J+3KL. The Council unanimously agreed to convene sessions of that Special Meeting when time permitted during 3-4 June 1992, in order to complete all those outstanding matters.

The Council was informed by the Executive Secretary that he held proxy votes from Norway and Poland.

The session was then adjourned at 1020 hr on 5 June 1992.

The Council reconvened at 1045 hr on 13 June 1992 to consider nominations for the office of STACFIS Chairman (see Section IX below), and a new joint request for scientific advice received on that day from Canada and Denmark (Greenland) on the status of Greenland halibut in terms of the total area of stock distribution.

In view of the short time remaining at this meeting, and the uncertainty about the availability of all necessary data, the Council agreed not to open an agenda item to address this joint request, and to defer the consideration of this matter to the September 1992 Annual Meeting.

The session was adjourned at 1115 hr.

The Council reconvened again at 1710 hr on 16 June 1992. The reports of the Standing Committee on Research Coordination (STACREC) and the Standing Committee on Publications (STACPUB) were considered and adopted.

The session was adjourned at 1745 hr.

The concluding session was convened at 0915 hr on 17 June 1992. The Council then considered and adopted the Report of the Standing Committee on Fishery Science (STACFIS). Having addressed the STACREC recommendations for a new Rule of Procedure for data submission (see Section III.1b) and all other outstanding matters, the Council considered and adopted the Report of the Scientific Council of the 3-17 June 1992 meeting.

The meeting was adjourned at 1110 hr on 17 June 1992.

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.

The 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-X.

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

1. General Review

a) Catch Statistics

The Council noted with concern the difficulties experienced by STACFIS in determining the best estimates of catch levels in the 1991 fisheries. It supported the STACFIS recommendation that for the future, national representatives, at the same time as endeavouring to make all necessary data relevant to the assessments available to Designated Experts by May 15 (NAFO Sci. Coun. Rep. 1991, p. 44), should also attempt to provide as much catch/effort data (including preliminary data) as are available.

The Council agreed that in future, final estimates of catch should be determined as early as possible during the meeting in order to facilitate the assessments.

b) Commercial and Research Sampling

The Council shared the concerns of STACFIS and STACREC concerning current and future sampling of the commercial fisheries and the various research activities related to stocks assessed annually. It was agreed that this matter will be brought to the attention of the Fisheries Commission during the September 1992 meeting.

c) Timely Availability of Assessment Related Data

The Council once again expressed concern that much of the data required for completion of various assessments was not available until the first day of the meeting and that there was no indication of improvement of this situation over 1991. Because of this, considerable time was again spent by some Designated Experts after their arrival at the meeting in assessment preparation. The Council requested the Secretariat to circulate to all Contracting Parties, early in 1993, a special reminder indicating the importance of submitting all necessary data to the Designated Experts by the May 15 deadline and requesting compliance.

It was agreed that this issue will be brought to the attention of the Fisheries Commission during the September 1992 meeting.

2. General Fishery Trends

The Council noted that a substantial amount of provisional catch data for 1991 were not available, particularly from Canada-N, EEC-France (M), EEC-Spain, France (SP), Norway, and South Korea, therefore it was not possible to make any comparisons with last year's data.

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 (in respect of the Faroe Islands and Greenland) and the Fisheries Commission, and had advised on catch levels corresponding to reference levels 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 the assessments are as follows:

SUMMARY SHEET - Cod in Division 3M

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	0	0	0	0	0	0	0	0
Agreed TAC	13	13	13	0	0	0	13	13
Reported catches	14	15	11	2	1[1]	2[1]	8[1]	
Non-reported catches				-[2]	39	30	3	
Total landings	14	15	11	2	40[1]	32[1]	11[1]	
Sp. stock biomass								
Recruitment	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 were stable around 12 000 tons for 1980-87. Reported nominal catches were less than 2 000 tons from 1988 to 1990. Actual catches were estimated to be around 40 000 tons in 1989 and 31 500 tons in 1990. Total catch in 1991 was estimated to be 11 000 tons.

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. Stock biomass decreased from 1990 to 1991 according to the EEC survey results and also the USSR/Russian survey results when both trawlable plus pelagic biomass are considered.

Fishing Mortality: Uncertain but assumed to be high.

Recruitment: There are indications that the 1990 year-class may be relatively strong.

State of Stock: Spawning stock biomass, which had approached the minimum acceptable level of about 25 000 tons in 1990 (SCR Doc. 91/67) decreased by about 20% in 1991 even with maturation of the previously strong 1986 year-class.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =		
F_{91} =	No information available	
F_{max} =		

Recommendations: Previous attempts to impose moratorium failed. STACFIS therefore recommends that during 1993 the catch must be maintained at as low a level as possible and every effort be taken to prevent the catch of small fish. Exploitation of the expected relatively strong 1990 year-class must not occur until 1994 at the earliest when their mean length will be greater than 40 cm. (see Special Comments below)

Special Comments: Means of reducing catches of juvenile cod are discussed in "Responses to Questions by the Fisheries Commission".

SUMMARY SHEET - Cod in Divisions 3N and 3O

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC				Same as agreed.				
Agreed TAC	33	33	33	40	25	18.6	13.6	13.6
Reported catches	37	51	42	43	33[1]	18[1]	17[1]	
Non-reported catches	-	-	-	-	-	11	12	
Total landings	37	51	42	43	33[1]	29[1]	29[1]	
Sp. stock biomass	126	139	145	123	102	89	81	
Recruitment (age 3)	37	10	7	14	14	6	8	
Mean F (ages 7-10)	0.23	0.21	0.25	0.28	0.23	0.24	0.42	

[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 catches have subsequently declined. The 1991 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 was conducted using Canadian and USSR survey indices in a formulation of the adaptive framework and the Laurec-Shepherd technique. The results of both analyses were quite similar with regard to estimates of population abundance and fishing mortality.

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 0.2 and were stable between 0.2 and 0.3 from 1982 to 1990. The 1991 mean F for ages 7 to 10 was estimated to be 0.4. Fishing mortalities in recent years have been higher than average at younger ages.

Recruitment: Research vessel surveys indicate that the 1983 to 1988 year-classes are extremely weak. The geometric mean recruitment for the 1977-90 is approximately 20 million fish. There are indications that the 1989 year-class may be above average.

State of Stock: The SPA, calibrated with research vessel indices, indicates that the stock is at an extremely low level. The biomass increased in the early-1960s and peaked at 470 000 tons in 1967. It declined to 55 000 tons in 1976, but increased again to 220 000 tons in 1984. Another decline occurred in recent years and is currently estimated to be about 90 000 tons.

Forecast for 1993:

Option	Basis	Predicted catch (1993) ('000 tons)	Predicted SSB (1.1.1994) ('000 tons)
$F_{0.1}$	= 0.25	10.2	45.0
F_{max}	= 0.40	16.4	41.2
$F^{(91)}$	= 0.40	16.4	41.2

Recommendation: The 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 in 1993 should not exceed the estimated $F_{0.1}$ catch of 10 200 tons.

Special Comments: All necessary steps should be taken to eliminate the catch of small fish from this stock. The SSB is declining and will not begin to rebuild until the 1989 and later year-classes begin to make a contribution. The SSB may never improve beyond current estimates if fisheries on immature cod continue at current high levels. In addition, excessive harvesting of cod from this stock at age 2 will result in considerable loss of yield in the long term.

SUMMARY SHEET - Redfish in Subarea 1

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC			No TAC					
Agreed TAC	11.5	18	19	19	19	19	19	19
Reported catches	4	5	1	1	1[1]	0.5[1]	0.3[1]	
Total landings	4	5	1	1	1[1]	0.5[1]	0.3[1]	
Sp. stock biomass								
Recruitment (age 2)	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. 1992 catch lowest on record.

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

Fishing Mortality: No estimates.

Recruitment: No direct estimates but information from surveys on nursery grounds off West Greenland. O-group studies in 1990 and 1991 off West Greenland indicate high abundance of juvenile fish.

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

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available.	
F_{91} =		
F_{max} =		

Recommendations: 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	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	20	20	20	20	20	<50	43	35
Agreed TAC	20	20	20	20	20	50	50	43
Reported catches	20	29	44	23	48[1]	67[1]	38[1]	
Non-reported catches					10	16	17	
Total landings	20	29	44	23	58[1]	83[1]	55[1]	
Sp. stock biomass								
Recruitment (age 2)	No information available							
Mean F								

[1] Provisional. 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. In 1991 catches declined to 55 000 tons.

Data and Assessment: Catch rates declined from 1987 to 1991. Trawlable biomass estimates from EEC bottom trawl surveys and total biomass estimates from USSR/Russian trawl-acoustic surveys indicate a reduction from 1987 to 1991.

Fishing Mortality: No estimate available.

Recruitment: Russian bottom trawl survey in 1991 indicates high abundance of juvenile redfish.

State of Stock: Appears to be declining in recent years, based on both commercial catch rates and survey data. The average biomass estimated from Russian trawl-acoustic surveys from 1990 and 1991 is about 180 000 tons.

Forecast for 1993: Based on Y/R calculations.

Option	Basis	Predicted catch (1993) (tons)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	0.11	20 000	
F_{91} =		No information available	
F_{max} =	0.20	36 000	

Recommendations: Catches in 1993 should not exceed 20 000 tons (see Special Comments below).

Special Comments:

1) Continued declining trend of the stock and high fishing pressure indicate a danger of a long-term depression of the resource.

2) Considering the possible double counting of demersal biomass and that calculating an average biomass from a time series with a declining trend will result in an estimate biased upwards. STACFIS based its advice on the more conservative reference level.

SUMMARY SHEET - Redfish in Divisions 3L and 3N

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	25	25	25	25	25	25	14	14
Agreed TAC	25	25	25	25	25	25	14	14
Reported catches	21	43	71	45	32[1]	25[1]	18[1]	
Non-reported catches			7	8	2	4	7	
Total Landings	21	43	78	53	34[1]	29[1]	25[1]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Average catch was about 20 000 tons prior to 1985. In 1986, catches doubled to 43 000 tons and increased again in 1987 to 78 000 tons. Since then catches have declined steadily to 25 000 in 1991. TAC has been exceeded each year since 1985.

Data and Assessment: Catch rate indices derived for Div. 3L and Div. 3N generally not considered reflective of year-to-year changes in stock abundance. However, all indices indicate a general decline in recent years. Bottom trawl surveys by USSR/Russia in Div. 3LN and Canada in Div. 3L suggest a decline since 1984.

Fishing Mortality: No estimate available.

Recruitment: No estimate available but appears poor in Div. 3L since the early-1980s. In Div 3N a mode appeared in the Russian and Canadian surveys in 1991 at 12-14 cm but the strength of this cannot be evaluated.

State of Stock: Available indices exhibit considerable between-year variability but generally indicate a continuation of the stock declines noted during previous assessments.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: Catches be reduced and total catch for 1993 not to exceed 14 000 tons.

Special Comments: Catches for non-Contracting Parties in recent years have ranged from 6 900 tons in 1990 to 24 000 tons in 1987.

SUMMARY SHEET - Silver Hake in Divisions 4V, 4W and 4X

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	100	100	100	161	235	-	100	105
Agreed TAC	100	100	100	120	135	135	100	105
Reported catches	75	83	62	74	91[1]	69[1]	69[1]	
Sp. stock biomass								
Recruitment (age 1)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: 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. Nominal catches since 1970 ranged from a maximum of 300 000 tons in 1973 to a minimum of 36 000 tons in 1983. From 1977 to 1989, catches increased, from 37 000 tons in 1977 to 91 000 tons in 1989. Catches dropped to 69 000 and 68 000 tons in 1990 and 1991 respectively.

Data and Assessment: Catch-at-age from 1977 to 1991 were included in formulations of ADAPT using research vessel (juvenile and adult) and commercial CPUE indices. The estimate for age 1 (the 1990 year-class) had a high CV, was outside the range of historical age 1 values, and was thus considered unreliable. The size of this year-class was determined from comparisons of the juvenile RV index and SPA at age 1.

Fishing Mortality: Weighted fully recruited fishing mortality for ages 3-5 = 0.72, which is $F_{0.1}$.

Recruitment: The 1990 year-class is thought to be of average size, while that of 1991 is slightly below average.

State of Stock: Commercial standardized catch rates dropped in 1990 and 1991, to 50% of the peak level seen in 1989. Population biomass estimates for the RV survey declined since 1986, and are now below levels estimated for the mid-1970s.

Forecast for 1993: Catch in 1992 is expected to be 40 000 tons based on Canadian and non-Canadian allocations.

Option	Basis	Predicted catch (1993) (tons)	Predicted SSB (1.1.1994)
$F_{0.1}$	= 0.72	75 000	
F_{91}	=		
F_{max}	=		

Recommendations: TAC for 1993 be set at 75 000 tons based on projection at $F_{0.1}$.

Special Comments:

SUMMARY SHEET - American Plaice in Division 3M

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	2	2	2	2	2	2	2	2
Agreed TAC	2	2	2	2	2	2	2	
Reported catches	1.7	3.8	5.6	2.8	3.5[1]	0.8[1]	1.6[1]	
Non-reported catches		No information available						
Total landings								
Sp. stock biomass								
Recruitment (age 2)		No information available						
Mean F								

[1] Provisional.

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. By 1990 and 1991 the reported catches had declined to levels below the TAC of 2 000 tons.

Data and Assessment: No analytical assessment. Commercial data scarce in most years. Information from USSR/Russian survey (1972-91), and EEC survey (1988-91) used to evaluate stock status.

Fishing Mortality: No information available

Recruitment: 1986 year-class appears to be strong based on information from EEC surveys (1988-91)

State of Stock: SSB from EEC surveys appears to be relatively stable

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =		
F_{91} =	No information available	
F_{max} =		

Recommendations: TAC remain at 2 000 tons for 1993

Special Comments:

SUMMARY SHEET - American Plaice in Divisions 3L, 3N and 3O

Source of Information:

Year		1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC		49	55	48	28	30.3	24.9	25.8	25.8
Agreed TAC		49	55	48	40[1]	30.3	24.9	25.8	25.8
Reported catches		49.5	60.3	55.0	41.4	40.5[2]	23.9[2]	23[2]	
Non-reported catches		4.7	4.3	0	0.1	0.1	8.1	16	
Total catch		54.2	64.6	55.0	41.5	40.6[2]	32[2]	39[2]	
Sp. stock biomass	ADAPT	142	133	104	82	71	58	57	
	L/S	141	132	102	81	69	53	44	
Recruitment (Age 5)	ADAPT	141	114	109	104	97	169	135	
	L/S	139	102	79	67	63	98	110	
Mean F	ADAPT	0.67	1.04	0.80	0.84	0.74	0.73	0.51	
	L/S	0.68	1.06	0.82	0.88	0.84	0.87	0.59	

[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 a 18-year high of about 65 000 tons in 1986 to about 32 000-39 000 tons in 1990-91.

Data and Assessment: Analytical assessment of catch-at-age data was conducted using Canadian survey results in a formulation of the adaptive framework (ADAPT) and the Laurec-Shepherd (L/S) technique. Population estimates derived from the L/S analysis were lower than those from ADAPT.

Fishing Mortality: Both the ADAPT and L/S analyses indicate higher fishing mortalities (0.7-0.8) in recent years (1987-90) compared to those from the mid-1980s (0.5-0.6). Fully recruited F in 1991 is estimated to be slightly lower at 0.59 for L/S and 0.51 for ADAPT. This seems unlikely, given the increase in fishing effort in 1991. The L/S shows much higher Fs at ages 6-8 than ADAPT in 1988-91, 0.2-0.55 in L/S compared to 0.1-0.25 in ADAPT, with both showing the F at these ages to be higher in recent years, reflecting increased catches of juveniles in the Regulatory Area.

Recruitment: Both calibration analyses reflect a continued decline in recruitment at age 5 from levels over 250 million fish in the mid-1970s to about 150 million fish in the mid-1980s. ADAPT estimates the age 5 population in 1987-98 are about 100 million with the L/S estimates at about 60-80 million. Both analyses show values in 1990 and 1991 (1985 and 1986 year-classes) to be higher than the preceding 3 at 169 and 139 million from ADAPT and 98 and 110 million from L/S.

State of Stock: This stock is currently at a level far below historic levels. The ADAPT analysis indicates a 40% decline in age 5+ numbers from 1984 to 1991, while the L/S shows a decline of 60%. The SSB, measured as knife edge at ages 9+, has declined from about 180 000 tons in the early-1980s to between 44 000 (L/S) and 57 000 (ADAPT) tons in 1991.

Forecast for 1993:

Option Basis	Predicted catch (1993) ('000 tons)	Predicted SSB (1.1.1994) ('000 tons)
ADAPT:		
$F_{0.1}$ = 0.26	14.5	56.9
$F_{max} = F_{91}$ = 0.51	26.0	48.9
L/S:		
$F_{0.1}$ = 0.26	10.5	21.0
F_{max} = 0.50	18.8	17.0
F_{91} = 0.59	22.0	16.0

Recommendations: Fishing mortality must be reduced in 1993 to allow the 1985 and 1986 year-classes to contribute to the SSB. The $F_{0.1}$ catches derived from both calibration analyses are 10 500 (L/S) and 14 500 (ADAPT). Given the low SSB and preliminary results from the 1992 survey, indicating a further decline, it may be advisable to accept the lower of the $F_{0.1}$ estimates.

Special Comments: Catches of 30 000 tons in 1992 (TAC plus estimate for non-Contracting Parties) will generate fishing mortalities of 0.6 (ADAPT) or 0.8 (L/S) and a continued decline in SSB. The current analyses indicate the 1992 $F_{0.1}$ catch to be between 14 000 and 17 000 tons. This would suggest that a reduction in the 1992 catch may be prudent.

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

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	5	5	5	5	5	5	5	5
Agreed TAC	5	5	5	5	5	5	5	5
Reported catches	9	9	8	7	4[1]	2.7[1]	3.3[1]	
Non-reported catches[2]						1.4	1.5	
Total landings						4.1[1]	4.8[1]	
Sp. stock biomass								
Recruitment (age 2)	No information available							
Mean F								

[1] Provisional.
[2] Data inadequate to estimate misreported catches prior to 1990.

Weights in '000 tons

Catches: In the period 1970-84 catches ranged from a low of 2 400 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 in recent years.

Data and Assessment: Estimates of stock size from research vessel surveys were variable, and were not considered adequate for this stock because they do not cover deeper areas where witch flounder are also found. Abundance indices are not adequate to base 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 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: TAC of 5 000 tons for 1993.

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

SUMMARY SHEET - Yellowtail Flounder in Divisions 3L, 3N and 30

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	15	15	15	15	5	5	7	7
Agreed TAC	15	15	15	15	5	5	7	7
Reported catches	24.0	24.5	16.3	16.2	9.1[1]	8.9[1]	7.0[1]	
Non-reported catches	5.0	5.7	0	0.1	1.1	5.1	8.1	
Total landings	29.0	30.2	16.3	16.3	10.2[1]	14.0[1]	15.1[1]	
Sp. stock biomass								
Recruitment (age 2)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: Catches peaked in 1972 at 39 000 tons, declined rapidly, then 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 to about 10 000 tons in 1989 but increased to 13 000 and 15 000 tons in 1990 and 1991 respectively. Considerable uncertainty exists with the catch data for this stock.

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

Fishing Mortality: No information available.

Recruitment: The 1984-86 year-classes appeared to be stronger than the 3 preceding weak year-classes. The 1988 year-class appears to be strong from the results of juvenile surveys in 1990 and 1991.

State of Stock: The stock remains at a low level. Potential growth of the stock from the 1984-86 year-classes has not occurred, likely because of large catches of juveniles from these cohorts by fisheries in the Regulatory Area.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: TAC of 7 000 tons for 1993 (see Special Comments below).

Special Comments: Continuation of the current exploitation pattern towards juveniles in some fisheries will result in decreased yield-per-recruit. Catches by non-Contracting Parties have increased in 1990 and 1991. Unless total catches are reduced from present levels of double the TAC, the stock will likely remain at its current low level, with some fisheries dependant only on the strength of recruiting year-classes at very young ages.

SUMMARY SHEET - Greenland Halibut in Subareas 0 and 1

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	25	25	25	25	25	25	25	25
Agreed TAC								
Reported catches	10	9	10	10	10[1]	20[1]	21[1]	
Sp. stock biomass								
Recruitment (age 2)	No information available							
Mean F								

[1] Provisional.

Weights in '000 tons

Catches: The catches increased in 1990 and again in 1991 due to increased fisheries in Div. 0B by Canada, Faroe Islands and USSR/Russia. In Subarea 1, 92% of the catch was taken by Greenland in the fjords of West Greenland mainly by 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: The offshore component in Subarea 0B is now exploited slightly above the level experienced around 1980. The offshore fishery in Div. 1CD is still insignificant.

Forecast for 1993:

Option	Basis	Predicted catch (1992)	Predicted SSB (1.1.1993)
$F_{0.1}$ =		No information available	
F_{91} =			
F_{max} =			

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

Special Comments:

SUMMARY SHEET - Greenland Halibut in Subarea 2 and Divisions 3K and 3L

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	75	100	100	100	100	50	50	50
Agreed TAC	75	100	100	100	100	50	50	50
Reported catches	19	16	31	19	19[1]	29[1]	35[1]	
Mis-reported catches						18	20-40	
Total landings	19	16	31	19	19[1]	47[1]	55-75[1,2]	
Sp. stock biomass								
Recruitment (age 2)	No information available							
Mean F								

[1] Provisional.
[2] STACFIS could not reliably estimate total landings in 1991.

Weights in '000 tons

Catches: Peaked at 38 500 tons in 1978 then declined to an average of 20 000 tons from 1985-89. Increased sharply in 1990 and 1991 mainly due to developing fishery in the Regulatory Area of Div. 3LM. Canadian catches relatively stable in recent years, with declines in gillnet catches offset by increases in otter trawl catches.

Data and Assessment: Analytical assessments considered unacceptable until migratory patterns and stock structure are fully understood. Research vessel surveys continue to give the more important indices of abundance for the stock distributed in the survey area.

Fishing Mortality: Unknown

Recruitment: Until the 1991 survey, the year-classes of 1984-86 appeared to be relatively strong. The results in 1991 suggest that they are now less abundant.

State of Stock: Most of the indices of abundance for 1991 indicate a decline from 1990. The number of older fish in the survey areas continues to decline. The decline in some indices may not be due entirely to the fishery.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: Catches should be reduced in 1993 to the level advised (50 000 tons), which is for the entire stock, including the portion in the Regulatory Area in Div. 3LM. Until more is known of stock structure, precautionary measures to prevent concentration of effort on one segment of the stock area should be considered.

Special Comments: The effect on the stock of continued catches in the Regulatory Area at 1990 and 1991 levels is unknown, but STACFIS cautions about possible over-exploitation of parts of the stock. Past advice for this stock has been to distribute fishing effort over a wide area if possible. The deepwater survey results indicate that Greenland halibut densities in Div. 3LM in fall 1991 were lower than in Div. 3K.

SUMMARY SHEET - Roundnose Grenadier in Subareas 0 and 1

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	8	8	8	8	8	8	8	8
Agreed TAC	8	8	8	8	8	8	8	
Reported catches	0.06	0.09	0.38	0.52	0.05[1]	0.15[1]	0.15[1]	
Total landings	0.06	0.09	0.38	0.52	0.05[1]	0.15[1]	0.15[1]	
Sp. stock biomass								
Recruitment (age 2)	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 only fish areas with depths less than 1 500 m and roundnose grenadier occur in deeper waters. The trawlable biomass estimates for Div. 1CD in 1987, 1988 and 1991 were about 45 000 tons. The 1989 estimate of 5 900 tons and 20 300 tons in 1990 were not considered to be realistic. Surveys do not cover the entire stock area.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: TAC for 1993 remain at 8 000 tons.

Special Comments:

SUMMARY SHEET - Roundnose Grenadier in Subareas 2 and 3

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	11	11	11	11	11	11	11	11
Agreed TAC	11	11	11	11	11	11	11	
Reported catches	5	7	8	6	5[1]	4[1]	5[1,2]	
Non-reported catches								
Total landings	5	7	8	6	5[1]	4[1]	9-14[1,2]	
Sp. stock biomass								
Recruitment (age)	No information available							
Mean F								

[1] Provisional.
[2] STACFIS could not reliably estimate total landings in 1991.

Weights in '000 tons

Catches: Prior to 1979 catches averaged about 26 000 tons but have since declined to an average of about 5 000 tons. In 1991 STACFIS could not precisely estimate the actual catch but determined it to be within the range of 9 000-14 000 tons.

Data and Assessment: 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 is unknown.

Fishing Mortality: No estimate available.

Recruitment: No estimate available.

State of Stock: Not possible to evaluate.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =		
F_{91} =		
F_{max} =		

Recommendations: TAC for 1993 remain at the 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 Division 3L

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	60	130	283	90	335	350	[1]	[1]
Agreed TAC	26	55	25	45	46	56	56	32
Reported catches	25	48	20	54	51[2]	47[2]	21[2]	
Non-reported catches								
Total landings	25	48	20	54	51[2]	47[2]	21[2]	
Sp. stock biomass	596	1300	2830	900	3345	3500	1900[3]	
Recruitment[4] (age 2)	73.2	63.7	87.8	380.4	314.8	353.2	7.7	
Mean F	No information available							

Weights in '000 tons

[1] STACFIS concluded that a catch of 50 000 tons would be below 10% exploitation rate. The 1992 advice is now revised to 30 000 tons.
[2] Provisional.
[3] Up to 1990, these are projected. The 1991 estimate is back-calculated.
[4] Recruitment at age 2 in the year shown. 1985 is projected from acoustic surveys. From 1986 to present, measured directly from acoustic surveys.

Catches: All catches are inshore and determined by market. The dominant market is the Japanese roe market.

Data and Assessment: Projections from acoustic survey estimates of recruiting year-classes.

Fishing Mortality: Not estimated but assumed to be very low. Recommended TAC based on exploitation rate of 10%. Catches were much lower than recommended TAC in recent years.

Recruitment: Estimated from acoustic surveys. 1989 year-class at age 2 from acoustic survey, 1988 year-class in 1991 estimated from a significant relationship between inshore trap catch rates and mature biomass from same year acoustic survey.

State of Stock: High during late-1980s but now declining.

Forecast for 1993: 1992 biomass projected to be about one-third of 1989 and 1990 levels during Special Meeting, March 1992. Recent evidence suggests this is optimistic and spawning biomass may be below 500 000 tons. Based on projection from 1992 acoustic estimate, 1993 mature biomass is projected to be 213 000 tons.

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: Previous advice for 1992 that a catch of 50 000 tons would not exceed 10% exploitation rate revised down to 30 000 tons. Preliminary prognosis for 1993 indicates a catch of 21 000 tons would approximate a 10% exploitation rate.

Special Comments: Based on recent analysis, the goal of providing a TAC of 10% of the projected mature biomass has been met reasonably well. The actual TACs and landings have been well below the advised TAC. STACFIS concluded that fishing has not contributed to the present decline in the capelin stock.

Data from inshore in 1992 will allow validation of the prognoses for 1992 and further evaluation of the preliminary 1993 prognosis.

SUMMARY SHEET - Capelin in Divisions 3N and 3O

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	0	0	10	10	28	30	30	30[1]
Agreed TAC	0	0	10	15	28	30	30	30
Reported catches	+	0	1	7	5[2]	21[2]	+[2]	
Non-reported catches								
Total landings	+	0	1	7	5[2]	21[2]	+[2]	
Sp. stock biomass[3]	212	527	273	560	28	-	-	
Recruitment (age 2)	No information available							
Mean F								

[1] Scientific Council later considered this may exceed 10% exploitation rate.
[2] Provisional.
[3] 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 of the spawning stock after 1989.

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

Recruitment: No estimates of recruitment at age 2 as in other capelin stocks.

State of Stock: Mean stock size 1981-89 was about 303 000 tons. USSR acoustic survey during 1975-77 indicated mean biomass of 912 000 tons. No fish were located during the normal spawning period in 1991.

Forecast for 1993: No projections but based on parallel patterns of abundance with other spawning stocks, this stock is probably declined to a very low level in 1992 and is expected to be at a low level in 1993.

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: Recommend that no directed capelin fishery be allowed during 1993.

Special Comments: The Scientific Council is concerned about apparent low abundance levels and their impacts on future recruitment and predator stocks.

SUMMARY SHEET - Squid in Subareas 3 and 4

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	150	150	150	-	-	-	-	-
Agreed TAC	150	150	150	150	150	150	150	150
Reported catches	1	+	2	1	7[1]	11[1]	1[1]	
Sp. stock biomass								
Recruitment	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 in 1989 and 1990 but declined again in 1991.

Data and Assessment: Only commercial fishery catch data available in recent years. No commercial sampling or research presently conducted.

Fishing Mortality: No information available.

Recruitment: No information available.

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

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{sq} =		
F_{max} =		

Recommendations: No advice possible.

Special Comments: STACFIS was not able to provide advice without up-to-date information on squid, especially for recruitment. No research is presently being conducted on this stock.

SUMMARY SHEET - Shrimp in Subareas 0 and 1

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Offshore SA 0+1 (south of 71°N)								
Recommended TAC	36	36	36	36	44	50	50	50
Agreed TAC[1]	42.1	42.1	40.1	40.1	40.1	44.9	46.2	44.2
Reported catches	42.2	44.6	46.2	43.6	49.9[3]	52.8[3]	57.3[3]	-
Offshore SA 1 (north of 71°N)								
Recommended TAC	-	-	-	-	-	-	2.5	-
Agreed TAC	-	-	11.6	11.5	8	6.8[2]	6.8[2]	6.4[2]
Reported catches	4.3	11	10.7	6.7	2.5[3]	2.1[3]	1.1[3]	-
SA 0+1 total (including inshore catches in SA 1)								
Reported catches	54.0	63.1	63.8	60.5	68.1[3]	69.6[3]	76.3[3]	-

[1] Not including catches of vessels <75 GRT. Weights in '000 tons
[2] Including the area from 69°30'N to 71°N, west of 58°W.
[3] Provisional.

Catches: Increased to about 50 000 tons in 1976, decreased to about 45 000 tons in 1980-84, then gradually increased to 76 000 tons in 1991.

Data and Assessment: Research survey indices showed an increase from 1988 to 1989 followed by a decline to 1991. Catch-rate indices from the commercial fishery showed that the abundance in 1988-91 is lower than the 1987-88 level.

Fishing Mortality: No information available.

Recruitment: 1986 and 1987 year-classes weaker than 1985 year-class.

State of Stock: In contrast to the 1987-88 situation, the success of the fishery and the level of the stock is dependent in 1992 and 1993 on only the 1985 year-class. There is concern that the spawning biomass will be reduced to the lowest level observed since 1981.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{91} =		
F_{max} =		

Recommendations: TACs for 1992 and 1993 not to exceed 40 000 tons for Subarea 0 and Subarea 1 offshore south of 71°N.

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

STACFIS recommended that *measures to reduce discards should be established (e.g. increase in mesh size) and that shrimp discarding should be closely monitored.*

SUMMARY SHEET - Shrimp in Denmark Strait

Source of Information:

Year	1985	1986	1987	1988	1989	1990	1991	1992
Recommended TAC	5.0	-	-	-	10	10	10	8
Agreed TAC[1]	6.1	7.5[2]	7.7[2]	8.7[2]	9[2]	14.1	14.5	13.0
Reported catches	8.1	11.0	12.2	12.6	10.7[3]	10.3[3]	8.7[3]	
Sp. stock biomass								
Recruitment (age 2)	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 about 10 300 tons in 1990 and further to just below 8 700 tons in 1991.

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

Fishing Mortality: Not known.

Recruitment: Not known.

State of Stock: The abundance in recent years has been reduced to a low level, primarily due to a decrease in the abundance of females. Prospects for 1992 and 1993 appear to be poor in that no strong year-classes are evident from the 1991 and preliminary 1992 fishery data. These conditions appear to be related to fishing pressure, but might also be caused by a change in distribution of the stock.

Forecast for 1993:

Option Basis	Predicted catch (1993)	Predicted SSB (1.1.1994)
$F_{0.1}$ =	No information available	
F_{sq} =		
F_{max} =		

Recommendations: Based on the continued depressed condition of the stock, STACFIS advices that the TAC for 1993 should be 5 000 tons. STACFIS anticipates that this TAC level of 5 000 tons will have to be maintained for several years in an attempt to provide protection for the spawning biomass and rebuild the stock.

Special Comments: Discard rates observed in 1990 and 1991 indicated that these removals are significant and STACFIS recommends that *discarding should be monitored closely.*

4. Future Yields

The Council noted that throughout its report, STACFIS had provided various recommendations and suggestions aimed at increasing future yields from the various stocks. The potential benefits may be jeopardized, however, through continued uncontrolled activities of non-Contracting Parties fleets in the Regulatory Area. It was agreed that this matter will be brought to the attention of the Fisheries Commission during the September 1992 Meeting.

5. Responses to Questions by the Fisheries Commission

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

a) Cod in Divisions 2J, 3K and 3L (SCR Doc. 92/68)

The Scientific Council was again requested 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 was also requested on the age composition of that portion of the stock occurring in the Regulatory Area.*

The stock separation issue has been reviewed previously (NAFO Sci. Coun., Rep. 1986) and it was then concluded that it was appropriate to assess cod in Div. 2J, 3K and 3L as a single stock complex. There is currently no additional information to change this conclusion.

Estimates of the proportion of the cod biomass in Div. 3L in the Regulatory area were updated to include the 1991 research vessel survey data. The results for autumn surveys were similar to those presented previously, although the 1991 spring survey estimate of biomass in the Regulatory area (10.8%) was the highest in that time series. The results from the survey series used are as follows:

Season RV survey conducted	Years RV survey conducted	Range of proportions of Div. 3L biomass occurring in the Regulatory Area (1991 value in brackets)	Average proportion (%)
Winter	1985-86	23.8-26.8	25.3
Spring	1977-91	0.4-10.8 (10.8)	3.5
Autumn	1981-91	0.5-7.7 (2.9)	3.0

The proportions observed are estimates for the months in which the surveys were conducted and may not represent distributions in non-surveyed months. Although only two winter surveys have been conducted, the proportion of biomass in the Regulatory Area at that time appears to be substantially higher than at other times. This pattern is also supported by the occurrence of a commercial fishery in the area, mainly during the winter months. The higher proportion of biomass in the Regulatory Area during the spring of 1991 may have also occurred during winter as cod catch rates by fleets fishing in the Regulatory Area during winter were higher than usual.

Results of the autumn surveys 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 was as follows:

Division	Relative proportion of Div. 2J+3KL biomass (%)
2J	36
3K	36
3L	28

Survey data indicated that the proportion of total stock biomass occurring in the Regulatory Area was less than 10% in winter, less than 5% on average in spring and autumn, and there were no annual trends. However, information available from research vessel surveys and the commercial fisheries in Div. 2J+3KL in recent years (1989-91) suggests that there has been a shift in distribution in a southerly direction and as well to deeper waters. If changes in the stock distribution pattern continue, predicting future proportions will be difficult.

Age compositions derived from spring and autumn surveys in Div.3L indicate that for most years there was a higher proportion of younger cod in the Regulatory Area. Estimates for winter surveys showed that age compositions were similar in both areas. Age compositions for the entire Div.2J+3KL cod research vessel survey biomass were similar to those which occurred in Div.3L inside the 200-mile fishing zone.

b) Squid in Subareas 3 and 4

With respect to squid in SA 3 and 4, the Scientific Council was asked to: *examine all data available to it and if possible to present options for management of the stock that are based on the NAFO principles of optimum utilization and conservation.* The Council was also asked to: *provide information on the distribution throughout the year of the stock and on the factors that determine whether the resource becomes available within the NAFO area.*

STACFIS noted that as in the recent past, no new information pertaining to squid in SA 3 and 4 was available for review at this meeting. The resource only occurs in the NAFO area during summer through migration from more southern areas. Availability has been extremely variable. No research is planned for 1992 or future years, and STACFIS will not be able to provide any information to the Fisheries Commission pertaining to squid in SA 3 and 4 until this situation changes.

c) Capelin in Divisions 3NO

With respect to capelin in Divisions 3NO, the Scientific Council was requested to: *advise on the most rational level of management, 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. Management options such as maintaining minimum spawning biomass, a 10% and a 20% exploitation rate should be evaluated in terms of both maintaining stock size and the impact on the ecosystem.*

STACFIS noted that it had responded to the extent that the scientific information allowed to a similarly worded request in 1991 (NAFO Sci. Coun. Rep., 1991, p. 101-104). No further analyses have become available since that meeting and STACFIS had no reason to alter the conclusions in that report. In view of the potential for large variances associated with projections for capelin stocks and its importance as a prey species especially for commercially important predators such as cod and flatfish, STACFIS reiterated its recommendation of a conservative approach to management. Currently, there is a lack of data for this stock but the available information indicates that the stock is probably very low in abundance. Consequently, STACFIS recommended that a *closure of the commercial fishery in 1993 be placed to provide maximum protection for the stock.*

STACFIS was concerned about the lack of response from the Fisheries Commission to its answer to the 1991 request, except for a repeat of the question by Fisheries Commission with only minor word changes. Some comments on the previous response would have been useful in formulating a response to the present request.

d) Standard Mesh Size for Otter Trawling

The Scientific Council was requested to :

- *review further the question of a standard 130-mm mesh size for otter trawling in the Regulatory Area, and particularly to consider the species for which derogation would be required. The Council is asked*

to include consideration of area and season in this review, to advise on appropriate mesh sizes for fisheries for which the 130 mm would be too large, to advise on appropriate by-catch limits for other species (in aggregate or individually) in fisheries using small mesh sizes and to report on any interactions between the various fisheries.

- *analyze the various technical measures which could permit the elimination of massive catches of juvenile flatfishes in the NAFO area. This should cover the implementation of minimum legal sizes and the introduction of a single basic mesh size. Special attention should be paid to multispecies analyses and especially technical interactions.*

- *consider the question of a minimum fish size for cod in the different parts of the Regulatory Area, both in terms of the current regulation of mesh size in otter trawls and in terms of increasing yield per recruit.*

- *with respect to cod in Div. 3M, the Scientific Council is requested to provide advice on means of improving the utilization (yield-per-recruit) of the resource.*

- *with respect to redfish in Div. 3M, the Scientific Council is requested to provide advice on means of reducing the harvest of juvenile fish, including such factors as the seasonality of fishing.*

At its Special Meeting of 11-14 May 1992, the Fisheries Commission agreed to forward an additional request for scientific advice from the Scientific Council. The following text was agreed at that meeting:

> *"In addition to the request in paragraph 9 of NAFO/FC Doc. 91/10 on a standard 130 mm mesh size, the Scientific Council is asked to evaluate the effect of introducing one uniform mesh size, irrespective of material, thus deleting note 2 in Part V - Schedule IV of the NAFO Conservation and Enforcement Measures."*

STACFIS decided to provide a single response to these requests since the problems which they imply and the possibilities for amelioration are common to all of them.

i) Standard 130 mm mesh size for otter trawling

At present, NAFO regulations permit the possibility of using either 120 mm or 130 mm mesh size depending on the material with which the net is constructed. (FC Doc. 91/7, Part V, Schedule IV). STACFIS is of the opinion that the between-haul selectivity of fishing gears is such that it is unlikely that the expected selectivity of trawl nets made of different materials is significantly different. A standard mesh size of 130 mm, irrespective of material used in the construction of the net, should be adopted.

ii) Derogations from the use of 130 mm mesh size

The only trawl fisheries in the Regulatory Area for which a derogation from the use of 130 mm are justified are those for capelin and squid. For these fisheries a lower legal minimum mesh size should be permitted. At present, the legal minimum mesh size for fishing for squid in the Regulatory Area is 60 mm. There is, at present, no legal minimum mesh size for fishing for capelin in the Regulatory Area.

STACFIS is, at present, not in a position to comment on considerations of area and/or season which might be relevant in this context.

Fisheries for either squid or capelin in the Regulatory Area are not known to catch any other species. In principle, therefore, there should be a zero by-catch limit for other species. There is no known technical interaction between the capelin and squid fisheries or between fisheries for squid or capelin and fisheries for other species.

Consideration should be given to adopting a one-mesh size rule for those vessels wishing to use meshes less than 130 mm. If this condition is not imposed there is considerable risk that fishermen will deliberately exploit species other than capelin and squid with nets of less than 130 mm mesh but, when their catches are inspected, will claim that 130 mm mesh was used to take these catches.

iii) Reduction in the catches of juvenile fish

- Flatfish.

At present, catches of large quantities of juvenile flatfish of lengths less than 25 cm occur in fisheries by mobile gears for American plaice and yellowtail flounder on the Grand Banks (Div. 3NO). Four possibilities for reducing these catches by the implementation of technical measures were considered.

Closed areas. Areas of high density of juvenile American plaice and yellowtail flounder have been identified on the Grand Banks. Closure of such areas to fishing by mobile gears would undoubtedly reduce catches of the juveniles. However, adults also inhabit the areas of high juvenile density and hence catches of adults would also be severely affected.

Closed seasons. The majority of information on the distribution of juvenile American plaice and yellowtail flounder comes from surveys carried out in August and September and therefore the distribution of juveniles at other times of year is not as well known. However, limited information from Spring surveys indicates that juveniles do not change their distribution seasonally and the probable effectiveness of seasonal closure is therefore dubious.

Modification of the rigging of towed gears. In principle it may be possible to reduce the numbers of juveniles which enter towed nets by specifying towing speeds, size of bobbins, bridle angles etc. In practise, the extent of knowledge on the effect of such factors is limited and it would be difficult to draft regulations in such a way that the required rigging could be enforced.

Improvement in codend selectivity by increase in mesh size or effective mesh size. The selection factor of both American plaice and yellowtail flounder lies between 2.2 and 2.4. and the selection range (L50-L25) is about 3 cm. Enforcement for mobile gears of a mesh size of 130 mm, free of attachments, should therefore result in the capture of a very low proportion of individuals of these species of lengths less than 25 cm. The fact that this is currently not the case indicates that real mesh sizes are considerably lower than 130 mm and/or various means (legal or otherwise) are being employed to significantly reduce the selectivity of the nets. STACFIS is of the opinion that rigorous enforcement of legally rigged 130 mm mesh size offers the highest probability for reduction in catches of juvenile American plaice and yellowtail flounder while maintaining fisheries on the adults.

- Improving the utilization (yield-per-recruit) of cod in Div. 3M

The selection factor for cod lies between 3.4 and 3.7 and the selection range (L50-L25) is approximately 4 cm. On this basis it would be expected that very few cod of length less than 40 cm should be caught in otter trawl fisheries. In fact, various fisheries by mobile gears for cod in Div. 3M are known to catch cod of sizes well below those expected, if the participating vessels employ legally-rigged 130 mm mesh. STACFIS therefore reaches the same conclusion for cod in Div. 3M as that for flatfish on the Grand Banks i.e. rigorous enforcement of legally rigged 130 mm mesh should eliminate most or all of these catches and thereby increase yield-per-recruit of cod.

- Reduction of the harvest of juvenile redfish in Div. 3M

  The selection factor and selection range of redfish for those gears used in its fisheries are not well defined. However, it appears highly probable that enforcement of legally rigged 130 mm mesh would lead to reduction in the harvest of juvenile redfish.

  STACFIS is not able, at present, to comment on such factors as seasonality (or regionality) of redfish fisheries which might be relevant in the present context.

- Other effects of enforcement of 130 mm mesh size

  STACFIS also notes that there are a number of other fisheries which exhibit symptoms similar to those described above (e.g. Div. 3LN cod and redfish). For all of these fisheries, enforcement of legally-rigged 130 mm mesh would result in increased yield-per-recruit. In addition, the state of the stocks of species caught as by catch in various areas would also be improved (e.g. American plaice in Div. 3M).

iv) Minimum legal landing sizes

Minimum legal landing sizes should be instituted as an adjunct to effective enforcement of 130 mm legal minimum mesh size. The main purpose of such a measure is to discourage fishermen from attempting to reduce the selectivity of their gears.

Initially, legal minimum landing sizes should be established for those species of highest importance in the otter-trawl fisheries. STACFIS suggests that the legal minimum landing sizes should approximate the 25% retention length for each species and that a single value for each species should be applied universally throughout the Regulatory Area. The legal minimum landing sizes should lie within the range of values indicated below. (A range is presented to accommodate the various estimates of selection factors for each species).

Cod	40-45 cm
American plaice	25-28 cm
Yellowtail flounder	25-28 cm

At present, no advice can be given for other species because of the lack of information on selectivity parameters.

v) Non-Contracting Parties

Fleets registered in non-Contracting Party countries and fishing for cod and flatfishes in the Regulatory Area are assumed to employ mesh sizes well below 130 mm (possibly as low as 60-70 mm). These vessels are not bound by NAFO regulations and are unlikely to be affected by any measures implemented by NAFO to improve the selectivity of trawls.

If the selectivity of trawlers of NAFO members is improved, the numbers of young fish caught will be reduced leading to an immediate increase in the numbers and biomass of young fish in the sea. This will give rise, at a later date, to an increase in the numbers and biomass of fish of all ages. Non-Contracting Parties will benefit both immediately and in the longer term from this increase and it is possible that they will take much of the expected gain in yield and that increase in biomass will be less than that achievable if all trawlers adhered to NAFO regulations.

6. Environmental Research

The Council noted that the Environmental Subcommittee of STACFIS had met on 9 and 13 June 1992 with M. Stein as Chairman. The number of documents reviewed on both environmental issues and biologically oriented subjects had substantially increased from 1991.

The Council was encouraged by the growing interest on environmental issues in relation to the status of certain stocks and saw the value of having an overall view of environmental conditions before the stock assessments were undertaken. Accordingly, the Council endorsed the recommendation that the Environmental Subcommittee meet at the beginning of the June Meeting of the Scientific Council. The Council, however, noted the discussion on the problem of how to incorporate environmental information in the assessment procedures, and was encouraged by the Subcommittee's continuing work on finding methods of linking environmental conditions to changes in the fisheries.

The Council was particularly pleased to note attempts were being made to cooperatively computerize and analyze some of the large databases in Germany and Russia.

7. Ageing Techniques

The Council noted that the collaborative ageing work on silver hake being done between Canada and USSR/Russia will result in a comprehensive manual, when the current work on nucleotides were completed.

The Council was pleased the ageing workshop held at St. John's, Newfoundland during 3-12 December 1991 provided scientists from Canada, Denmark, France, Germany, Portugal and Spain involved in ageing techniques for American plaice and Greenland halibut, a forum for discussion, comparison and understanding of techniques employed on otoliths and scales. It is noted that further exchanges of materials will take place and a follow-up meeting is proposed for probably sometime in 1993.

In addition, the Council noted two further scientific papers on ageing were reviewed by STACFIS.

8. Gear Selectivity

The Council noted that discussions relevant to this subject was part of the responses to the Fisheries Commission requests.

9. Review of Scientific Papers

The Council noted that 10 papers, which were not reviewed by STACFIS during the general assessments, were reviewed and summarized separately.

10. Other Matters

a) Review of Arrangements for Stock Assessments

The Council noted with concern that STACFIS was continuing to face difficulties in obtaining catch information for many stocks on a timely basis and endorsed the recommendation that all available information should be reviewed before the commencement of the assessment reviews.

b) Special Sessions

The Council noted the comprehensive discussions on the 1992, 1993 and 1994 Special Sessions as reported by STACFIS.

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

1. Fishery Statistics

a) The Council reiterated the great concern as expressed by STACREC on the delays in the national reporting of fishery statistics through the STATLANT 21A and 21B system. In addition to STATLANT 21A data, the delays now being experienced in receiving the STATLANT 21B data (1989-91) were of particular concern. While these delays in submission of data were seriously affecting the stock assessment work and the publication of the *Statistical Bulletin*, the Council was also concerned that these delays seriously affect other NAFO business.

The Council noted with serious concern that *NAFO Statistical Bulletin* Vol. 39 was long overdue. The Council also took note that although the updating of the catch and effort database back to 1960 was completed last year, the 30-year time series compilation by the Secretariat was awaiting the disaggregated data from France for the 1983-85 period.

The Council endorsed the STACREC suggestion that all data collected by other Standing Committees, particularly STACTIC and STACFAC, be identified and relevant data be made available for use in the stock assessments prior to the June meeting.

b) The Council agreed with STACREC on the need to resolve the difficulties associated with obtaining STATLANT data in time for stock assessments, and discussed the recommendation by STACREC that a new Rule be inserted in the Scientific Council Rules of Procedure. The Executive Secretary prepared, as requested, a draft of an appropriately worded Rule based on the conditions and dates recommended by STACREC.

The Council decided to bring to the attention of the General Council and the Fisheries Commission the grave consequences to the stock assessment process, and subsequent fisheries management decisions, of the increasing delay in the provision of fisheries data. It was agreed to pursue actively the establishment of a legal obligation on Contracting Parties with regard to the schedule for the provision of data envisaged in Article VI, para. 3.

> "The Contracting Parties shall furnish to the Scientific Council any available statistical and scientific information request by the Council for the purpose of this Article."

The Executive Secretary was asked to place the matter on the Agenda of the two other bodies of the Annual Meeting in September.

The Council noted that STACREC suggested the deadline date of 15 April for STATLANT 21A data be changed to 15 May, specifically to accommodate difficulties faced by some statistical offices to meet the earlier deadline date and to ensure all nominal catch data would be available in advance of the June Meeting of the Scientific Council.

Recognizing that STATLANT 21B data are also necessary in time for the June Meeting of the Council, the Council endorsed the recommendation that the Secretariat should consult Contracting Parties on a practical deadline for submission of these data.

In addition the Council agreed, that in order to facilitate the work of the Designated Experts, national representatives provide the necessary data to Designated Experts in time for incorporation in the assessments before the June Meeting of the Scientific Council.

c) The Council noted that STACREC had reviewed the customary document prepared by the Secretariat which is due to be presented at the 15th Session of the CWP meeting in July 1992.

Noting that the Chairman of STACREC was unavailable to attend the CWP meeting, the Council endorsed the recommendation that H. Lassen (EEC-Denmark) or H. P. Cornus (EEC-Germany) be requested to attend that meeting. As recommended at the June 1991 Meeting, it was hoped that a representative from Russia will attend the meeting.

2. Biological Sampling

a) The Council was pleased that the data necessary for the *Inventory of Sampling Data* for the period 1985-89 were received, and the publication will be completed this year.

b) The Council noted with concern that the level of biological sampling of the fisheries in the Regulatory Area carried out by the national programs in 1993 may be severely decreased due to funding constraints. Emphasizing that without adequate sampling in the Regulatory Area the assessment of stocks will be severely hampered, the Council urged Contracting Parties to maintain the representative biological sampling.

3. Biological Surveys

The Council noted STACREC had reviewed the inventories of surveys conducted in 1991 and surveys proposed for 1992 and early 1993. The Council again welcomed the publication of the list of surveys on a stock by stock basis in the SCS Document Series.

The Council was concerned that there was a high probability that the usual surveys conducted by the Russian Federation may be cancelled in 1992 and 1993, and hoped that at least the more essential surveys will not be discontinued. In general the Council agreed with STACREC that the main priority should be to maintain the existing survey programs rather than to initiate new ones.

The Council endorsed the STACREC recommendation that descriptions of surveys related to Greenland halibut be compiled and considered in terms of better coordination.

4. Other Matters

The Council noted that the *List of Fishing Vessels* for 1989 was published by the Secretariat, and that data are being requested for the next triennial publication.

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

1. Review of Scientific Publications

The Council was pleased to note that Journal Vol. 12 was published and there was substantial progress in preparation for the next regular issue as well as the special issues with papers from 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" and the 1990 Canada-USSR bilateral meeting on "Capelin in the Northwest Atlantic".

The Council was also pleased with the turn-around time achieved with Studies papers noting that Studies Number 15 was published on schedule and Studies Number 16 containing 17 papers and 5 abstracts from the 1990 Special Session on "Management under uncertainties related to biology and assessment, with case studies on some North Atlantic fisheries" was published in about a one year time-frame.

The Council was once again concerned that data were still pending for the publication of *NAFO Statistical Bulletin* (Vol. 39) for 1989.

The Council was pleased with the timely publication of *Scientific Council Reports*, 1991, and endorsed the STACPUB recommendation to include a photograph of the participants of the June 1992 meeting in the publication of the *Scientific Council Reports*, 1992.

The Council was also pleased with progress made in other publications; the *List of Fishing Vessels for 1989* and the *Inventory of Sampling Data* of the 1985-89 period.

In addition, the Council noted that the Executive Summary of the June 1991 meeting presented to the General Council and Fisheries Commission at the Annual Meeting in September 1991 was well received, and that a similar document will again be prepared this year as well.

2. Production Costs and Revenue for Scientific Council Publications

The Council noted that there were no significant departures from the previous year's production costs and revenues.

3. Promotion and Distribution of Scientific Publications

The Council observed that a noticeable reduction in the free mailing list was made, while the subscription list remained about the same.

The Council felt that further considerations on methods by which the scientific paper contributions to the Journal and the expansion of the readership would be valuable.

The Council was pleased that there was significant progress in the consolidation of a single issue of the Journal with papers on the West Greenland cod stock, along with the invitational papers by Sv. Aa. Horsted. Similarly, it was encouraging to note the possibilities of some additional Russian contributions as mentioned by the head of the Russian delegation, V. K. Zilanov, during his recent visit, and also the acceptance by M. Grosslein (USA) to prepare an invitational paper.

4. Editorial Matters

The Council noted that 17 of the 24 papers presented at the September 1991 Cod Symposium were currently under review for publication in a Studies issue.

The Council was pleased to note a total of 46 papers were published or were in their final stages of preparation for publication in the Journal or Studies. In addition a total of 26 were under editorial review for the Journal.

The Council was encouraged by the attempts of STACPUB to improve the editorial process and endorsed the recommendation that Associate Editors take steps to make final decisions on papers that have been under review for a long time.

The Council was pleased to welcome Sv. Aa. Horsted and R. Misra to the Editorial Board as Associate Editor for Vertebrate Fishery Biology and Associate Editor for Biomathematics, respectively.

5. Papers for Possible Publication

The Council noted that STACPUB had considered 85 SCR Documents and 22 SCS Documents presented and nominated 8 papers for consideration for publication in the Journal and 7 papers for Studies. In addition 10 papers from the Canada-USSR meeting on capelin in November 1990 had been submitted and reviewed.

6. Microfiche Projects

The Council noted that although 15 microfiche sets of ICNAF documents (2 in 1991) had been sold, STACPUB now considers the microfiche technology obsolete. The Council agreed with STACPUB in pursuing alternative methods for archiving NAFO documents.

7. Other Matters

The Council endorsed STACPUB recommendation that the revised station locations of the Standard Oceanographic Sections in the Northwest Atlantic, be printed with a hard cover for distribution to national institutes.

V. RULES OF PROCEDURE

The Council discussed the matter of deadline dates for submission of fisheries data, but there was nothing to report at the present stage.

VI. COLLABORATION WITH OTHER ORGANIZATIONS

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

The Chairman informed the Council that the Joint ICES/NAFO Working Group workshop on survey methodology had been rescheduled to 5-12 October 1992 to avoid a conflict with the dates of the NAFO Annual Meeting. The Council noted the report of that meeting would be available for review at the June 1993 meeting.

b) Fifteenth Session of CWP, July 1992

The Council noted the plans to host the 15th Session of the CWP 8-14 July 1992 at NAFO Secretariat had progressed well, and the Council expressed appreciation to the Mayor of Dartmouth for the invitation to the participants to a wine and cheese reception at City Hall on 10 July 1992.

The Council noted STACREC had addressed the Scientific Council representation to this CWP meeting in July 1992.

VII. ARRANGEMENTS FOR SPECIAL SESSION

1. Special Session of September 1992

The Council noted comprehensive plans were discussed at STACFIS, and a draft of the workbook had been prepared by the co-convener R. K. Mohn (Canada). The Council noted the change of dates to 9-11 September 1992 for this meeting to be held at

NAFO Headquarters. Subject to the success of this meeting, the Council will consider future similar Sessions.

2. Special Session in 1993

The Council was pleased with the many topic proposals for a 1993 Special Session presented to STACFIS and was particularly pleased that there will not be a break in the Special Session series. The Council was also encouraged by the potential this has for the Scientific Council publications.

3. Special Session in 1994

The Council agreed with the STACFIS decision to defer the decision on the proposed topics to the September 1992 Meeting.

VIII. FUTURE SCIENTIFIC COUNCIL MEETINGS

1. Annual Meeting and Special Session in September 1992

The Council would next meet for the Annual Meeting of NAFO at the Holiday Inn, Dartmouth, Nova Scotia, Canada, during 14-18 September 1992. The meeting would be preceded by the Special Session titled "State-of-the-Art in Fish Stock Assessment: a Tutorial/Workshop on Calibration Methods and Their Practical Use" during 9-11 September 1992, at the NAFO Headquarters in Dartmouth, Nova Scotia, Canada.

2. Scientific Council Meeting in June 1993

The Council confirmed that the Scientific Council together with its Standing Committees and Subcommittee would meet during 2-16 June 1993. The location, not settled yet, could be either in Halifax or Dartmouth, Nova Scotia, Canada (see X. OTHER MATTERS).

3. Annual Meeting and Special Session in September 1993

The Council noted the proposed dates for the Annual Meeting to be held at the Hilton Hotel, Halifax, Nova Scotia, Canada, were 6-10 September 1993. Since the preceding week in which the Council would normally have the Special Session would be separated by a long weekend, the Council agreed to defer until September 1992, the decision on the dates for the 1993 Special Session.

4. Scientific Council Meeting in June 1994

The Council agreed on the tentative dates of 8-22 June 1994 for the Meeting of the Scientific Council.

IX. NOMINATION AND ELECTION OF OFFICERS

The Chairman's proposal (3 June 1992) to set up a Nomination Committee composed of C.A. Bishop (Canada) and B. W. Jones (EEC) was accepted.

On 13 June 1992 the Chairman requested the Nominating Committee to present their proposal. The Committee, having consulted with representatives, reported that it was ready to make a nomination.

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

The Committee nominated H. P. Cornus (EEC-Germany). There being no further nominations, the Chairman declared H. P. Cornus as duly elected next Chairman of the Standing Committee on Fishery Science. He will take office after the Annual Meeting of September, 1992.

X. OTHER MATTERS

Further to the Council's comments at the June 1991 Meeting with respect to inadequacies of the space at the NAFO Headquarters for Scientific Council meetings, the Council noted the Executive Secretary was making every attempt to find a more suitable location. Although an alternative was not found for this meeting of June 1992, it was hoped that this would be achieved for the June 1993 Meeting.

XI. ADOPTION OF REPORTS

1. Standing Committee Reports

At sessions on 16 and 17 June 1992, the Chairman of STACFIS, STACREC and STACPUB presented summaries or comments of their respective Standing Committee Reports. The Council then adopted each report.

2. Scientific Council Report, June 1992

At its concluding session of 17 June 1992, the complete report of the 3-17 June 1992 Meeting of the Scientific Council along with the reports of its Standing Committees was 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 A. Avila de Melo, H. Lassen 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 skillfully 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 Special Session being convened by R. K. Mohn and R. Cook.

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 June 3-17, 1992 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 I at Appendix IV). Representatives from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), European Economic Community (Denmark, France, Germany, Portugal, Spain, United Kingdom), Iceland, Japan and Russia were in attendance, as well as an observer from United States of America (USA).

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. The Report of the American plaice and Greenland halibut Ageing Workshop is summarized in Section V and detailed in Annex 2.

I. GENERAL REVIEW

1. Opening

The Chairman welcomed the various national representatives to the NAFO Headquarters in Dartmouth, and Canada.

Discussions were held on reactions arising from the decision made in 1991, to provide separate documentation titled the Executive Summary containing the Summary Sheets and text relevant to the Fisheries Commission. It was agreed that responses were all positive to the decision to provide such documentation, and therefore the practice should be continued.

2. Catch Statistics

STACFIS shares the concern, expressed by STACREC, concerning late submissions of catch statistics to the Secretariat, noting that the unavailability of landings information in time for the June meeting seriously hampers the Committee's ability to prepare assessments for review during the meeting. It is strongly recommended that *for the future, national representatives, at the same time as endeavoring to make all necessary data relevant to the assessments available to Designated Experts by May 15 (NAFO Sci. Coun. Rep. 1991, p. 44), should also attempt to provide as much catch/effort data (including preliminary data) as are available.* In addition, because of the recent difficulties in determining the best estimates of catch for the various stocks, and difficulties encountered at various times throughout the meeting, STACFIS recommended that *during the first day of future June meetings, under usual agenda item 'General review of catches and fishing activity', all available information on catches for the various stocks should be reviewed so that best estimates of catches can be determined before commencement of the assessment reviews.*

3. Commercial and Research Sampling

STACFIS acknowledged and concurred with the concerns expressed by STACREC regarding the importance of current and future sampling of the commercial fisheries and the negative effects of any reductions of the various research activities in relation to stocks assessed annually. It is recommended that *Scientific Council bring the concerns of STACFIS on the potential negative impacts of a reduced annual database on the stock assessments, to the attention of the Fisheries Commission.*

During review of documentation pertaining to results of various research cruises, it was noted that detailed information on the survey dates as well as vessels and gear used over the time series period was not always available. Without these data, it is difficult to determine possible reasons for sudden and unexpected changes in indices. The necessary data were collected during the June meeting in 1989 and presented in SCS Doc. 90/22, and was updated in 1991 as SCS Doc. 91/18. In 1991, STACREC concluded (Sci. Coun. Rep. 1991, p. 114) that the best approach would be to have Designated Experts update the information annually for review by STACFIS. The updated list was compiled only during the course of the June 1992 Meeting. STACFIS recommends that *in the future, Designated Experts present this updated information at the time of preparation of the preliminary assessments.*

It was also noted that for some survey series, standard errors associated with the estimates were not available. STACFIS recommends that *in future, numbers (e.g. abundance/biomass) derived from research surveys be accompanied by estimates of variance associated with these.* It is further requested that the Secretariat remind national representatives of this recommendation during circulation of information in preparation for the June 1993 meeting.

4. Timely Availability of Assessment Related Data

STACFIS again noted that in many instances, assessment related data were not available before the first day of the meeting. The negative implications of this, as described by STACFIS previously (Sci. Coun. Rep., 1991, p. 44), are: 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. STACFIS reiterated that Contracting Parties should make every effort to provide all relevant data necessary for assessments to the Designated Experts by May 15 of each year. National representatives should ensure, wherever possible, that available data on length and age by gear from their respective commercial fisheries be compiled to reflect the removals catch at age from these fisheries. STACFIS again recommends that *Scientific Council bring the problem of availability of assessment related data to the attention of the Fisheries Commission.*

5. General Trends for the Northwest Atlantic

STACFIS noted with serious concern that a substantial amount of provisional catch data for 1991 were not available, particularly from Canada-N, EEC-France (M), EEC-Spain, France (SP) and Norway, and also South Korea, therefore it was not possible to make any comparisons with last year's data.

6. Fishery Trends by Subarea

Due to the lack of 1991 data from Can-N, EEC-France (M), EEC-Spain, France (SP) and Norway, and also South Korea, the fishery trends could not be determined.

Table 1. Provisional nominal catches ('000 tons) by Subarea for 1990 and 1991. (+ indicates less than 500 tons. **N.B.** the 1990 data exclude EEC-France (M) and France (SP) reports; the 1991 data exclude Canada-N, EEC-France (M), EEC-Spain, France (SP), Norway and also South Korea reports).

	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
Species	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991
Cod	+	+	60	20	32	+	236	36	141	102	57	55	+	+	528	214
Haddock	–	–	+	–	–	–	5	1	14	15	6	7	–	–	25	23
Redfishes	+	+	+	+	+	+	115	66	63	61	1	1	–	+	179	127
Silver hake	–	–	–	–	–	–	1	+	70	140	13	11	7	5	91	157
Red hake	–	–	–	–	–	–	+	1	+	1	1	1	+	1	2	4
Pollock	–	–	–	–	+	–	2	1	36	39	11	10	+	+	49	49
American plaice	–	–	–	+	1	+	30	2	8	7	2	4	+	+	41	13
Witch flounder	–	–	–	–	+	+	9	3	3	3	1	2	+	+	13	7
Yellowtail flounder	–	–	–	–	–	–	9	1	3	2	14	7	+	+	26	10
Greenland halibut	11	6	8	11	9	10	21	16	2	2	–	–	–	–	52	44
Other flounders	+	+	+	+	+	+	5	2	9	9	9	12	4	4	26	27
Roundnose grenadier	+	+	+	+	+	+	4	4	–	–	–	–	–	–	4	5
White hake	–	–	–	–	+	–	4	1	10	9	6	6	+	+	20	16
Wolffishes	+	+	1	+	+	+	3	3	1	1	+	1	–	+	5	4
Other groundfish	+	+	+	1	+	+	1	+	4	5	16	18	5	9	27	42
Atlantic herring	–	–	–	–	+	–	8	–	252	171	51	48	+	1	311	220
Atlantic mackerel	–	–	–	–	+	–	1	–	23	19	5	4	36	23	65	46
Atlantic menhaden	–	–	–	–	–	–	–	–	–	–	11	13	326	283	337	296
Other pelagics	–	–	–	–	–	–	1	1	1	1	5	5	7	5	15	12
Capelin	–	–	+	+	44	–	131	1	6	+	–	–	–	–	182	1
Other finfish	+	+	+	1	3	+	27	26	14	10	24	21	20	14	88	78
Squids	–	–	–	–	–	–	5	+	6	2	8	8	20	24	39	34
Clams	–	–	–	–	–	–	11	3	10	5	38	32	350	354	409	393
Scallops	–	–	–	1	+	–	2	1	37	29	134	133	55	59	228	223
Other molluscs	–	–	–	–	+	–	+	+	2	3	23	21	54	53	78	76
Shrimp	7	2	68	69	11	3	2	+	15	13	4	3	1	–	109	92
Crabs	–	–	–	–	1	–	10	+	15	20	4	3	74	51	104	74
Lobsters	–	–	–	–	–	–	1	+	38	44	24	26	4	3	67	73
Other invertebrates	–	–	–	–	–	–	–	–	+	+	7	10	1	+	8	11
Total	19	9	139	104	102	14	644	167	784	719	476	460	965	891	3129	2363

II. STOCK ASSESSMENTS

1. Cod in Division 3M (SCR Doc. 92/11, 13, 21, 27, 29, 31; SCS Doc. 92/12, 13, 14, 18)

a) Introduction

i) Description of fishery

The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillneters, Spanish pair-trawlers and Faroese longliners. Cod is also caught as by-catch in redfish and flatfish fisheries conducted by EEC-Spain as well as the Portuguese redfish fishery. 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. 1).

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	12.4[1]	12.4[1]	13	13	13	13	0	0	0	13	13
Catch	13	10	13	14	15	11	2	40[2,3]	32[2,3]	11[2,3]	

[1] Excludes expected catches by EEC-Spain.
[2] Includes estimates of misreported catches.
[3] Provisional.

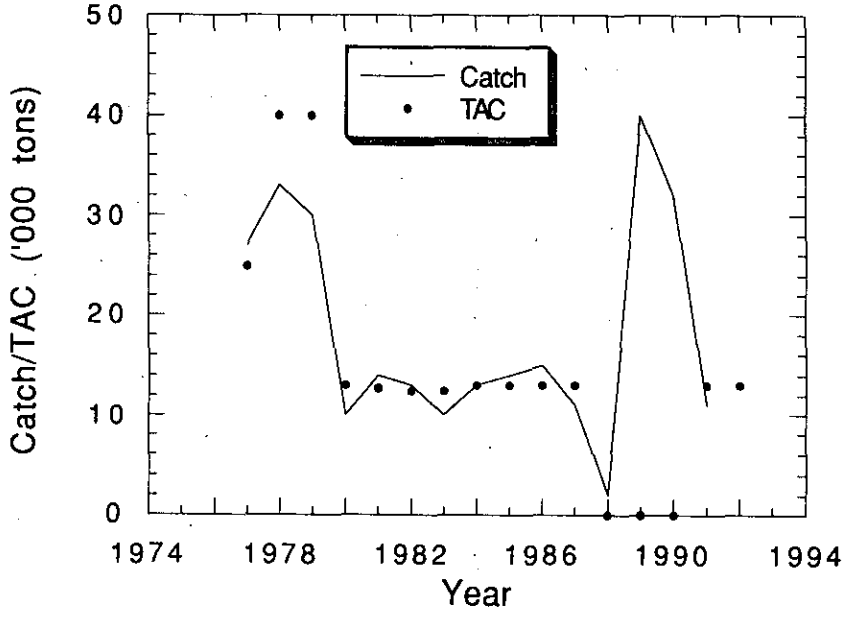

Fig. 1. Cod in Div. 3M: catches and TACs.

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 of misreported catches were available for 1988, but it is believed that actual catches also exceeded those reported for that year.

b) Input Data

i) Commercial fishery data

Sampling data for 1991 were available for Portuguese stern-trawlers and gillneters and for Spanish freezer and pair-trawlers. The abundant 1985 and 1986 year-classes dominated the gillnet catches; the 1986 year-class dominated the pair-trawl catches. The 1988 year-class, with lengths between 35 and 45 cm, dominated the trawler catches.

Some by-catches were taken in the redfish fishery, but this was at a rate of less than 10% based on information from the Portuguese fleet.

The Faroese fishery was conducted in 1991 by three longliners; their catch rate decreased from 1990 to 1991, to the low level observed in 1988.

ii) Research survey data

Biomass and abundance estimates were available from research vessel trawl surveys conducted by USSR/Russia from 1977 to 1991 (Fig. 2). Trawlable biomass estimates increased from 3.9 thousand tons in 1990 to 6.7 thousand tons in 1991. Nevertheless the acoustic biomass estimates decreased substantially and total biomass (bottom plus pelagic estimates) showed a decline from 15 200 tons in 1990 to 8 200 tons in 1991. A review of the survey data since 1988, when pelagic trawls were introduced, indicated that no mid-water catch of cod was observed when catches of redfish were greater than 100 kg. This suggests that the by-catch of cod in the redfish fishery using mid-water trawl must be insignificant, but the behaviour of the survey and commercial fishing gears are not completely comparable.

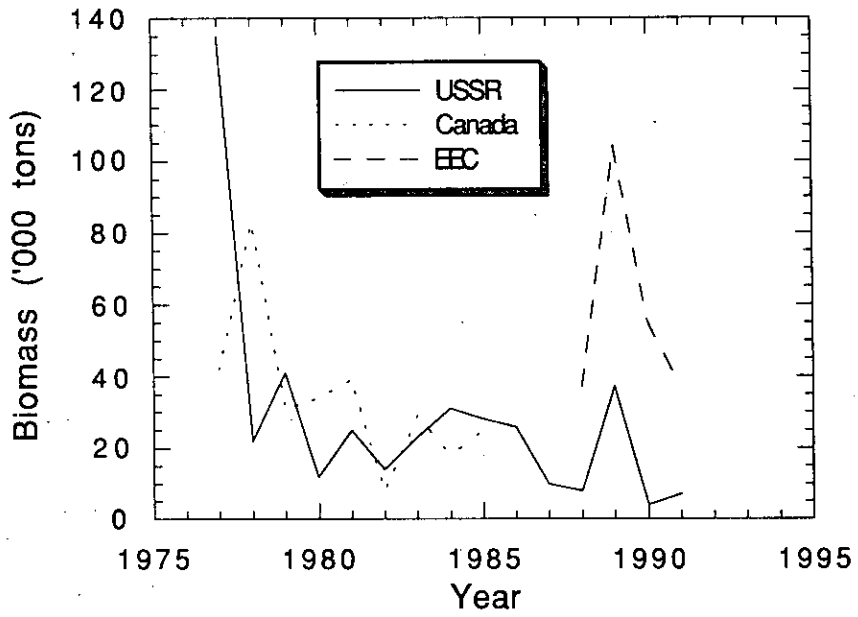

Fig. 2: Cod in Div. 3M: biomass estimates from research vessel data.

Stratified-random bottom trawl surveys were conducted by the EEC from 1988 to 1991. Estimates of biomass increased from 37 000 tons in 1988 to 104 000 tons in 1989 and decreased to 37 000 tons in 1991. The 1991 survey results were dominated by the 1990 year-class suggesting it was very abundant. This year-class was not detected in the USSR survey, probably because that survey was carried out too early in 1991 to catch it.

In both surveys the 1986 year-class of cod, aged 5 in 1991, remained relatively abundant. The year-classes of 1987, 1988 and 1989, were weaker than that of 1986.

It was noted that total biomass in the EEC survey shows the same tendency as USSR/Russian bottom plus pelagic biomass estimates in the period 1988-91. The biomass was at a relatively higher level in 1989 as a consequence of the 1985 and 1986 year- classes but has declined since then.

A tagging experiment was carried out by the EEC on the Flemish Cap to check the isolation of the stock. Nine recaptures have been registered so far, two from outside the bank. However, further work is required to establish a clear picture of possible interrelationships with other areas.

c) Estimation of Parameters

An analytical assessment of the stock has not been conducted since 1984 because of perceived inadequacies in the commercial fishery database.

Average length at first maturity was calculated in 1991 as 52 cm, the same length as previously observed. Based on research vesssel results, spawning stock biomass decreased from 1990 to 1991 by about 20% in spite of the recruitment of the 1986 year-class to the spawning stock. The spawning stock was estimated to be less than 19% in number but as much as 40% in weight of the total stock size in 1991.

d) Prognosis

The relatively abundant 1985, and the strong 1986, year-classes supported the fishery in 1989 and 1990. Their abundances are now quite reduced and no longer sufficient to support any future fishery. There are indications that the 1990 year-class may be very strong and should this prove to be the case it could provide an opportunity for recovery of the stock biomass in the near future. STACFIS recommends that *the exploitation of the 1990 year-class should not be initiated until 1994 at the earliest when they reach age 4 and their mean length will be greater than 40 cm.* Therefore, STACFIS also recommends that *during 1993 the catch be maintained at as low a level as possible and every effort be taken to prevent the catch of small cod.*

Last year STACFIS concluded that "if cessation of fishing cannot be achieved, no action can be advised that would result in an improvement of the stock" (NAFO Sci. Coun. Rep., 1991, p. 54). After further review in light of the failure of the previous moratorium it was concluded that alternative conservation measures are possible and these are described in Section III "Responses to Fisheries Commission Requests".

2. Cod in Divisions 3N and 3O (SCR Doc. 92/13, 25, 75; SCS Doc. 92/12, 13, 14)

a) Introduction

i) Description of 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. 3). Catches increased after 1978, peaking at 50 000 tons in 1986, but again declined to about 33 000 tons in 1989. The total catch for 1991 including those reported and estimated was 29 000 tons.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	17[1]	17[1]	26	33	33	33	40	25	18.6	13.6	13.6
Catch	32	29	27	37	51	42	43	33[2]	29[2,3]	29[2,3]	

[1] Excludes expected catches by EEC-Spain.
[2] Provisional.
[3] Includes estimates of misreported catches (12 300 tons).

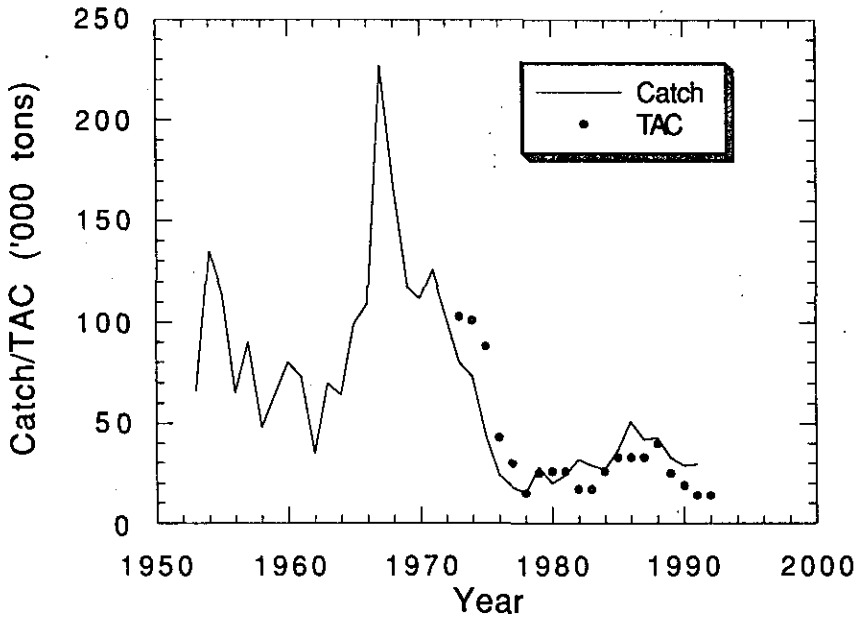

Fig. 3. Cod in Div. 3NO: catches and TACs.

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 1991, catch was more than double the recommended TAC.

For the period since 1978, catches have been taken predominantly by Canada and EEC-Spain. All non-Canadian catches in 1991 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 gillnet and longline. Canadian catches were stable at approximately 19 000 tons from 1985 to 1988 but have since declined to about 12 000 tons in 1991. About 4 000 tons of this total were estimated to have been caught by gillnetters in Div. 3NO. Catches by EEC-Spain, mainly by pair-trawlers directing for cod, averaged approximately 17 000 tons from 1986 to 1989 but were reported to be about 4 000 tons in 1991. 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 reported catch in 1991 was about 1 100 tons. The latter was taken by otter trawl and gillnet and fleets. Otter-trawl catches were obtained mainly in Div. 3N as mainly a by-catch in the American plaice and redfish fisheries.

In recent years catches have been estimated for countries fishing in the Regulatory Area, and in 1991 this amounted to about 12 300 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 concern with Canadian data was the definition of directed effort for otter-trawlers which take a large portion of their cod catch as by-

catch in flounder fisheries. In spite of these problems, STACFIS considered that the annual Canadian otter-trawl index could be useful as an indicator of general trends. Canadian catch rates increased from 1977 to 1982 but have declined steadily since that time. The 1991 index declined sharply from 1990 to 1991 and is estimated to be the lowest in the time series. Spanish catch rates only relate to a small portion (20%) of the stock area where distributional changes have occurred during the time period and as well there are no data available from the 1991 fishery. A new catch rate index is being investigated using data obtained by observers since 1987. In 1991 the pair-trawl fishery took place predominantly in the second half of the year and based on this new index catch rates declined from 1990 to 1991 but were still higher than in 1988-89. Portuguese trawl catch rates were similar in 1990 and 1991 while directed effort doubled over the same period. Gillnet catch rates in 1991 were 30% higher than in 1990 while effort was reduced by 50%. This resulted mainly from increased activity in Div. 3O where gillnet catch rates were the highest recorded for Div. 3N and 3O since 1989.

Catch-at-age. Biological sampling data from the Canadian otter-trawl, longline, and gillnet fisheries as well as Spanish pair-trawl and Portuguese gillnet and otter-trawl fisheries were used to estimate the age composition of the commercial catch in 1991. The 1985 and 1986 year-classes (ages 6 and 5) were most numerous in the Canadian catch. The 1989 year-class (age 2) was the most abundant in the trawl fisheries of EEC-Portugal and EEC-Spain in 1991. Sampling from the latter countries was used to derive age compositions for all estimated cod catches in the Regulatory Area. This indicated that in excess of six million age 2 cod were caught. Catch and length frequency data indicated that most of these small cod were obtained in the last quarter of the year and also that the majority were 24 to 35 cm in length. The catch of such high numbers of cod in this length range would suggest that an effective trawl mesh size considerably smaller than that regulated might have been used, possibly as small as 90 mm.

The average weights-at-age for 1991 were within the range of values observed in recent years and there were no discernable trends. However, average weights estimated for the Portuguese catch were low, particularly for younger ages.

The 1981 and 1982 year-classes (age 9 and 10) were dominant in the Portuguese gillnet fishery in 1991 although the total catch by this fleet was relatively small. These two year-classes which have been dominant in the Div. 3NO catch in recent years were also abundant in the Canadian catch in 1991.

In recent years a considerable portion of the total catch has been estimated. Because of this the reliability of catch-at-age estimates is a persistent concern.

ii) Research survey data

Stratified-random research vessel surveys have been conducted by Canada in Div. 3N for the 1971-92 period, with the exception of 1983, and in Div. 3O for the years 1973-92 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. 4a). 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 1992 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 at low levels, with the 1992 estimate being the lowest observed in the time series.

The low levels of biomass and abundance in recent years have 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 age in the 1991 survey was 2 (the 1989 year-class) which comprised about 60% of the total abundance.

As in 1991, the 1992 spring survey also covered the deeper water strata (366-732 m) not surveyed in previous years. Biomass in the depth range (366-545 m) was substantial in Div. 3O in 1991 but was considerably lower in 1992. Abundance estimates for this depth zone in 1992 were higher as the result of a large catch of small cod. Biomass and abundance for these depth zones in Div. 3N were not substantial. Information was not available to determine whether the 1991 and 1992 distributions were 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.

Additional stratified-random surveys were conducted by Canada during autumn in 1990 and 1991. Biomass and abundance estimates were at similar levels in both years in Div. 3O but were considerably higher in Div. 3N in 1991. The age composition from the 1991 survey also indicated that the 1989 year-class was strong.

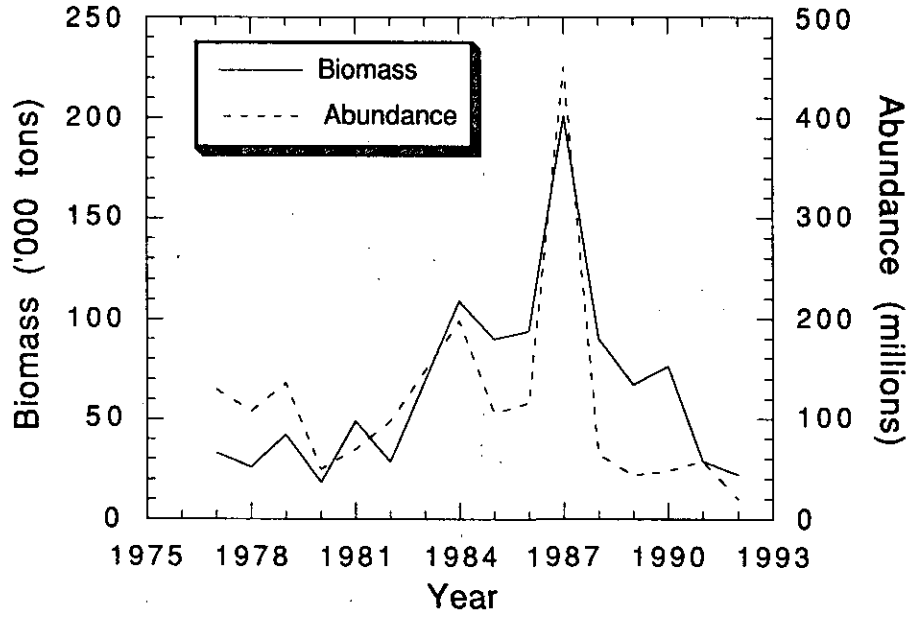

Fig. 4a. Cod in Div. 3NO: biomass and abundance from Canadian RV data.

Surveys by the USSR were conducted on a random-stratified basis (1983-91), 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. 4b).

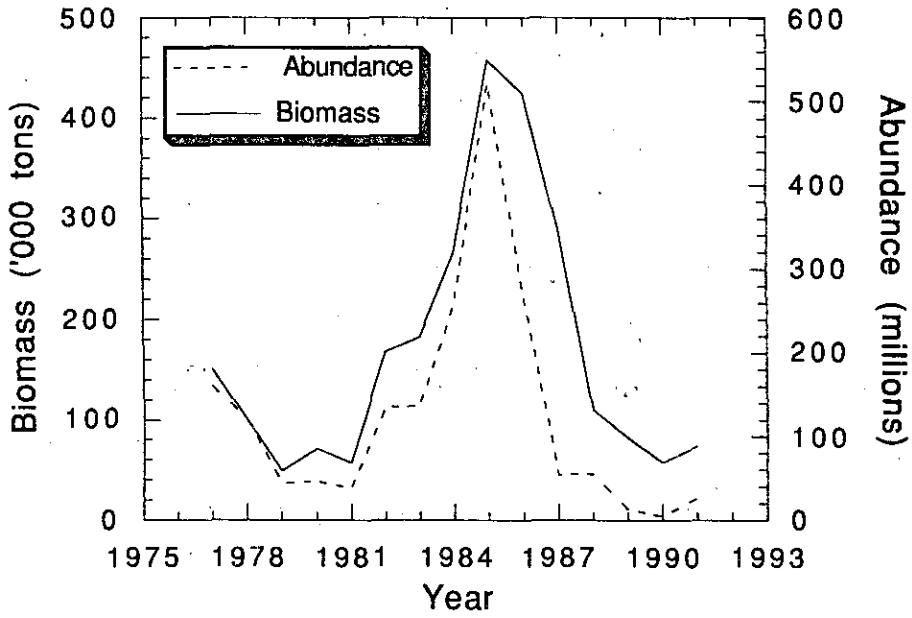

Fig. 4b. Cod in Div. 3NO: biomass and abundance from USSR/Russian RV data.

The 1990 abundance estimate was the lowest in the time series while biomass was lowest since 1981. In 1991 abundance increased in both Div. 3N and 3O with biomass showing a decline in Div. 3N but increasing in Div. 3O. The increase in abundance resulted mainly from the appearance of the relatively abundant 1989 year-class although there was a general increase in abundance for most age groups from 1990 to 1991.

c) Estimation of Parameters

(i) Sequential population analysis (SPA)

Formulations of the adaptive framework (ADAPT) and the Laurec-Shepherd (L/S) technique, including Canadian and Russian RV survey data, were used for the determination of stock size for 1991. Results from ADAPT indicated that coefficients of variation (CVs) on the population abundance estimates were in the range of 40% to 50%, while that on the age 3 estimate was higher at 65%. All RV age specific catchabilities were estimated with CVs in the range 20% to 30%. Residual patterns showed several year effects, both positive and negative, in both survey series. The mean of the squared residuals for the Canadian survey is about 30% lower than that of the Russian survey, indicating a better fit of the Canadian RV to the estimated SPA. The high CVs on virtually all abundance estimates and the patterns of residuals described above would imply considerable uncertainty with the results of this calibration analysis. Similar comments regarding uncertainty were also made during the previous two assessments of this stock (NAFO Sci. Coun. Rep., 1991, p. 57) and this uncertainty was attributed to large year-to-year variation in survey estimates as well as poorly estimated catch at age from some components of the commercial fishery.

The L/S analysis was conducted using structure similar to that of ADAPT. The age specific catchabilities did not exhibit any discernable trends in their respective time series. It was generally the case, however, that catchabilities at age estimated from the Canadian survey data displayed less year-to-year variation than those estimated from the USSR/Russian data. This implies that the Canadian survey receives more weight in the determination of terminal year fishing mortality.

With the Canadian RV data demonstrating a better fit in ADAPT and receiving more weight in L/S, additional analyses with both techniques using only Canadian RV data were conducted. ADAPT resulted in estimated population numbers being higher, but still at a relatively low level overall, than the ADAPT with both survey indices, however, CVs at age were much higher. The L/S results were very similar to those from the original L/S analysis including both survey indices. Given the higher CVs with this ADAPT evaluation and the similarities between the two L/S analyses STACFIS considered that, at present, the analyses which include both RV time series are appropriate.

(ii) Yield-per-recruit

The most recent yield-per-recruit analysis was conducted during 1990 (NAFO Sci. Coun. Rep., 1990, p. 76). The reference fishing mortality levels estimated were $F_{0.1}$ = 0.25 and F_{max} = 0.40 with respective yields-per-recruit of 1.03 and 1.08 kg.

d) Assessment Results

The results of both the accepted ADAPT and L/S analyses were quite similar with the age 3+ population abundance different by only 4% in the terminal year (1991). The pattern of fishing mortality and year-class size was also very similar in both analyses. While the ADAPT results are associated with rather high CVs, the consistent results between the two techniques indicated that the population estimates are at least approximately correct and were considered by STACFIS to be suitable to provide catch and biomass projections.

The assessment results indicated that the fishing mortalities for ages 7-10 for 1965 to 1976 displayed large year to year variation and were in the range of 0.2 and 1.2 (Fig. 5). During 1978 to 1981 Fs were less than 0.2 and from 1982 to 1990 were in the range of 0.2 to 0.3. The 1991 mean F for ages 7 to 10 was estimated to be 0.40. During the 1991 assessment of this stock high fishing mortalities at ages 4 to 6 cast considerable doubt on the results of the calibration. These ages in 1990 are still associated with high Fs while the same year-classes in 1991 are associated with Fs which are more closely related to those for previous years.

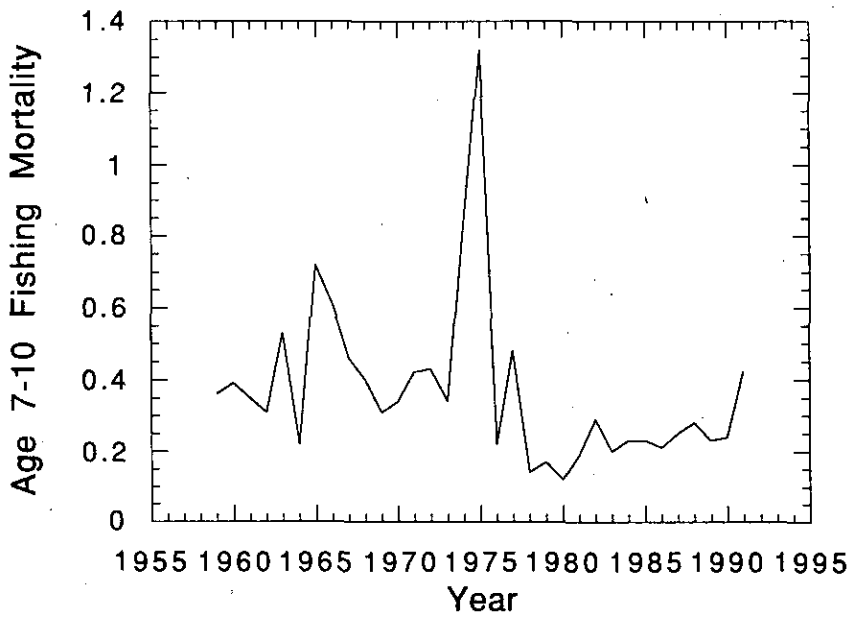

Fig. 5. Cod in Div. 3NO: age 7-10 fishing mortalities from SPA.

Beginning of the year population biomass for ages 3 and older increased in the early-1960s and peaked at about 470 000 tons in 1967 (Fig. 6). A subsequent decline followed and the estimate for 1976 was 55 000 tons. Biomass again increased and reached 220 000 tons in 1984. Another decline occurred in recent years and the age 3+ beginning of the year biomass for 1991 was estimated to be approximately 90 000 tons, the lowest estimate since 1977.

The spawning stock biomass (SSB) for this was derived through application of a maturity ogive. The SSB was at its highest during the 1960s and peaked at 190 000 tons in 1967, followed by a decline to about 20 000 tons in 1976. SSB was in the range of 100 000 to 150 000 tons from 1982 to 1989 but has been declining in recent years. The 1991 estimate was 80 000 tons. It is expected that the recent decline will continue, as several weak year-classes recruit to the SSB.

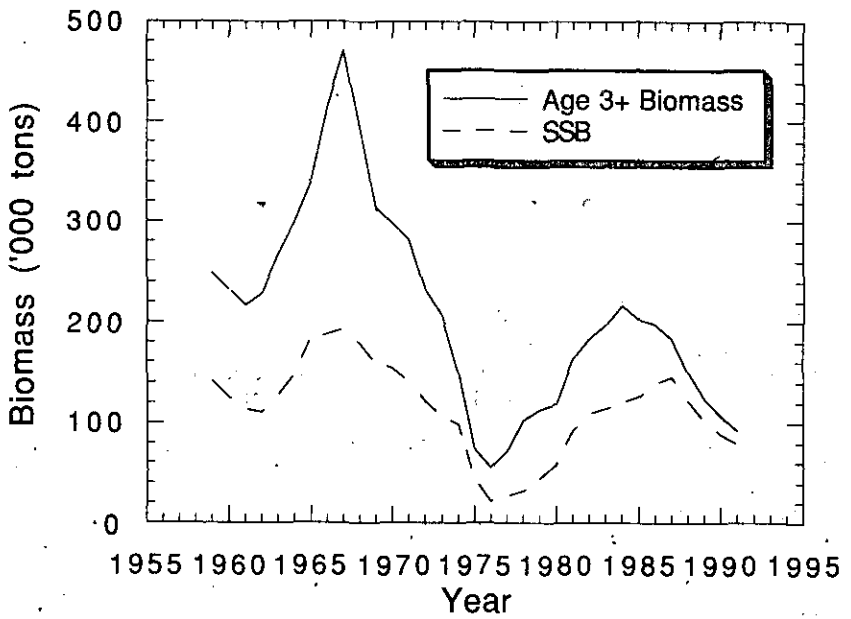

Fig. 6. Cod in Div. 3NO: age 3+ and spawning stock biomass (SSB) from SPA.

The highest recruitment levels, measured at age 3, occurred during the 1960s when several year-classes were estimated to be above 100 million fish (Fig. 7). Recruitment estimates for the early-1970s to the mid-1980s were at a lower level than the 1960s with most being less than 50 million fish. There has been a "recruitment failure" in recent years with the age 3 estimates for 1986 to 1991 (i.e. 1983 to 1988 year-classes) the lowest in the time series, averaging below 10 million fish per year. The geometric mean recruitment for the period of the calibration analyses (1977-91) is about 20 million fish.

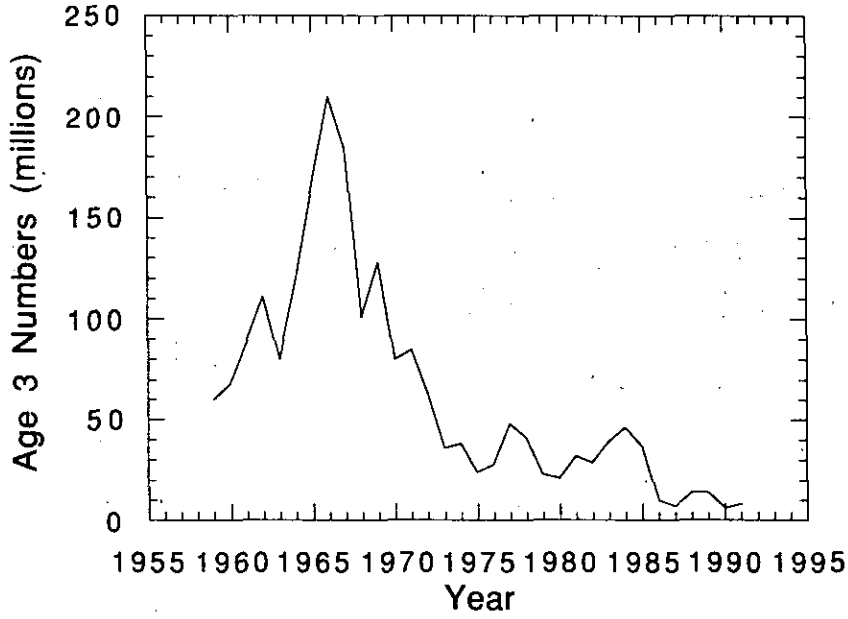

Fig. 7. Cod in Div. 3NO: age 3 recruitment from SPA.

e) Catch Projections

The parameters which were used to project stock size and SSB are given in Table 2. Two options were used for the age 3 population at the beginning of 1992, 20 and 34 million. Twenty million is the geometric mean for 1977-91 while 34 million is the geometric mean for 1977-84. The higher value for recruitment was included because estimates from the Canadian RV indicate this year-class to be above average at age 2. There was however, an unknown but possibly considerable level of fishing mortality exerted on this year-class at age 2 during 1991 by fisheries occurring in the Regulatory Area. There were also two levels of catch used for 1992, 25 000 tons as an approximation of the actual catch which may occur and 13 600 tons, the 1992 TAC. The pattern of fishing mortality at age during the recent three years has shown considerable variation relative to previous years and was generally higher at younger ages. Therefore, to provide some stability, the partial recruitment vector used was derived from the average from 1977-91. The partial recruitments for recent years are most certainly affected by the fisheries for small fish outside 200 miles. Mean weights-at-age were averages of values from 1989 to 1991.

Table 2. Cod in Div. 3NO: parameters used in projections of catch and stock biomass.

Age	Stock Size 1 Jan 1992 ('000 tons)	Average Weights (kg) Start of year	Mean annual	Percent Mature	Partial Recruitment
3	20 000	0.41	0.54	0.00	0.21
4	5 539	0.71	0.94	0.04	0.47
5	2 513	1.21	1.55	0.22	0.87
6	2 162	1.91	2.35	0.64	0.94
7	1 084	2.78	3.28	0.94	1.00
8	304	3.96	4.77	0.99	1.00
9	557	5.59	6.54	1.00	1.00
10	1 378	7.49	8.57	1.00	1.00
11	1 391	9.37	10.24	1.00	0.71
12	984	11.31	12.49	1.00	0.40
13	1 071	12.74	13.00	1.00	0.40
14	319	13.25	13.50	1.00	0.40
15	0	13.75	14.00	1.00	0.40

The two levels of catch and the size of the 1989 year-class assumed for 1992 result in four scenarios of projected catch for 1993 and SSB at the beginning of 1994. The ranges of these values were relatively small and STACFIS considered it appropriate to use the average values of the four catch projection estimates as the best approximations of projected catch and biomass. These estimates are presented in Table 3 and Fig. 8. A catch of 13 600 tons in 1992 implies a fishing mortality of about 0.3 and SSB at January 1, 1993 of 54 000 tons, while a catch of 25 000 tons results in a 1992 F of about 0.6 and January 1, 1993 SSB of 44 400 tons. The 1993 catches resulting from $F_{0.1}$ and F_{max} are 10 200 tons and 16 400 tons respectively.

Table 3. Cod in Div. 3NO: projections of 1993 catch and 1994 spawning stock spawning stock biomass (SSB) at various reference fishing mortality levels.

Reference Fishing Mortality Levels	Catch (1993) tons	SSB (1.1.1994) tons
$F_{0.1}$ = 0.25	10 200	45 000
F_{max} = 0.40	16 400	41 200
F_{91} = 0.40	16 400	41 200

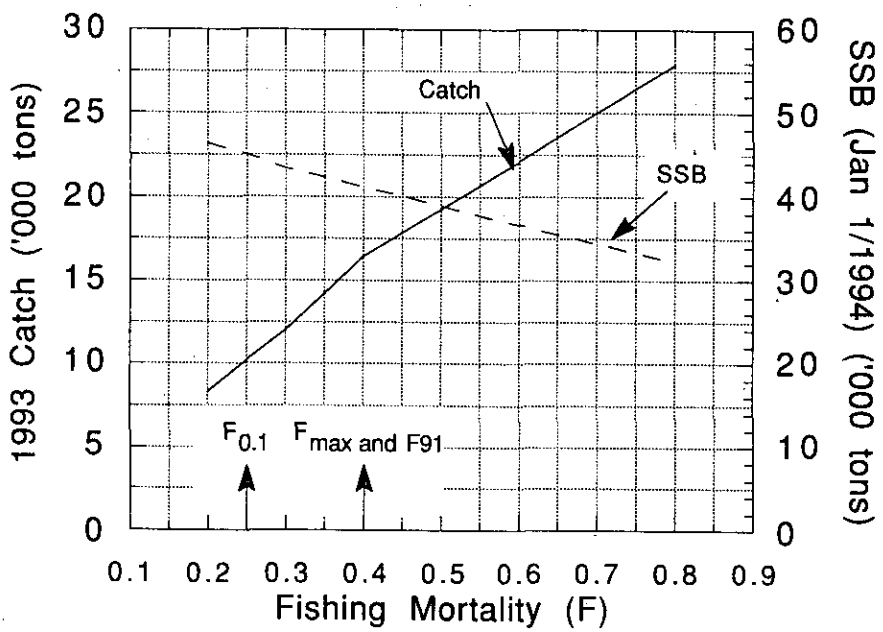

Fig. 8. Cod in Div. 3NO: yield and spawning stock biomass (SSB) at various levels of F in 1993.

This stock is currently at an extremely low level mainly because of a succession of six weak year-classes. The age 3+ population biomass is close to the lowest level ever observed and the adult population has declined and will continue to decline as the weak year-classes recruit to the SSB. The 1991 research vessel survey results indicated that the 1989 year-class, at age 2, was above average. However, the fishery in the Regulatory Area during 1991 caught a substantial number of individuals from this year-class. Preliminary results from Canadian spring surveys during 1992 indicate even further reductions in both biomass and abundance. All necessary steps should be taken to eliminate the exploitation of small fish from this stock. The SSB is declining and will not begin to rebuild until the 1989 and later year-classes begin to make a contribution. This will not occur until 1994. The SSB may never improve beyond current estimates if fisheries on immature cod continue at the current high levels. In addition, excessive harvesting

of cod from this stock at age 2 will result in a considerable loss of yield in the long term.

3. Redfish in Subarea 1 (SCR Doc. 92/30, 32, 43, 44, 48; SCS Doc. 92/17, 18)

a) Introduction

Redfish are taken mainly as by-catch in the trawl fishery for cod. Landings were considered to be almost exclusively golden redfish (*Sebastes marinus* L.) until 1986. It is believed that subsequently the portion of beaked redfish (*Sebastes mentella* T.) represented in the catches increased, and in 1991, the majority of the redfish catches were considered to be beaked redfish. Total nominal catches were stable between 1978 and 1983 averaging 8 000 tons (Fig. 9). 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-Germany fleet. However, occasionally in this period, a directed fishery on redfish could be observed for this fleet. During the same time a directed redfish fishery was started by Japanese trawlers, but they only partly compensated for the reduction in total EEC-Germany catches. With the closure of the offshore cod fishery in 1987, catches decreased further to only 1 200 tons, and remained at this low level. After reopening of the cod fishery and in spite of increased effort by trawlers from Greenland and the EEC-Germany, the provisional landings in 1991 are the lowest on record (300 tons).

Recent catches ('000 tons) are as follows:

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Landings	8	7	6	4	5	1	1	1[1]	0.5[1]	0.3[1]

[1] Provisional.

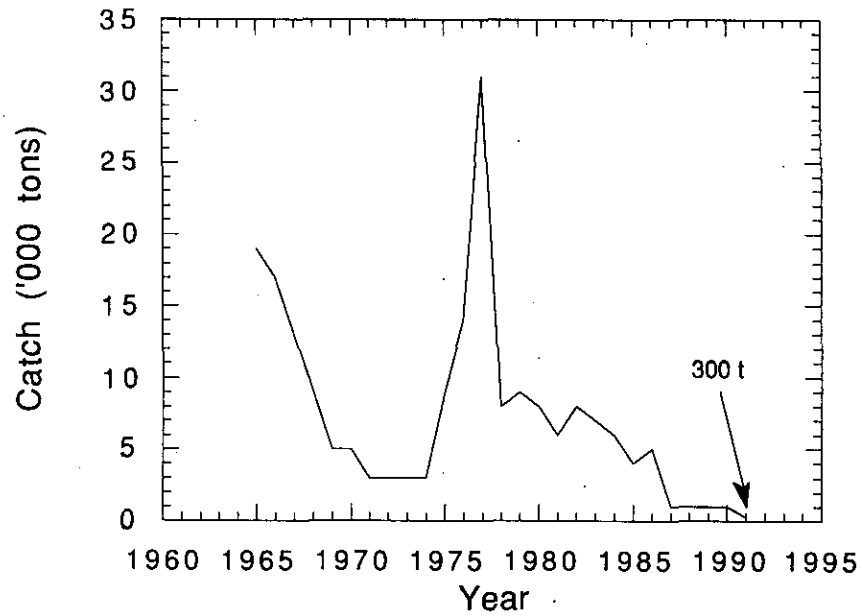

Fig. 9. Redfish in Subarea 1: catches.

In 1991 small juvenile redfish (*Sebastes marinus* L. and *S. mentella* T.) were quite abundant in all Divisions. In the northern Div. 1ABC large numbers were taken as by-catch in the shrimp fishery and discarded.

b) Input Data

i) Commercial fishery data

No data available.

ii) Research survey data

EEC-Germany groundfish survey. Relative biomass and abundance estimates were derived from the stratified-random bottom trawl surveys conducted by the EEC-Germany since 1982 in Div. 1B to 1F. These surveys were primarily designed for cod as target species and did not cover the entire depth distribution of either golden redfish or beaked redfish. Additionally, the pelagic occurrence of these species adds to the highly variable estimates between some years. Survey coverage changed from 1990 to 1991 in that the area corresponding to the 400 m to 600 m depth zone was not sampled. Nevertheless, with these problems in mind, particularly for beaked redfish below 400 m, the biomass and abundance indices of each species in depth <400 m declined from 1990 to 1991 to the lowest on record. This is mainly due to a decrease of both estimates in the northern parts (Div. 1BC) which was not compensated for by the marginal increase of abundance and biomass of both species in the southernmost Div. 1F in 1991. The increase of both redfish species in Div. 1F may be influenced by immigration from East Greenland or the Irminger Sea. The most drastic decline of abundance of golden redfish occurred from 1989 to 1990 due to the disappearance of small fish in Div. 1B to 1E. This could not be solely related to the fishery. Biological or environmental events may explain this.

Juvenile redfish could be observed in quite considerable quantities in all Divisions covered by the survey.

Greenland shrimp survey. Stratified-random shrimp surveys have been conducted by Greenland since 1988 from Div. 1A to 1D. Relative estimates of abundance and biomass declined substantially from 1988 to 1990, by approximately 36%. An increase from 1990 to 1991, mostly due to large recruitment of small juvenile redfish from the breeding areas in the Irminger Sea, was observed. The survey results indicated a gradual migration with growth of young redfish from northern areas (Div. 1A, 1B) westward and southward, and from shallow to deeper waters. The results also confirmed the coincidence of redfish nursery grounds with the area of distribution of shrimp. In 1991 the survey was extended to investigate the Disko Bay area. First results indicate that this area is not important as a redfish nursery area. However, because of only one year of observation, this conclusion might be preliminary.

Greenland-Japan groundfish survey. Since 1987, annual Greenland-Japan cooperative trawl research surveys on the target species Greenland halibut, roundnose grenadier and redfish have been conducted in Div. 1A to 1F in 1987 and 1988 and from 1A to 1D in the recent years. Survey results have been variable from year-to-year. Different timing and area of coverage from 1987 to 1989 make it difficult to interpret this. However, comparisons between 1989 and 1991, when the area of coverage but not the timing was the same, indicate an increase in trawlable biomass of beaked redfish. The biomass of golden redfish was very low in both years.

EEC-Germany larval and 0-group studies. Pilot studies on the distribution of larval and 0-group fish were carried out in summer 1989, in summer and autumn 1990 and in autumn 1991. In 1989 and 1990 almost no redfish larvae were caught during the summer. In autumns of 1990 and 1991, however, high abundance of 0-group redfish were observed close to the coast off southwest Greenland. In the northern region high densities were observed predominantly at the offshore stations in warmer water.

STACFIS acknowledged the importance of such research and recommended that *studies on distribution and abundance of redfish larvae and 0-group in Subarea 1 be continued.*

c) Prognosis

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. Drift of larval and 0-group redfish 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.

4. Redfish in Division 3M (SCR Doc. 92/12, 13, 14, 17; SCS Doc. 92/12, 27)

a) Introduction

From 1979 to 1985, catches were at or below the TAC level (20 000 tons) (Fig. 10). Catches began to increase in 1986, and were over double the TAC in 1987 (44 000 tons) and 1989 (58 000 tons). The estimated catch for 1990 was the highest on record for this stock (83 000 tons) and nearly double the agreed TAC. The catch for 1991 was estimated to be 55 000 tons which is about 10% above the agreed TAC. The majority of the reported catches were taken by Russia (24 700 tons) EEC-Germany (5 800 tons) and EEC-Portugal (3 800 tons). In addition, 17 000 tons were estimated to have been taken but not reported.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	20	20	20	20	20	20	20	20	50	50	43
Catch	15	20	20	20	29	44	23	58[1,2]	83[1,2]	55[1,2]	

[1] Includes estimates of misreported catch.
[2] Provisional.

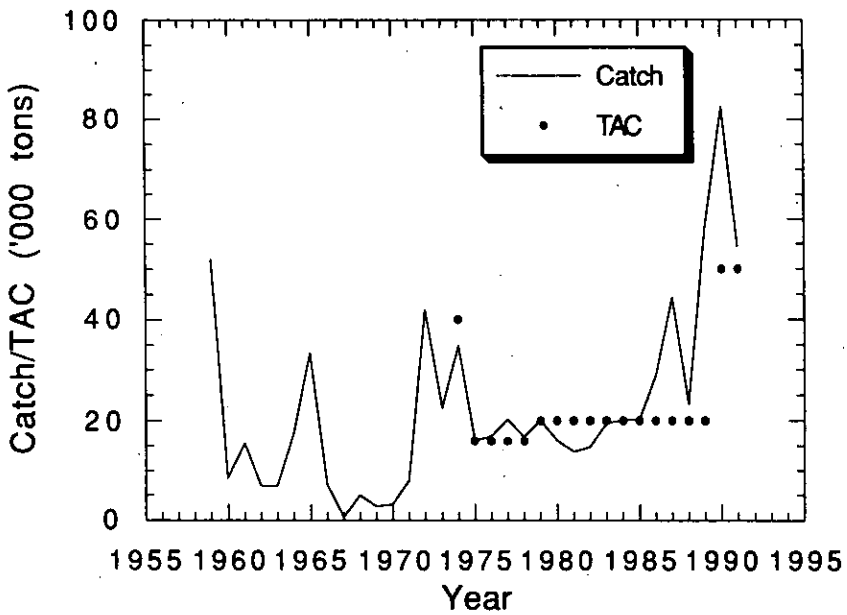

Fig. 10. Redfish in Div. 3M: catches and TACs.

The majority of the catch is considered to be beaked redfish (*Sebastes mentella* and *S. fasciatus*).

b) Input Data

i) Commercial fishery data

Catch and effort data from the ICNAF/NAFO period 1959-88 were combined with provisional data for 1989, 1990 and 1991 and analyzed using a multiplicative model to derive an estimate of standardized catch rate and effort.

Information for years prior to 1974 is limited and estimates for these years are considered unreliable. Catch rates showed no obvious trend from 1974 to 1987, but have been declining since that time. The 1991 estimate is the lowest in the time series (Fig. 11).

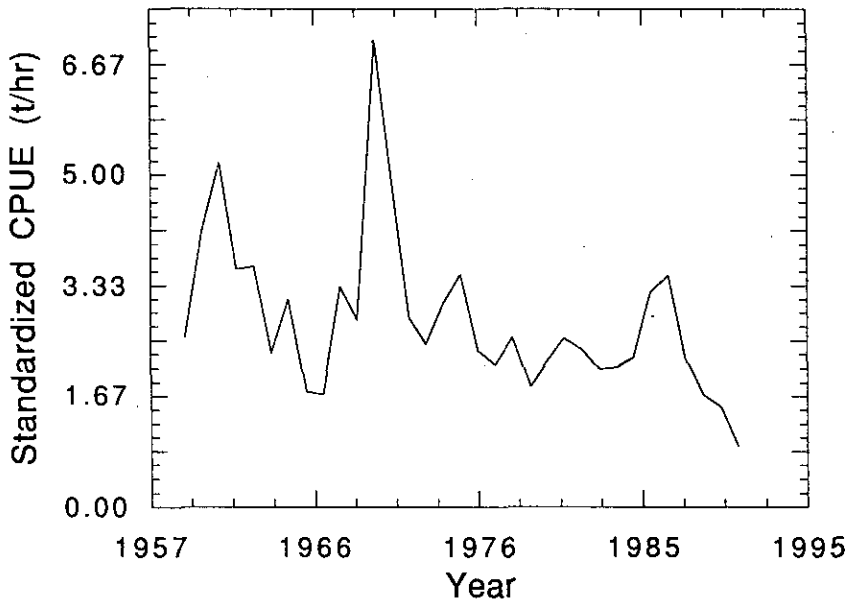

Fig. 11. Redfish in Div. 3M: standardized catch rates.

No sampling data of the commercial fisheries of Russia and EEC-Germany from 1991 were available for review. Length frequencies from the Portuguese trawl fishery in 1991 indicated lengths 26-31 cm predominated in the catches. Length frequencies from the Spanish trawl fishery showed a mode between 33 and 37 cm.

ii) Research survey data

The results from EEC trawl surveys indicated a decline in biomass from 158 000 tons in 1988 to 64 000 tons in 1991. Estimates from USSR/Russian bottom trawl surveys for 1983 to 1991 showed large fluctuations from one year to the next, however, there was a general decrease from 1986 to 1990. Biomass increased in 1991, but was still lower than the 1989 estimate. The recent increase could be attributed to the relative abundance of small redfish available to the bottom trawl gear. Results of the Russian acoustic surveys indicate successive declines in total biomass over the five years they have been conducted (Fig. 12). It was previously noted (NAFO Sci. Coun. Rep., 1989, p. 64) that the proportion of the redfish biomass up in the water column above the swept area of the bottom trawl may vary from year to year. This proportion declined steadily from 1988 to 1991 (see text table below). In 1991 the smallest proportion at 61% was observed. Although it was not clear whether the results of the Russian combined trawl and acoustic surveys in previous years include double counting of the bottom layer as appeared to be the case in 1991, there is a downward trend in the period 1987 to 1991 which is in agreement with the EEC trawl survey

results. STACFIS recommends that *a thorough investigation of the results of the Russian combined trawl and acoustic surveys should be carried out to ensure no double counting of the bottom layer.* Biomass estimates from the various surveys ('000 tons) are as follows:

		1983	1984	1985	1986	1987	1988	1989	1990	1991
USSR	Trawl	155	132	52	310	108	47	83	18	45
	Acoustic					322	322	283	229	62
	Total					428	379	366	247	107
	Biomass above bottom trawl in %						90	87	84	61
EEC	Trawl						158	137	104	64

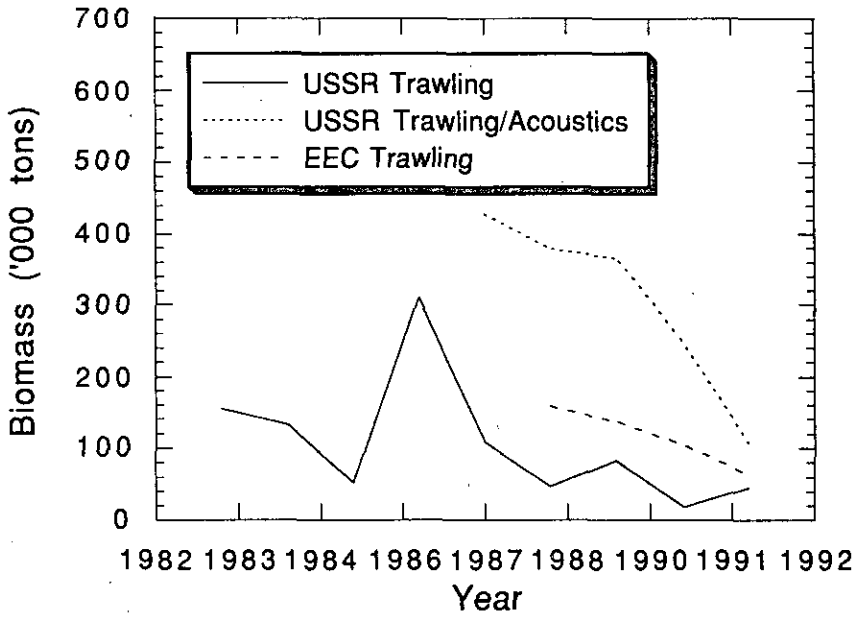

Fig. 12: Redfish in Div. 3M: biomass estimates from research vessel data.

In 1991, redfish less than 15 cm were dominant in the Russian trawl survey, whereas length groups 17 to 21 cm predominated in the EEC trawl survey catches.

c) Prognosis

Trawlable biomass estimates from EEC bottom trawl surveys and total biomass estimates from USSR/Russian trawl-acoustic surveys indicate a steady decline from 1987 to 1991. This decline is also apparent in the standardized catch rates. Because of the consistent declines observed in recent years (acknowledging even double counting of the bottom layer), STACFIS decided to adopt the same rationale as was used in the two recent years (NAFO Sci. Coun. Rep., 1990, p. 63) and applied $F_{0.1}$ (11%) and F_{max} (20%) exploitation rates based on Y/R calculations to average total biomass estimates from the Russian combined trawl-acoustic surveys for 1990 and 1991 (about 180 000 tons). This resulted in yields of about 20 000 tons and 36 000 tons for $F_{0.1}$ and F_{max} respectively. Considering the double counting of the bottom layer at least in 1991 the calculations of the exploitation rates based on $F_{0.1}$ and F_{max} are biased upwards. In addition, using a 2 year average when a steady decline is observed, will also bias the estimate upwards. STACFIS recommends that *the catches of redfish in Div. 3M should not exceed 20 000 tons in 1993.*

In light of the uncertainty of the current exploitation rate in relation to the stock size, STACFIS recommends that *further research on possible exploitation rates which the stock can sustain in the long-term (i.e.*

simulation studies) be carried out.

STACFIS recommends that *all available information on catch-at-age and length frequency both from commercial fisheries and surveys be examined and reviewed in 1993.*

5. Redfish in Divisions 3L and 3N (SCR Doc. 92/12, 59, 80; SCS Doc. 91/12, 14, 17, 18)

a) Introduction

From 1959 to 1985, the average nominal catch for Div. 3LN was about 21 000 tons ranging from 8 000 tons to 45 000 tons (Fig. 13). The 1986 catch, of 43 000 tons, was about twice that of 1985 with a further increase in 1987 to 78 000 tons. A subsequent decline occurred and the 1991 catch was 25 000 tons. During 1980-85, between 60-80% of the catch was taken in Div. 3N by the USSR fleet, while increases in 1986 and 1987 could be attributed to additional participation by fleets from EEC-Portugal and South Korea in Division 3L. During 1986, the USSR fleet diverted effort to Div. 3L as well.

From 1980 to 1990, the annual TAC has been 25 000 tons. The TAC was reduced to 14 000 tons for 1991 and maintained at that level for 1992. Since 1986 the TAC has been exceeded each year, and in some years catches have been double (1988) and even triple (1987).

The fishery is prosecuted throughout the year in Div. 3L while in recent years catches have been higher in the second half of the year in Div. 3N. The bottom trawl is the predominant gear in the fishery but in recent years there has been an increase in the proportion of catch taken by midwater trawling, especially in Div. 3L.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	25	25	25	25	25	25	25	25	25	14	14
Catch	22	20	15	21	43	78[1]	53[1]	34[1,2]	29[1,2]	25[1,2]	

[1] Includes estimates of misreported catches.
[2] Provisional.

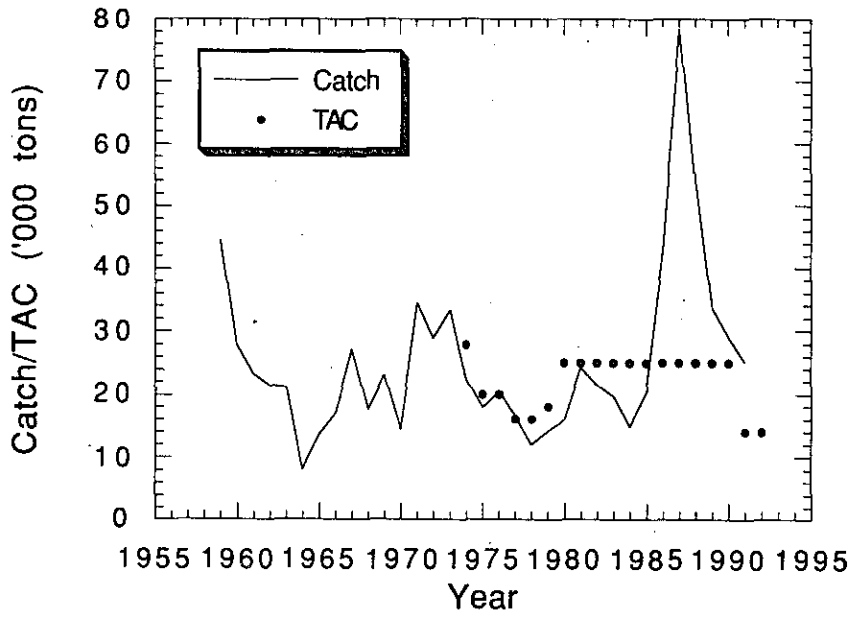

Fig. 13. Redfish in Div. 3LN: catches and TACs.

b) Input Data

i) Commercial fishery data

Divisional catch rates with effort measured in hours fished, were standardized using a multiplicative model. Investigations into the use of alternative criteria for including observations in a catch rate standardization did not result in the removal of the considerable between year variation. These revised indices were not considered to be reflective of year to year changes in stock abundance.

Divisional catch rates with effort measured in days fished were also standardized using a multiplicative model. There was considerable within and between year variability in the Div. 3L series which was not considered reflective of year to year changes in stock abundance. The index for Div. 3N was less variable and showed a decline from 1987 to 1991.

Sampling of the commercial fishery indicated the dominant size range in the catch was 22-32 cm.

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 relative abundance and biomass from 1984 to 1990. In 1991 the Russian survey results indicated an increase in biomass and abundance whereas a number of Canadian surveys in Div. 3L indicated a continued decline from 1990. It was noted that the Russian survey was conducted later than in previous years, and because of evidence from Canadian surveys indicating seasonal migrations, the increase in the 1991 Russian survey could not reflect an increase in stock abundance.

USSR/Russian acoustic surveys in Div. 3LN have been conducted concurrent with bottom trawl surveys since 1987. The total biomass estimated from the 1991 trawl-acoustic survey was 191 000 tons. This represented an increase of 151 000 tons from the 1990 estimate. STACFIS considered this to be unrealistic. There were concerns raised with regard to the procedure for evaluating the acoustic signals. Accordingly, STACFIS recommended that *details be provided to clarify how acoustic signals are separated between redfish and other species, and, that more detailed information be presented describing the vertical distribution as determined from the trawl-acoustic surveys.*

Since 1987 (Fig. 14) it was noted there were large changes in total biomass estimates from trawl-acoustic surveys between some years in adjacent Div. 3O but in the opposite direction, indicating that there may be some interchange between Div. 3LN and Div. 3O. Information on the distribution of bottom trawl catches from USSR/Russian and Canadian surveys were presented for evaluation. STACFIS considered the USSR/Russian trawl data did not indicate a major shift in distribution between Div. 3N and Div. 3O. Because of the semi-pelagic behaviour of redfish, STACFIS recommended that *further examination be conducted of the trawl-acoustic survey data to provide more detail on the location of concentrations of fish both near the bottom and in the water column in Div. 3LNO.*

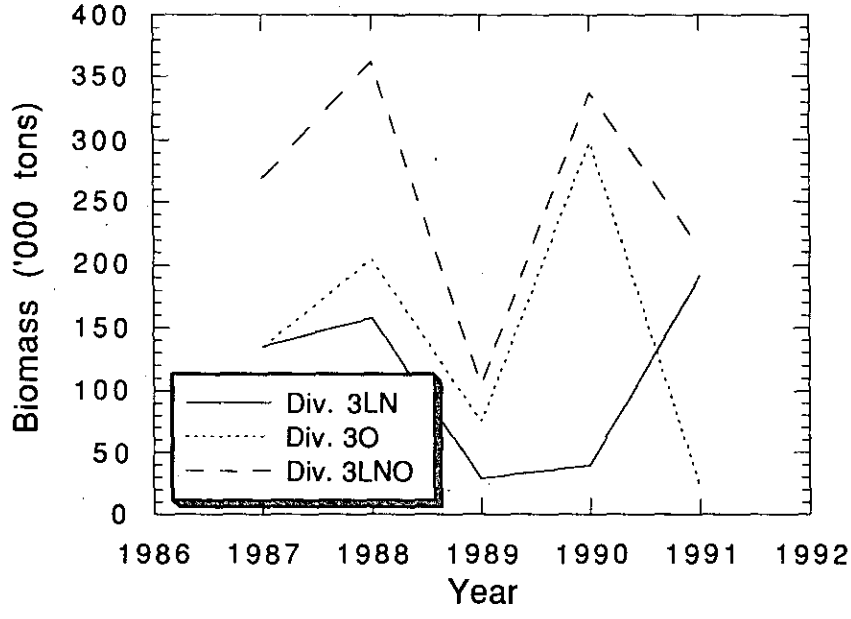

Fig. 14. Redfish in Div. 3LNO: total biomass estimates from USSR/Russian trawl-acoustic surveys.

The distribution of the botttom trawl catches revealed a continuous body of fish between Div. 3O and 3N. This raised some questions regarding the criteria for establishing Div. 3LN and Div. 3O as separate management units. It was pointed out that previous studies did not provide a clear indication of the relationships from these different divisions. STACFIS considered that this issue is worth revisiting and, accordingly, recommended that *existing data be examined to evaluate the current separation of Div. 3LN and Div. 3O in relation to adjacent divisions for the purpose of determining whether these management units are appropriate.*

Length compositions from USSR/Russian bottom trawl surveys in Div. 3LN from 1986 to 1991 indicate quite different size distributions in 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 indicated a pulse of recruitment in Div. 3N in 1989 at 14-16 cm. This was not observed in Div. 3L. In 1990 the relative size of this year-class (17-18 cm) was substantially smaller but in 1991 it was the dominant mode in the research catch (20-22 cm). The 1991 survey indicated another mode at 11-13 cm. 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 and age compositions from Canadian surveys in Div. 3L indicate there has been relatively poor recruitment since the early-1980s. The year-classes of the early-1980s were dominant in the research catch in the 1991 spring and fall surveys. The size distribution was different in the summer with a wider range of lengths present with no dominant mode. Length and age compositions for 1991 surveys in Div. 3N show different distributions from those of Div. 3L, similar to observations from the Russian surveys. A mode at 12-14 cm was present in the fall survey similar to the year class detected in the 1991 Russian survey.

Prognosis

TACs have been exceeded in each year since 1986 and in some years catches have been double (1988) and even triple (1987) the agreed TAC. STACFIS is confident that catches in 1987 and 1988 in particular (78 000 tons and 53 000 tons respectively) generated high fishing mortalities.

USSR/Russian bottom trawl surveys indicate a decline in density to relatively low values in recent years compared to the mid-1980s for Div. 3L and Div. 3N. The situation in Div. 3L is confirmed by the surveys conducted by Canada. Although a cautious approach should be taken in drawing conclusions about stock status given the inherent variability in bottom trawl surveys for redfish, STACFIS considered the results for both survey series are indicating a decline to low levels relative to the mid-1980s.

STACFIS considers the total biomass estimate from the Russian trawl-acoustic survey for 1991 to be unrealistic. There are also unresolved problems relating to the estimates for Div. 3LN and the relationship with Div. 3O that need to be addressed before STACFIS can more adequately evaluate these results.

The catch rate indices derived for Div. 3L and Div. 3N show much between year variability. Although each index by itself is not considered reflective of year to year changes in population abundance, taken together STACFIS considered there is a consistent signal of decline since 1989 for Div. 3L and since 1987 for Div. 3N. This corresponds to a period when some of the largest catches historically were taken.

Although there is no new information to determine a reference catch for Div. 3LN, the available indices signify a continuation of the stock declines noted previously. With the prospect of continuing poor recruitment in Div. 3L, and given that the pulse of recruitment detected in Div. 3N in 1991 would not be available to the fishery until the late-1990s STACFIS recommended that *for redfish in Div. 3LN catches be reduced and the total catch not exceed 14 000 tons for 1993*. STACFIS noted that catches for non-Contracting Parties since 1987 have ranged from 6 900 tons in 1991 to 24 000 tons in 1987.

Hake in Divisions 4V, 4W and 4X (SCR Doc. 92/23, 35, 39,50; SCS Doc. 91/12,
)

Introduction

The fishery is conducted primarily by large Cuban and USSR/Russian otter trawlers using small-meshed bottom trawls. Recently (1989), Canadian Tonnage Class (TC) 2 and 3 otter trawlers entered this fishery. During 1990 and 1991 the allocations to foreign nations were reduced in favour of allocations to Canadian Companies, which have entered into developmental arrangements with Cuban and USSR/Russian fishing companies to harvest silver hake. Despite these realignments, the resultant composition of the fleets actively fishing silver hake have not changed. 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.

Recent catches and TACs ('000 tons) are as follows (Fig. 15):

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	80	80	100	100	100	100	120	135	135	100	105
Catch	60	36	74	75	83	62	74	91[1]	69[1]	68[1]	

[1] Provisional.

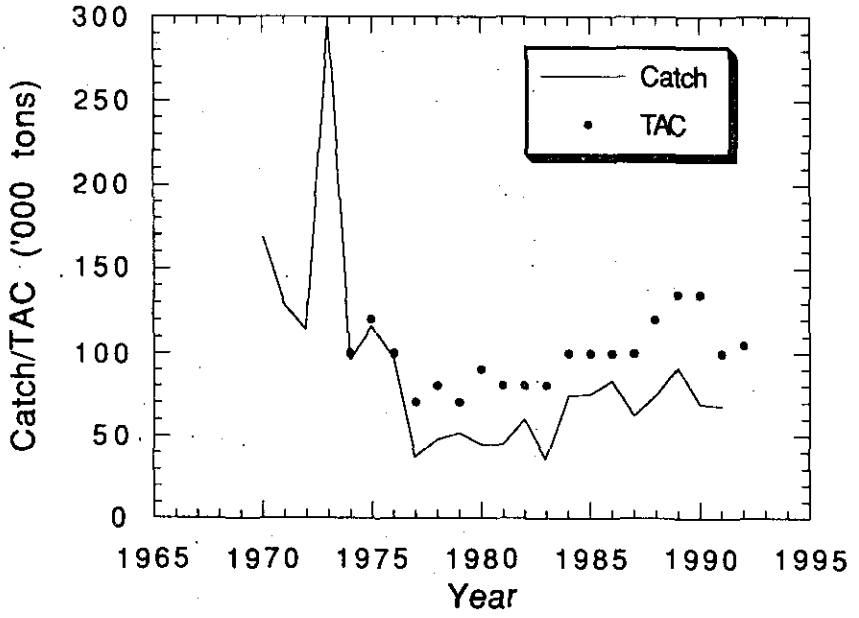

Fig. 15: Silver hake in Div. 4VWX: catches and TACs.

The 1991 fishery, with a special extension, opened on March 1 and finished 15 November. Experimental fisheries by Canadian vessels continued until 21 December 1991. Observed average monthly catch rates remained the same throughout the main fishery (March-July), although observations from five Russian vessels indicated a catch rate pattern similar to that of last year. In the 1990 fishery the CPUE declined in late-May and remained low until mid-July when it returned to April levels.

Similar to previous years, by-catch of haddock, and cod in 1991 was less than 1%. The pollock by-catch was higher in 1991 compared to 1990. In 1991 the by-catch of herring, mackerel and squid (*Illex illecebrosus*) was much lower compared to that observed in 1990. Although Japanese catch rates for silver hake increased in 1991, the overall catch rates were lower than those in 1990.

As in 1989 and 1990, Canada conducted a limited fishery using TC 2-3 vessels in 1991. These vessels fished in Emerald and LaHave Basins using small meshed gear during the months of March, April, October and November.

In recent years (1987-91) catch allocations have not been actively fished by some fleets. As a result, nominal landings have remained below the TAC levels. Since 1986 both the USSR/Russian and Cuba generally have taken more than 90% of their respective allocations.

Reports from the 1992 fishery indicate that catch rates are below average with high by-catches of pollock, and some vessels left the fishery by the first week in June, 1992. The reported catch to the end of May was 24 000 tons which is half that usually reported for the same period each year.

b) Input Data

i) *Commercial fishery data*

Catch rates. Standardized catch rates were calculated using a multiplicative model. Although catch rates showed a general upward trend from 1980 to a peak in 1989, they declined in 1990 and 1991 (Fig. 16). The current level is comparable to those seen in the late-1970s and early-1980s.

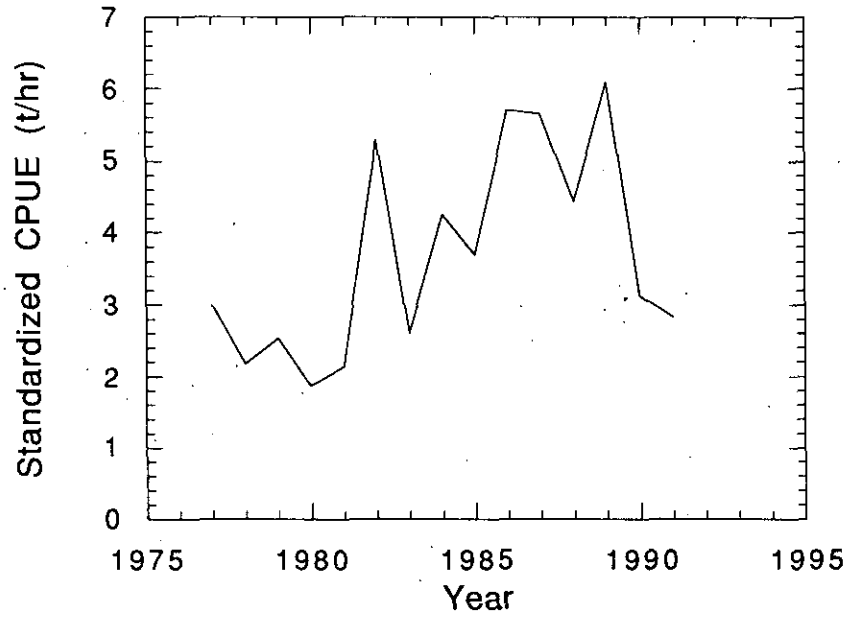

Fig. 16: Silver hake in Div. 4VWX: standardized catch rates.

Catch-at-age. The age composition of the catches in 1977 to 1991 was constructed from Canadian observer length frequency by sex data. These length frequencies were used with Canadian sexed age length keys for 1977-88, and combined Canadian/USSR and Russian sexed age length keys for 1989 to 1991. The 1991 catch was dominated by the 1988 year-class at age 3 (52%), followed by the 1989 year-class at age 2 (31%).

ii) Research survey data

The 1991 Canadian July research vessel survey results indicated that abundance and biomass both decreased slightly from 1990, with estimates since 1988 all among the lowest in the time series (Fig. 17) The 1989 year-class at age 2 is average at that age and is similar to the 1986 year-class estimated to be below average in the juvenile survey.

The 1991 juvenile index at 78.6 individuals per tow was the third lowest in the time series and is between that for the 1984 and 1987 year-classes. The 1991 survey results suggest that the 1991 year-class is only about half that of 1990. However, a comparison of 1991 research vessel and commercial catch numbers-at-age 1 for this latter year-class suggests that the estimate of the 1990 year-class from the juvenile survey may have been anomalously high. As in previous years, concentrations of juvenile silver hake were found on Emerald and Western Banks in the fall. The results of the joint USSR/Russian-Canada juvenile silver hake survey since 1981 are as follows:

Year-class	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Mean Number/tow	579	9	232	43	285	198	102	205	132	187	79
CV	0.11	0.14	0.11	0.16	0.22	0.19	0.23	0.17	0.14	0.13	0.13

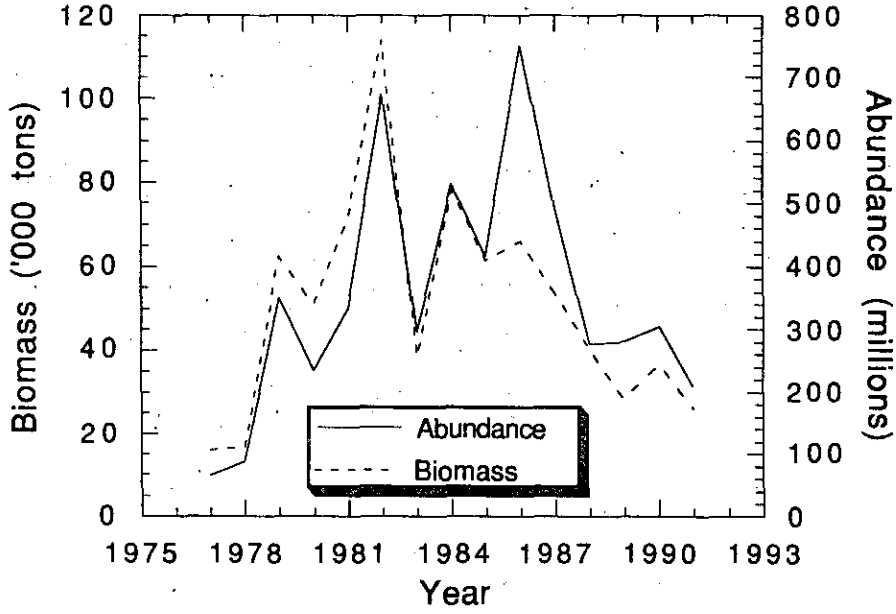

Fig. 17. Silver hake in Div. 4VWX: biomass and abundance estimates from July Canadian research vessel data.

iii) Environmental data

A review of 1991 water temperature anomalies on the Scotian Shelf suggested temperature anomalies were positive compared to the negative anomalies in 1990. Low catch rates during May and June of the 1991 fishery were similar to those reported for the 1990 fishery. STACFIS noted that based on available information, there appears to be little correlation between temperature anomalies and the commercial CPUE.

iv) Biological studies

Relationships between average weight, condition factor and abundance of silver hake was studied for different age and length groups. A statistically significant negative correlation was obtained in several cases between weight, commercial (standardized) CPUE and research survey (Canadian July RV survey) indices. However, some uncertainties in the results precluded drawing any firm conclusions concerning the relationship between silver hake growth, condition and stock abundance.

c) Estimation of Parameters

i) Sequential population analysis (SPA)

Two formulations of the adaptive framework (ADAPT) were reviewed to determine the stock size in 1991. These utilized research vessel, commercial CPUE and juvenile indices, assumed a dome partial recruitment pattern and a constant M=0.4. Although there were some differences in the input data and parameters used to calibrate the SPA, both showed similar 1991 fishing mortalities and overall population sizes. Because of these similarities, STACFIS focused its attention on the size of the 1990 and 1991 year-classes which will be the most influential in the 1993 fishery. Based on comparisons between juvenile survey results and SPA estimates of age 1, the 1990 year-class was considered average and the 1991 year-class in the range of the below average 1984 and 1987 year-classes. These comparisons resulted in sizes of the 1990 and 1991 year-classes of 1.1 billion and 0.84 billion fish, respectively, at age 1.

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-per-recruit of 0.060 kg.

d) Catch Projections

The size of the 1990 and 1991 year classes used for projections were set as described above. The 1992 year-class was set equal to the geometric mean (1981-90) of 1.1 billion fish, from SPA.

The weight-at-age for projections was the average of 1977-91 while the partial recruitment at age was averaged from 1986-90. Projection paramenters are summarized as follows:

Age	Jan 1, 1992 population numbers ('000)	Average weight (kg)	Partial Recruitment
1	840 099	0.058	0.017
2	739 216	0.142	0.219
3	353 717	0.192	1.000
4	147 204	0.234	1.000
5	36 662	0.272	1.000
6	12 069	0.328	1.000
7	3 593	0.430	0.399
8	802	0.540	0.246
9	614	0.681	0.073

Based on early indications from the 1992 fishery, STACFIS assumed that the 1992 catch would be about 40 000 tons. A projection, using these data, indicates that the $F_{0.1}$ catch in 1993 would be 75 000 tons (Table below).

1993 Catch (tons)	Population Numbers (1.1.1993) ('000)	Population Biomass (mid-year) (tons)
74 645	2 371 415	205 226

These estimates represent the lowest projected catch for this stock over the period for which it has been assessed. The size of this population, and hence the fishing success, is dependent on the strengths of recruiting year-classes. STACFIS notes there will be no strong year-classes present in the 1993 fishery.

e) Future Studies

STACFIS continues to support cooperative studies on silver hake, including continuation of the joint Canada-Russia juvenile survey, as well as investigations into factors affecting the availability of silver hake to the fishery in the area seaward of the small mesh gear line, which may be independent of the size of the resource.

As was stated last year, STACFIS recognized that a Canada-Russia experiment to validate age readings using radio-nucleotides is ongoing and encourages its completion. STACFIS reiterates its previous recommendation that *upon completion of the radio-nucleotide studies, one comprehensive document be prepared by Canadian and Russian authors.*

7. American Plaice in Division 3M (SCR Doc. 92/27,76; SCS Doc. 92/12, 13, 14)

a) Introduction

This stock has been regulated since 1974, when a TAC of 2 000 tons was agreed. The TAC has been maintained since then with the exception of 1978. Until 1985, landings were lower than 2 000 tons reported mainly by the USSR as by-catch of the cod fishery. In 1986 catches increased to a maximum of 5 600 tons in 1987 and decreased again to a value below 2 000 tons in 1990 and 1991.

The catch levels are not accurately known because of the lack of information of by-catches from vessels fishing cod and catches by non-Contracting Parties.

Recent TACs and catches ('000 tons) are as follows (Fig. 18):

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	2	2	2	2	2	2	2	2	2	2	2
Catch	1.1	1.9	1.3	1.7	3.8	5.6	2.8	3.5[1]	0.8[1]	1.6[1]	

[1] Provisional.

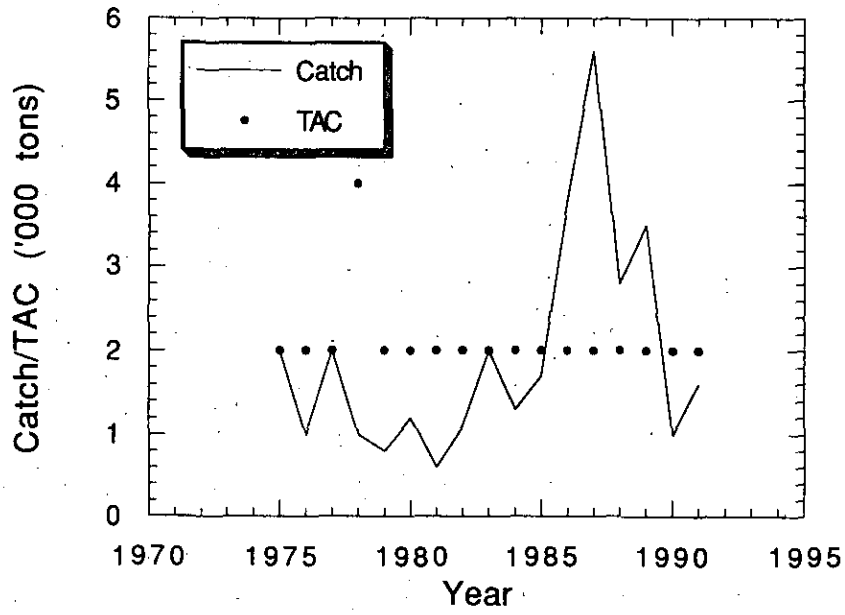

Fig. 18. American plaice in Div. 3M: catches and TACs.

b) Input Data

i) Commercial fishery data.

Length compositions from the Spanish and Portuguese fisheries were available for 1991 and both distributions showed two modes: one at 36 cm and another at 44-46 cm. Few fish larger than 50 cm were observed. The age composition of the Portuguese catch indicated these represented ages 5, 7 and 8.

ii) Research survey data (Fig. 19)

The USSR/Russian surveys showed high variability in the biomass estimates in recent years. The increase in the biomass in 1991 was the result of increased catches of older fish (ages 7 and 9).

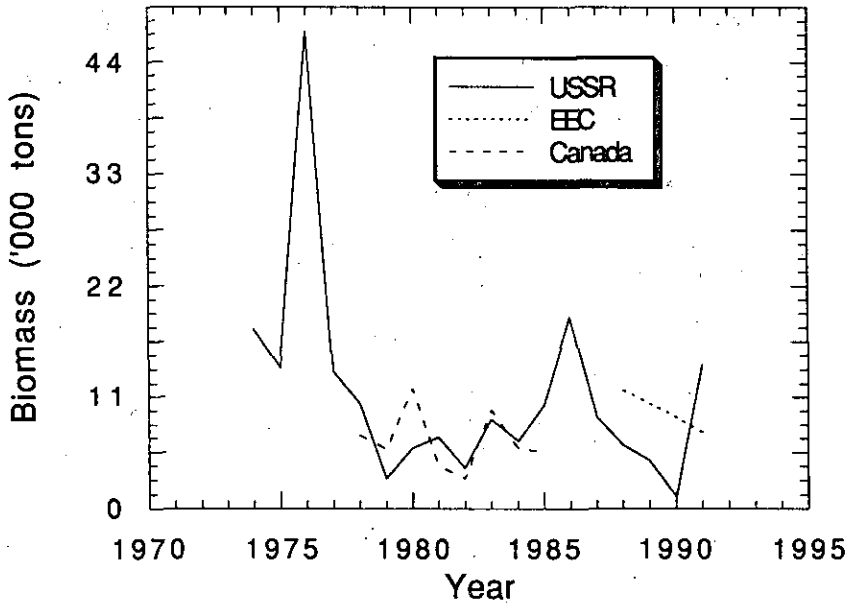

Fig. 19. American plaice in Div. 3M: biomass estimates from research vessel data.

The EEC survey results showed a continuous decrease in total biomass from 1988. The 1986 year-class continued as the most abundant in the survey catches; the subsequent year-classes of 1987, 1988 and 1989 seem to be poor in comparison.

The spawning biomass (5+) showed a decrease of 44% from 1988 to 1990, followed by a slight increase in 1991 resulting from the recruitment of the important 1986 year-class to the spawning stock.

Spawning biomass (5+) of American plaice estimated from EEC surveys on Flemish Cap

Year	1988	1989	1990	1991
Biomass	11.2	7.5	6.2	6.7

c) Prognosis

STACFIS noted the high variability in the American plaice biomass indices, but considering the apparent stability in the SSB from EEC surveys, advises that the TAC for 1993 remain at 2 000 tons.

8. American Plaice in Divisions 3L, 3N and 3O (SCR Doc. 92/79; SCS Doc. 92/12, 13, 14)

a) Introduction

This stock has been exploited since the early-1950s, with a peak catch of 94 000 tons in 1967 (Fig. 20). 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 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. Estimates of these catches in 1991 were higher,

at about 17 000 tons. Overall, catches declined from about 65 000 tons in 1986 to about 32 000-39 000 tons in 1990-91. The Canadian catch in 1991 was virtually identical to that in 1990, which was the lowest Canadian catch since 1963. The Spanish catch ranged from 9 000 to 14 500 tons between 1986 and 1989, but only about 300 tons were reported in 1990 and the same amount was derived from preliminary data reported in NAFO Circular Letters in 1991. Catches by USA vessels were relatively stable around 1 200 tons from 1985 and 1989 but declined to less than 10 tons in 1990 and 1991. South Korean catches, which were low in 1989 and 1990 at about 700 tons, based on reported catches and breakdowns of unspecified flounder catches, were estimated from surveillance reports to be much higher in 1991 at about 6 000 tons. Catches for other non-Contracting Parties 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. Estimated catches for these nations were about 1 900 tons in 1989-90 and about 700 tons in 1991.

Historically, most of the catch from Div. 3L has been taken by Canada, as was the case during 1991. The catch in Div. 3N was between 16 000-18 000 tons during 1987-89, which was about half the 1986 level, declined to about 11 000 tons in 1990, then increased in 1991 to about the 1987-89 level. The catches in Div. 3O were relatively stable around 5 000 tons from 1985-90, but increased to around 9 000 tons in 1991, due to an increase in catch by Canada in 1991 to 7 900 tons, its largest catch in Div. 3O since 1974.

It is obvious that catch statistics for this stock are not adequate. In some years, a substantial portion of the catch is estimated or determined from breakdowns of unspecified flounder catches.

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

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[4]
TAC	55	55	55	49	55	48	40[1]	30.3	24.9	25.8	25.8
Catch	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]	39[3,4]	

[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 misreported catches.
[4] Provisional.

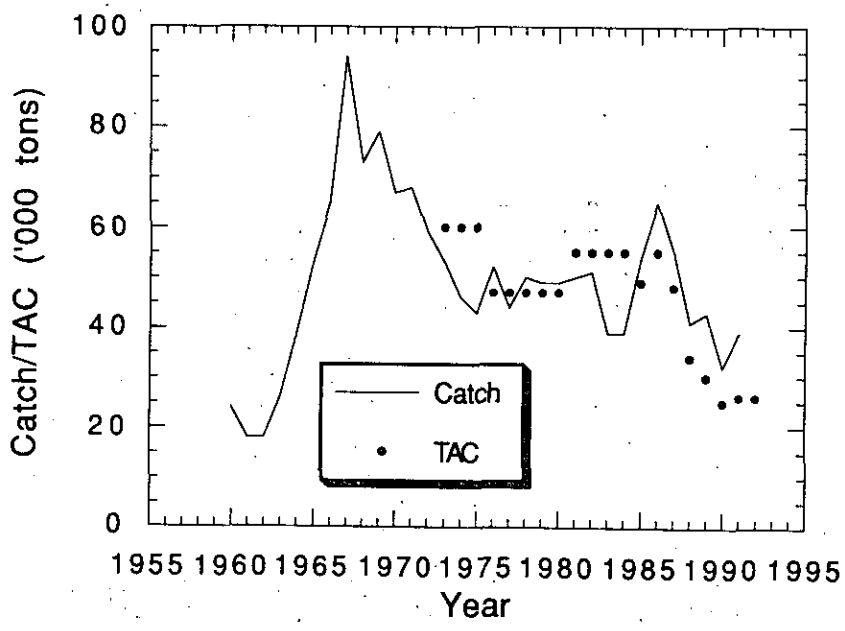

Fig. 20: American plaice in Div. 3LNO: catches and TACs.

b) Input Data

i) Commercial fishery data

Catch and effort. Data from the Canadian commercial fishery in Div. 3LNO from 1956 to 1991 were analyzed using a multiplicative model to obtain a standardized catch-rate series (Fig. 21). 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. 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 remained at this lower level over 1987-90. However, the 1991 catch rate declined by 37% to a level one-third less than the previous low value for this stock, observed in 1976. The decline in CPUE in 1991, which was seen in all 3 Divisions, meant that the standardized effort exerted by the Canadian fleet was about 50% greater than in 1990, and about the same level as in 1986-87.

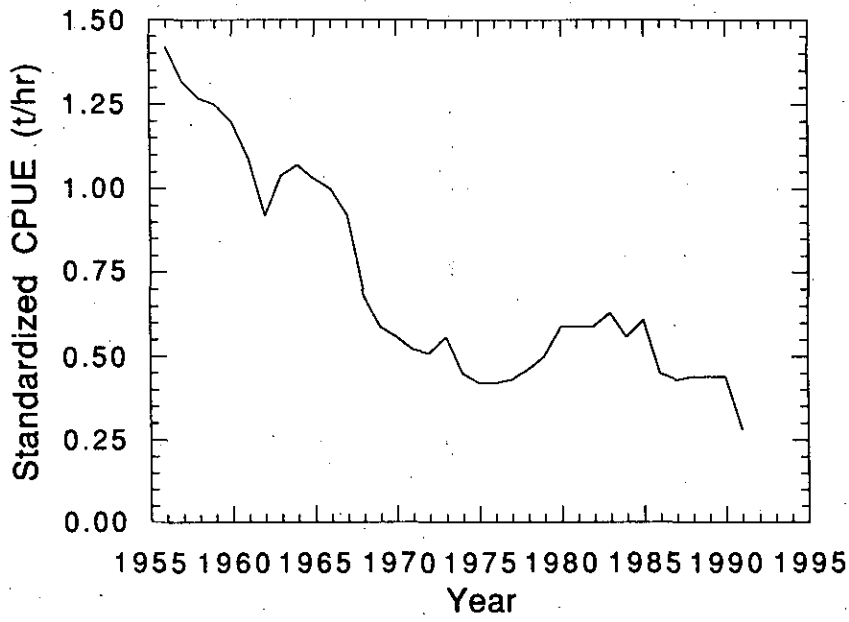

Fig. 21. American plaice in Div. 3LNO: standardized catch rates.

STACFIS noted that the CPUE from the Canadian fleet had declined sharply twice in the last six years, both following periods of relative stability. To examine the reasons for these patterns in the CPUE, STACFIS recommended that *area fished by the commercial fleet be incorporated in future analyses of catch rates.*

Catch rates (tons/hr) increased about 40% in the Portuguese trawl fishery in Div. 3N from 1990 to 1991, and there was an increase in effort directed toward American plaice during the latter half of 1991. However, the catch rate in number of fish per hour remained unchanged from 1990 to 1991, suggesting that the increase in weight could be related to the growth of the 1985 and 1986 year-classes, rather than to an increase in abundance. There were no CPUE data available from the Spanish fleet.

Catch-at-age and mean weights-at-age. Catch-at-age was calculated from the length frequencies and age-length keys from the Canadian, Spanish and Portuguese catches in 1991. The dominant age-groups in the 2 major fisheries which were sampled (Canada and EEC-Spain) were 8-11 and 5-7 respectively. Some of the difference in the modal ages in the catches of these fleets is due to the faster growth rate of

American plaice in the Regulatory Area of Div. 3N. It was noted that the length frequencies from the EEC fisheries were from catches, while those in the Canadian fishery were from landings, although it was noted that recent studies of discarding in the Canadian fishery showed very low rates (less than 4% by number) (NAFO Sci. Coun. Rep., 1990, p. 73). The age composition in the Portuguese fishery was similar to that of EEC-Spain, showing the 1985 and 1986 year-classes to be dominant. The catch at age for non-reported catches was calculated from the combined catch at age of EEC-Spain and EEC-Portugal. The total catch at age for the stock did not show the same bimodal pattern as in 1989 and 1990 because there was more overlap in 1991 in the catch at age of the Canadian and EEC fleets.

The number of older fish (age 11+) in the catch continued to decline in 1991, and was the lowest observed for this stock in the time series of catch at age (1974-91).

The mean weights-at-age in the Canadian catch in 1991 were generally higher than in 1990, continuing the trend of recent years. Weights-at-age for the total removals from the stock in 1990 were not calculated because of the absence of monthly catches from some fleets, which are necessary to properly weight the monthly sampling. The values for 1990 were calculated simply by averaging the 1989 and 1991 values and will be recalculated at a later date if appropriate data are available. The mean weights-at-age in 1991 were close to the highest in the time series.

The size of American plaice in the Spanish and Portuguese catches and information presented on selectivity, suggested that the effective mesh size being used in some fisheries in the Regulatory Area in recent years was likely to be still somewhat below the minimum regulated size.

Catch rate-at-age. An index of catch rate-at-age was calculated from the Canadian commercial fishery, as in the previous assessment of this stock. This index showed a stable but lower stock size in 1986-90, compared to the estimates of the early- to mid-1980s, followed by a decline in 1991, particularly at ages 10+. Last year, 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. This coincided with an increase in mesh size used by the Canadian fleet to a standard 130 mm in 1981. As per the recommendation in 1991, the relatively small amount of inshore catch was removed from the calculation of this CPUE index. Because of this change in mesh size, STACFIS recommended that *the catch rates from the Canadian fleet be analyzed from 1981 onward.*

ii) Research survey data (Fig. 22)

Canadian stratified-random groundfish surveys. Data from spring surveys in Div. 3L, 3N and 3O were available from 1971 to 1992, excluding 1983 in all areas and 1971, 1972 and 1974 in Div. 3O. Age-by-age abundance estimates for Div. 3L, 3N and 3O for the 1971-91 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 all recent assessments. No age by age estimates were available from the 1992 survey.

In Div. 3L, the biomass index remained relatively stable from 1985 to 1988, with swept-area estimates ranging from 174 000 tons to 193 000 tons. However, the estimates for 1989 to 1992 declined rapidly from 153 000 tons in 1989 to 36 000 tons in 1991 to just 13 000 tons in 1992. 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. Ages 6-9 dominated the survey catches in Div. 3L in 1991 and the estimated abundance at each age was far below any other values in the series. The abundance of age 9+ fish was about 35% of the estimate in 1988-89 and less than 10% of peak values in the late-1970s and early-1980s. Age by age estimates are not available for 1992, but are certain to be lower, given the decline in biomass from 1991.

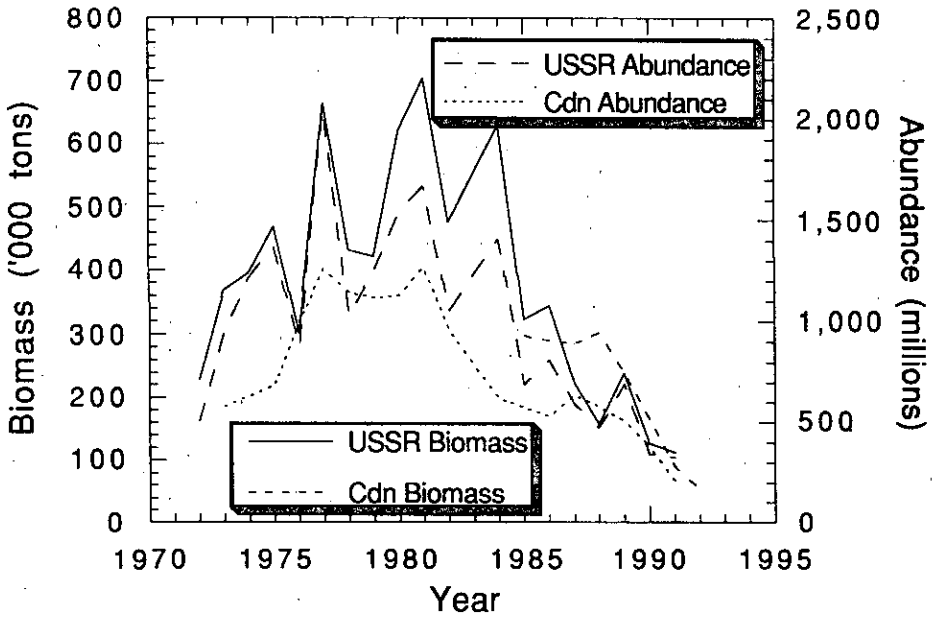

Fig. 22. American plaice in Div. 3LNO: biomass and abundance estimates from research vessel data.

In Div. 3N, the estimate of biomass declined from about 60 000 tons in 1984-85 to about 30 000 tons in 1990, 20 000 tons in 1991, and 8 000 tons in 1992. The abundance estimates have shown more fluctuation over the series compared to Div. 3L, but it was again clear that the abundance during 1986-92 was substantially lower than average and in 1991-92 was at the lowest levels in the 21-year series. The 1989 and 1990 surveys indicated that the 1985 year-class was the strongest at age 4 and the second strongest at age 5 in the time series. In 1991, this year-class appeared to be about average. The 1986 year-class appeared to be average or slightly better based on the 1990 and 1991 surveys.

In Div. 3O, the estimated biomass fluctuated between 44 000 tons and 77 000 tons in the 1984-90 surveys, with the 1991 and 1992 estimates being about 35 000 and 23 000 tons respectively. These are 2 of the 3 lowest biomass estimates for this Division. The estimates of abundance showed even more variability than Div. 3N, however, recent estimates were the lowest in the series. The 1990 and 1991 surveys showed that the 1985 and 1986 year-classes were larger than most cohorts since those of the 1970s.

Overall, the abundance estimates from surveys in Div. 3LNO combined have 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 550 million fish in 1985-89, then a further decline to about 200 million in 1991. In addition, the number of older fish (age 12+) in the surveys has continued to decline through 1987-91 to what is by far 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 close to 1986-88 mean. However, the 1991 survey indicated a decline to the lowest level observed, about 35% below that of 1989. The estimates in the fall surveys in 1990 and 1991 were higher than the corresponding spring estimates, although this pattern had not been observed consistently over the 10-year series of spring and fall surveys. There was evidence in the fall surveys of 1989 and 1990 to suggest that the 1985 and possibly 1986 year-classes were

relatively strong. However, in 1991 the latter year-class appeared to be slightly below average and the 1985 year-class the lowest in the series at age 6. These surveys also indicated a decline in the number of older fish in recent years.

Fall surveys were carried out in Div. 3NO in 1990 and 1991. These surveys indicated an increase in biomass from 1990 to 1991 of about 10%, contrary to the spring survey results. For Div. 3LNO overall, the biomass index in the fall of 1991 was about 70% higher than the previous one in spring 1991, and about 3.5 times higher than the subsequent estimate in spring 1992. The total biomass estimate from fall 1991 was still well below the total 3LNO estimates from spring surveys in the mid-1980s.

Neither spring nor fall surveys showed a trend of American plaice moving to deeper waters in recent years. The declines observed in the biomass over most strata on the Grand Bank were not countered by increases in the deeper areas.

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 in 1972-74, 1985-86, and 1990-91. These years corresponded to the lowest estimates of abundance for this stock, although the estimates of abundance in recent years are much lower than in previous years. The years with the highest abundance estimates (late-1970s) also corresponded to the years with the highest mean bottom temperatures. STACFIS noted that studies to determine if relationships exist between American plaice abundance or availability, and water temperature or other environmental factors, are continuing.

Declines in abundance of American plaice have also been observed in adjacent areas, particularly in Div. 2J+3K where the fishery has been at low levels in most years. This suggests that other factors, possibly environmental, may be contributing to reduced abundance of American plaice.

USSR/Russian stratified-random surveys. Results from USSR/Russian surveys in Div. 3LNO were available for 1972-91. Abundance and biomass were at a relatively high level from 1977-84, then declined to the lowest levels in the time series from 1987-91. This decline was present in all 3 Divisions. Age compositions indicate the 1985 and 1986 year-classes to be dominant in the catches in most recent surveys.

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 to 1991 surveys. Large 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 fairly localized, the distribution of adults is more widespread and 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 larger, resulting in a higher total abundance of ages 1-4 in this Division. As in previous years, the 1991 survey showed that about 80% of the abundance of American plaice younger than age 7 in Div. 3N is found in the Regulatory Area. It was noted last year 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.

In all 3 Divisions the 1985 and 1986 year-classes dominated the catches in 1989 and 1990. In Div. 3N, these cohorts were the largest in the time series, with both showing consistent strength since their appearance in the surveys at age 1. In 1991, these year-classes are still the predominant ones in the catches in Div. 3L, but in Div. 3NO the 1988 and 1989 year-classes were most abundant. The 1987 year-class appears to be weaker than those of 1985-86 and 1988-89. Only

Div. 3N data allow a comparison of estimates prior to 1989, and it appears that the 1985-86 year-classes in 1991 were still larger than the 1980-84 year-classes at ages 5 and 6.

STACFIS noted that these surveys also caught adult American plaice, and that the age 7+ numbers declined from 1989-91, consistent with the trend in the spring surveys.

Other Biological Studies. Maturity ogives for female American plaice caught in spring and fall surveys in 1985 and 1991 in Div. 3L were constructed. Probit analysis indicated little difference in the 50% maturity values for length and age between years and seasons, at around 34 cm and 8 years respectively. It was noted that further analyses of maturity data for this stock are planned for next year.

c) Estimation of Parameters

i) Sequential population analysis (SPA)

The catch-at-age (ages 5-18, 1975-91), the abundance-at-age from the Canadian groundfish surveys (ages 5-14, 1975-91 except 1983), and the catch rate-at-age from the Canadian commercial fishery (ages 9-14, 1975-91) were used in the same formulation of the Adaptive Framework (ADAPT) that was attempted in the 1991 assessment of this stock. The Laurec/Shepherd (L/S) calibration technique was also employed with the same data, except that the survey data were for 1984 onward (there are no data for 1983). STACFIS noted the problems in the catch-at-age for recent years, including the fact that ages younger than 5 were not present in the catch matrix despite relatively large catches at these ages, but concluded that these data were adequate to use in a VPA.

The results of the ADAPT indicated a lack of fit to the model, with severe year effects present in both indices. Most residuals in recent years in the age by age research vessel survey relationships were negative with the converse being true for the residuals (except 1991) in the catch rate relationships, although the trends were more pronounced for the CPUE data. This pattern has been noticed in previous years, and is the result of divergent indices up to 1990; the research vessel data indicating a decline in recent years and the catch rates indicating stability until the decline in 1991. The L/S analysis indicated a declining trend in catchability for most ages in the CPUE index. L/S also indicated greater between-year variability in the CPUE series, resulting in more weight being given to the survey results. Thus it was decided to redo both analyses excluding the catch rates.

Results from ADAPT with RV data only gave coefficients of variation (CVs) on the population estimates from 0.2 to 0.3, with the exception of 0.41 at age 5. The residual patterns in ADAPT were less severe than in the previous analysis, although all ages in 1991 still had negative residuals. The results from the L/S were very similar to those in the previous L/S analysis. It was concluded that calibration analyses conducted using RV data only were more appropriate than those using both RV and CPUE indices.

d) Assessment Results

Compared with ADAPT, L/S estimated 5+ population numbers in 1991 to be about one-third lower. Both analyses indicated stock size to be much reduced; ADAPT indicated a 40% decline in 5+ numbers from 1984 to 1991 and L/S a decline of 60%. The analyses indicated a decline of about 65% in SSB, assumed to be age 9+, from the early-1980s to 57 000 tons in 1991 with ADAPT and just 44 000 tons from L/S. Both showed higher F in recent years compared to the mid-1980s, with fully recruited Fs (ages 11-15) in most recent years around 0.7 to 0.8. Fully recruited F in 1991 was estimated to be slightly lower: 0.59 in L/S and 0.51 in ADAPT. This seemed unlikely, given an increase in effort in 1991. However, the L/S showed much higher Fs at ages 6-8 than ADAPT in 1989-91, (0.2 to 0.55 in L/S *versus* 0.1 to 0.25 with ADAPT) with both showing the F at these ages to be higher in recent years, reflecting increased catches of juveniles in the Regulatory Area.

Both ADAPT and L/S indicated a continued decline in recruitment at age 5 from levels over 250 million in the mid-1970s, to about 150 million in the mid-1980s. ADAPT estimated the age 5 population in 1987-89 at about 100 million, L/S at about 60 to 80 million. Both analyses showed the values in 1990 and 1991 (1985 and 1986 year-classes) to be higher than the preceding 3; 169 and 139 million from ADAPT and 98 and 110 million from L/S.

e) Catch Projections

STACFIS agreed to do catch projections for 1993 based on both the L/S and ADAPT results, given the difference between the two. The population sizes, mean weights-at-age, and partial recruitment (PR) vectors used in the projections are listed in the following Table.

Parameters used in catch projections for Div. 3LNO American plaice.

Age	ADAPT			L/S	
	1991 Pop	PR	Means wts.	1991 Pop	PR
5	13 5366	0.16	0.15	110 478	0.24
6	12 4322	0.24	0.25	66 279	0.42
7	48 833	0.29	0.35	25 833	0.53
8	42 669	0.35	0.45	22 298	0.60
9	33 428	0.53	0.55	19 697	0.69
10	19 833	0.79	0.70	15 284	0.81
11	11 987	1.00	0.91	11 383	1.00
12	5 129	1.00	1.21	5 342	1.00
13	2 452	1.00	1.62	2 280	1.00
14	1 578	1.00	1.99	1 280	1.00
15	755	1.00	2.21	548	1.00
16	525	1.00	2.79	245	1.00
17	187	1.00	3.42	130	1.00
18	0	1.00	4.30	0	1.00
19	0	1.00	4.50	0	1.00

The PR and mean weights are the average of the 1989-91 values. The 1978-89 geometric mean estimate of 150 million was used for the estimate of age 5 population in 1992 and the catch in 1992 was estimated at 30 000 tons, which is the TAC plus 4 200 tons assumed for non-Contracting Parties. The catch in 1992 generates an F of 0.58 in the projection from ADAPT and 0.81 in the projection from L/S. The following table contains the results of the catch projections:

Reference F		SSB Jan 1, 1993	Catch 1993	SSB Jan 1, 1994
ADAPT	$F_{0.1}$ = .26	41 600	14 500	56 900
	$F_{max} = F_{91}$ = .5		26 000	48 900
L/S	$F_{0.1}$	17 000	10 500	21 000
	F_{max}		18 800	17 300
	F_{91} = .6		22 000	16 000

The $F_{0.1}$ projection for 1992 is 17 200 tons for ADAPT and 14 000 tons for L/S.

This stock is currently at a level far below historic values. Preliminary estimates from the 1992 spring survey indicate further reductions in stock size. The SSB is at a very low level and may not improve if exploitation of recruiting year-classes continues at current levels. The L/S analysis indicates that catches around F_{max} in 1993 will be at about the same level as the remaining SSB. Fishing mortality should be reduced in 1993 to allow the 1985 and 1986 year-classes to contribute significantly to the growth of the SSB. Catches at the $F_{0.1}$ level in 1993 (10 500 with L/S, 14 500 with ADAPT) will result in a projected increase in SSB to 1994. Given the decrease in abundance shown in the preliminary results from the 1992 survey,

and the low level of the SSB, it may be advisable to accept the lower of the $F_{0.1}$ estimates. With catches of 30 000 tons in 1992, both analyses show that SSB will continue to decline (much faster in the L/S), suggesting that a reduction in the 1992 catch would be prudent. (Fig. 23-27)

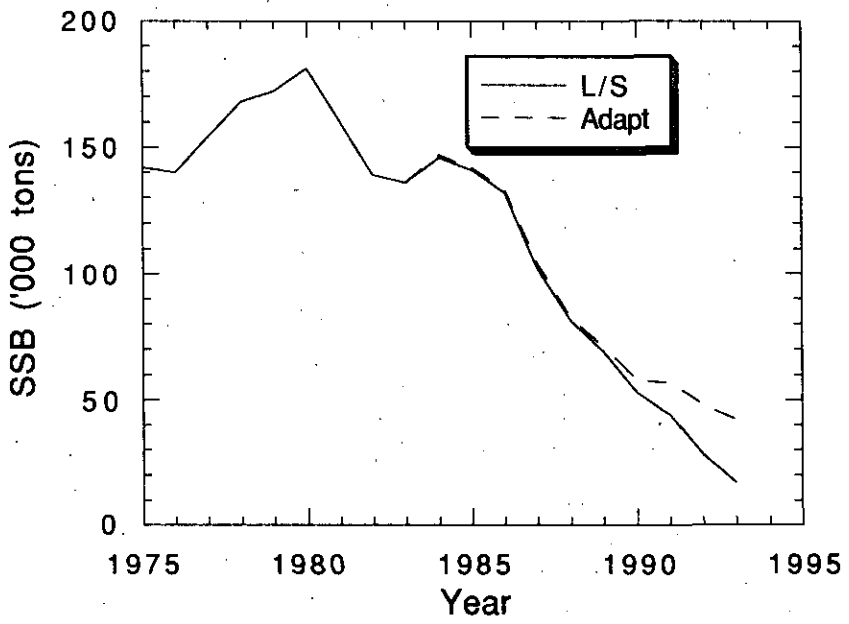

Fig. 23. American plaice in Div. 3LNO: trends in SSB from the L/S and ADAPT calibrations.

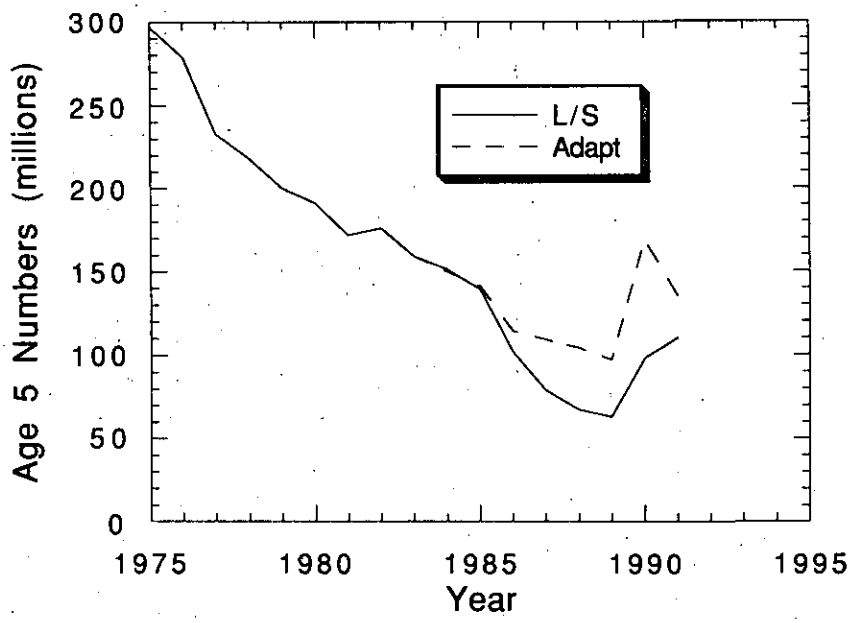

Fig. 24. American plaice in Div. 3LNO: trends in age 5 population numbers from the L/S and ADAPT calibrations.

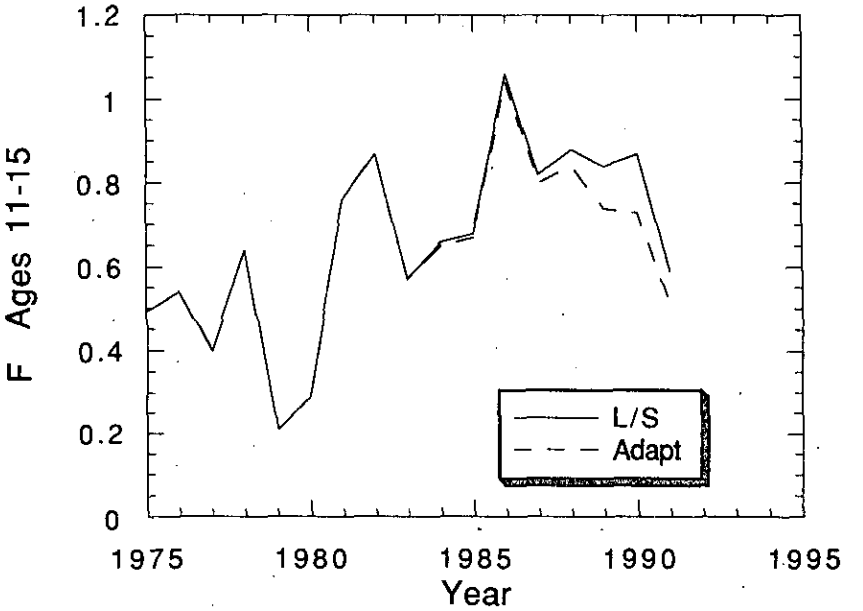

Fig. 25. American plaice in Div. 3LNO: trends in mean F (11-15 unweighted).

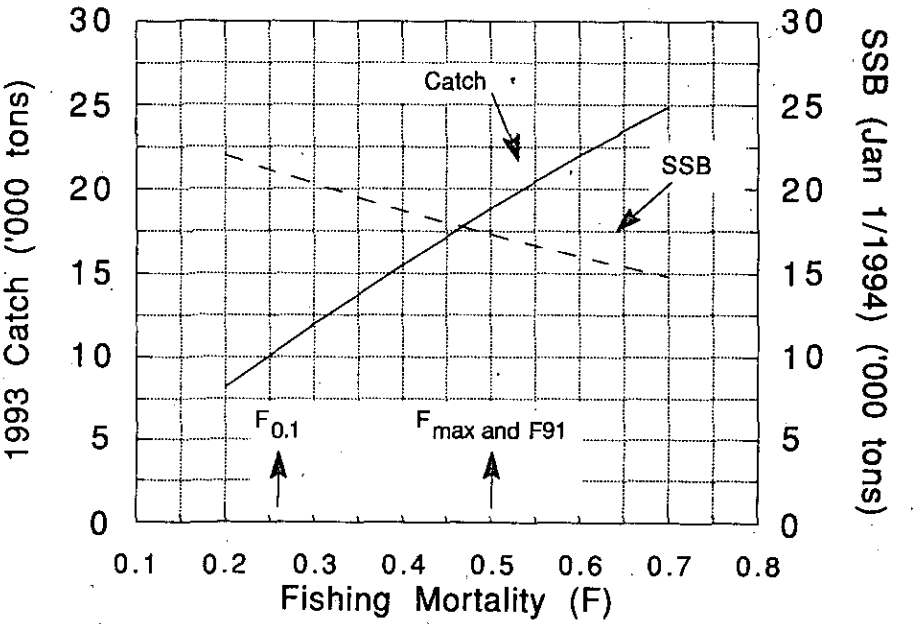

Fig. 26. American plaice in Div. 3LNO: projection of catch for 1993 and SSB at 1 January 1994, using the results from L/S.

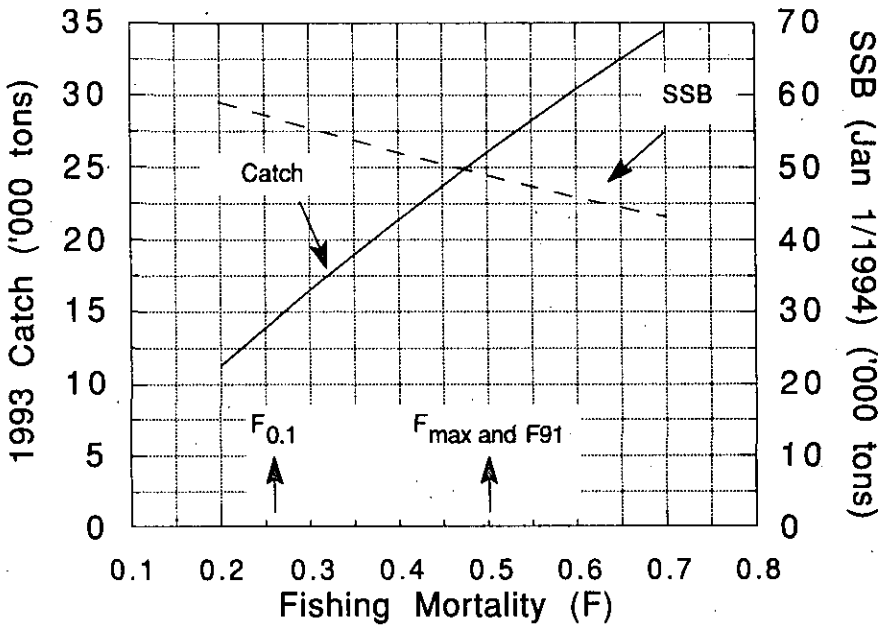

Fig. 27. American plaice in Div. 3LNO: projection of catch for 1993 and SSB at 1 January 1994, using the results from ADAPT.

9. Witch Flounder in Divisions 3N and 3O

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. 28). 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-Contracting Parties such as South Korea, USA, Cayman Islands and Panama also contributed to increased catches.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	5	5	5	5	5	5	5	5	5	5	5
Catch	4	4	3	9	9	8	7	4[1]	4[1]	5[1]	

[1] Provisional.

In 1987 and 1988, the total catch was about 7 500 tons, declining to between 3 600 and 4 800 tons in 1989 to 1991. Catches by Canada ranged from 1 200 tons to 3 000 tons in recent years (about 2 650 tons in 1990 and 1991) and were mainly from Div. 3O. Catches by USSR/Russian vessels declined from between 1 000 and 2 000 tons in 1982-88 to less than 100 tons in 1989-90, and to 0 in 1991.

Catch statistics are not adequate for this stock, given that there are catches by non-Contracting Parties 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.

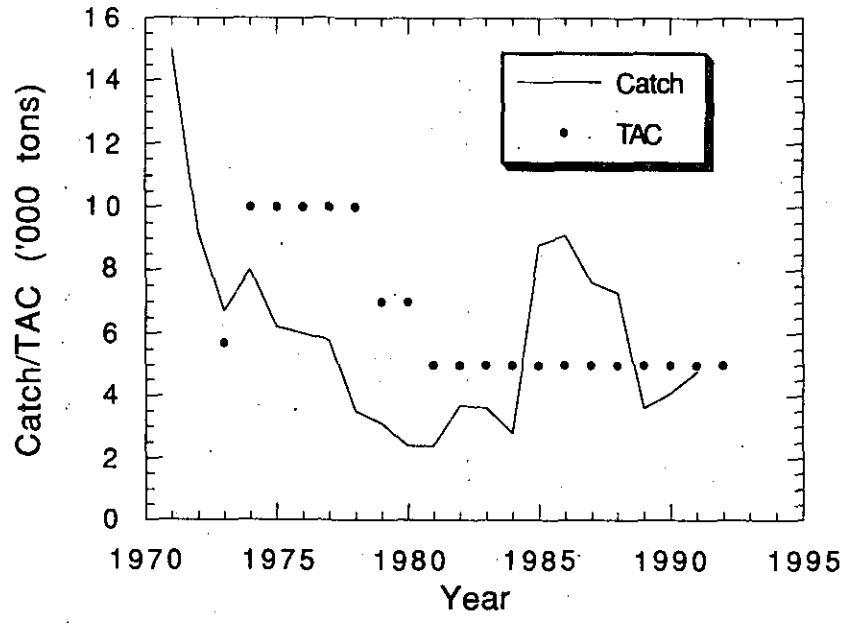

Fig. 28. Witch flounder in Div. 3NO: catches and TACs.

b) Input Data

i) Commercial fishery data

Catch rates. CPUE data from the Canadian trawler fleet directing for witch flounder in Div. 3O was presented. This fishery is carried out on pre-spawning concentrations and is usually one month or so in duration in the spring of each year. CPUE was highly variable and STACFIS agreed that it could not be used as an index of abundance for this stock. Although there was a USSR fishery for many years, much of the effort data were recorded as coming from a mixed fishery and were therefore not adequate as a measure of CPUE in the witch fishery. There is no CPUE from the Portuguese fishery in the Regulatory Area in Div. 3N as witch is caught mainly as a by-catch in other fisheries.

Catch-at-age. Data from the Canadian fishery in 1991 showed that most of the catch came from the 1979 and 1980 year-classes, which was also the case in 1990. Catch at age data from this fleet for 1979-89 showed that ages 9-12 were predominant in the catches in all years. Length compositions of witch in the Spanish and Portuguese fisheries in the Regulatory Area were similar to those from the catches by the Canadian fleet.

ii) Research survey data (Fig. 29)

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 in years prior to 1991, the biomass has likely 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, which is the limit of the survey. These surveys in Div. 3N showed that both abundance and biomass indices were stable in the 1987-89 period but that the 1990-91 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 well 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 total stock abundance.

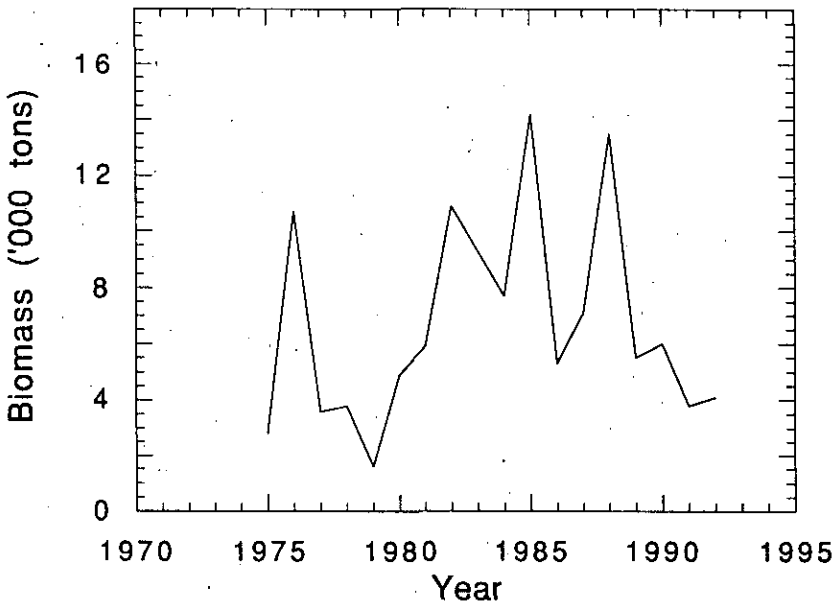

Fig. 29. Witch flounder in Div. 3NO: biomass estimates from Canadian RV data.

Survey biomass estimates were much higher in Div. 3O, but showed a greater degree of variability. Both the Canadian and USSR surveys showed a decrease in stock size from 1988 to 1990. However, the Canadian surveys in 1991 and 1992 showed the biomass to be at about the same level in each year and the Russian survey in 1991 showed an increase. It was noted that a different vessel was used for the survey in 1991. 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. Fall surveys in Div 3NO in 1990 and 1991 indicated a decline in abundance in 1991 and also suggested seasonal differences in distribution with regard to the survey area.

c) Catch Projections

STACFIS again noted that the present indices of abundance for this stock are not adequate to draw firm conclusions about 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 1993 remain at 5 000 tons.

d) Future Studies

STACFIS reiterates 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 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.*

10. Yellowtail Flounder in Divisions 3L, 3N, and 3O (SCR Doc. 92/61; SCS Doc. 92/12, 13, 14)

a) Introduction

Nominal catches increased rapidly from negligible levels in the early-1960s to a peak of over 39 000 tons in 1972 (Fig. 30). 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 1991. In 1991, the total catch was estimated to be about 15 000 tons, an increase of about 1 000 tons from 1990. With the TAC of 5 000 tons in 1989 and 1990 and 7 000 tons in 1991 restricting the fishery, the Canadian catches in 1989 to 1991 were restricted to the lowest observed since 1968. Except for 560 tons taken with Scottish seines, the remainder of the 1991 catch by Canada was taken by otter trawls.

The catch by South Korea was estimated at approximately 3 000 tons in 1991, a 50% decrease from 1990. However, the 1991 catch was based only on surveillance estimates, while previous values were based on reported catches of yellowtail and unspecified flounder. USA catches have declined steadily from 3 800 tons in 1985 to 0 in 1991.

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 1991, about 56% of the catch was estimated.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	23	19	17	15	15	15	15	5	5	7	7
Catch	13	10	17[1]	29[1]	30[1]	16	16[1]	10[1,2]	14[1,2]	15[1,2]	

[1] Includes estimates of misreported catches.
[2] Provisional.

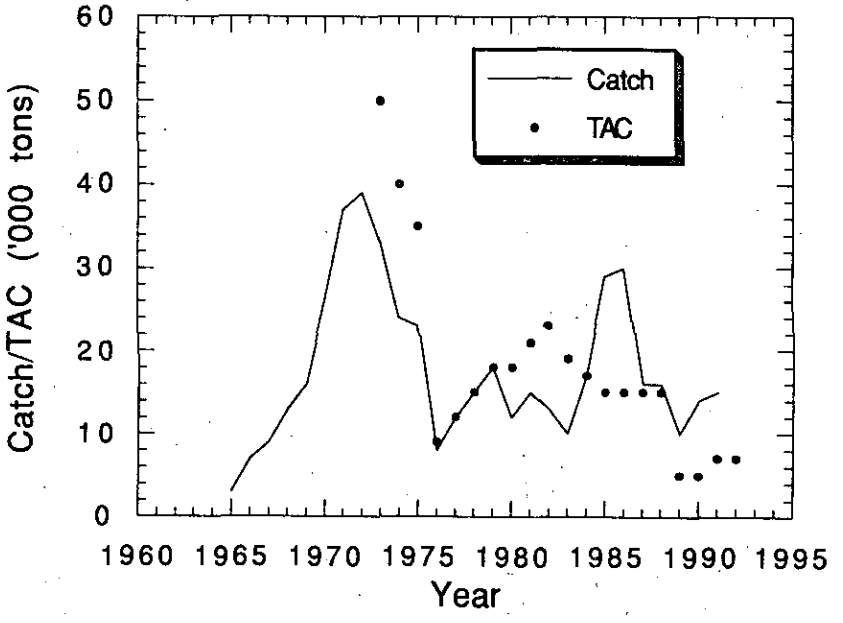

Fig. 30. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) Input Data

i) Commercial fishery data

Catch rates. A multiplicative model was used to analyze 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. The catch rate declined steadily from 1965 to 1975, then increased slightly to a relatively stable level in 1983-85 (Fig. 31). The index declined sharply in 1986 and remained at a relatively low level, although there was an increase of 15% from 1989-90. However, in 1991, the catch rate declined by 45%, to the lowest value in the time series, which is about two-thirds of the previously observed low in 1976. The decline in the index in 1991 was due mainly to a switch in effort by the fleet to Div 3O where a mixed fishery for American plaice and yellowtail flounder occurred. The CPUE in Div. 3N, where most of the stock is located, declined in 1991, but only to the levels observed in 1988 and 1989. Directed effort toward yellowtail flounder, associated with relatively good catch rates, were recorded for the first time in 1991 in the Portuguese trawl fishery in Div. 3N. No series of catch-rate data are available from the fisheries in the Regulatory Area, although STACFIS noted that the Fisheries Commission had requested catch information from non-Contracting Parties fishing for yellowtail flounder and other species in the Regulatory Area.

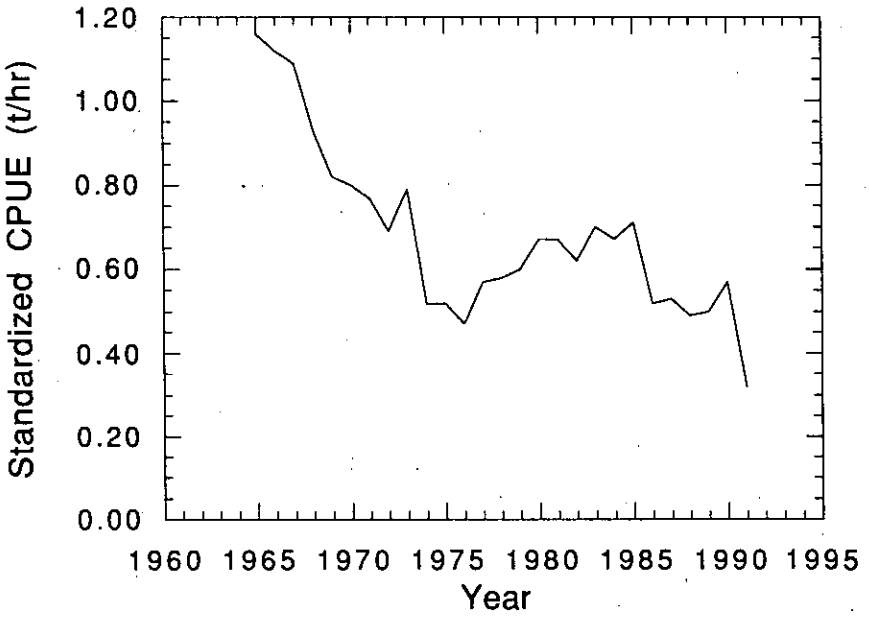

Fig. 31. Yellowtail flounder in Div. 3LNO: standardized catch rates.

Catch rates-at-age from the Canadian fleet for the period 1977-91 were calculated as per the STACFIS recommendation last year (NAFO Sci. Coun. Rep., 1991, p. 78). In 1991, the catch rates at most ages were relatively low, given the catch and effort analysis described previously.

Catch-at-age and mean weights-at-age. Catch-at-age was calculated from length frequencies of the Canadian, Portuguese and Spanish fisheries in 1991. Age-length keys from the Canadian 1991 juvenile flatfish RV survey were used to calculate numbers-at-age for the Spanish fishery. In the Canadian landings, ages 6-8 dominated in 1991, consistent with other years. Information reviewed previously (NAFO Sci. Coun. Rep., 1990, p. 83) indicated that discarding by the Canadian fleet is relatively low. The mean weights-at-age from the Canadian catch in 1991 were similar to recent values. In the Spanish fishery, ages 5 and 6 comprised 86% of the catch numbers with the dominant year-class being that of 1985. This was also the dominant year-class in the 1989 and 1990 fisheries by EEC-Spain, where it accounted for 53% and 40%, respectively, of the catch numbers. These year-classes were also the predominant ones in the gillnet fishery by EEC-Portugal.

Acting upon the 1991 STACFIS recommendation (NAFO Sci. Coun. Rep., 1991, p. 78), the catch-at-age and mean weights at age from the Canadian fishery were presented for years prior to 1986. Ages 6-8 generally comprised over 85% of the catch numbers, although prior to 1982 more young fish were present in the catches, due to smaller mesh size (120 mm) being used in the fishery. Mean weights-at-age did not show any trends in recent years.

In the 1990 assessment of this stock 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 1991 data, where the South Korean catch was estimated to be approximately 20% of the total catch, and for which no sampling data were available.

For these reasons no catch-at-age or mean weights-at-age were calculated for the total removals for many of the years since 1984. Although it would be possible to do such calculations, considerable uncertainty would surround them. Recognizing these difficulties, STACFIS concluded that it would still be a worthwhile exercise to try and construct a catch-at-age matrix for this stock, based on knowledge of the fisheries and assumptions about portions of the catch in some years. If a reliable catch matrix can be constructed, then SPA-based models can be attempted for this stock.

ii) Research survey data (Fig. 32)

Canadian stratified-random spring surveys. Surveys have been carried out by Canadian research vessels in Div. 3LNO each year from 1971 to 1992 with the exception of 1983. The surveys from 1984 to 1992 were comparable in terms of coverage and vessel/gear used. Most of the biomass of this stock was found in Div. 3N. In this Division, the biomass index declined from 65 000 tons in 1986 to approximately 35 000-40 000 tons in 1988-91 followed by a further reduction to 28 000 tons in 1992. 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. In 1992, the index of biomass dropped by 30% to 36 000 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 made the data comparable to the data from 1984-91. The total abundance index of this stock remained relatively stable averaging 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 yellowtail flounder aged 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 to be strong at ages 6 and 7 in 1989 and 1990 respectively, was estimated in 1991 to be one of the lowest in the time series at age 8. The weak 1981 and 1982 year-classes had essentially passed through the population by 1991. Generally, age 9+ fish comprise less than 5% of commercial and research vessel catches. STACFIS noted that the age by age information from the 1992 survey was not available and so the above analysis of year-class strengths from these surveys was the same as that presented in the 1991 assessment.

USSR/Russian stratified-random groundfish surveys (1972-91). The trends in stock size in the USSR/Russian surveys were identical to those in Canadian surveys, showing a sharp drop in abundance in 1985,

and a continued decline to very low levels in 1988-91. The 1990 and 1991 estimates of abundance and biomass were very similar. As in the Canadian surveys, age 7 dominated the USSR/Russian survey catch, with few yellowtail flounder aged 1-3 present, suggesting similar selectivity between Canadian and USSR/Russian survey trawls. The 1985 year-class, which appeared strong at age 4 in the 1989 survey, appeared to be weak in 1990. No age by age information was available from the 1991 survey.

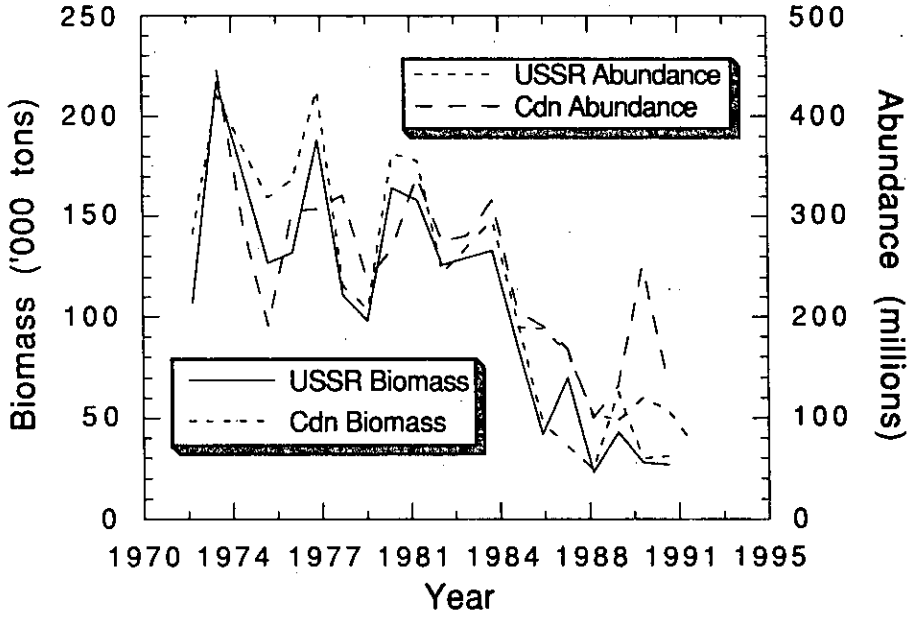

Fig. 32. Yellowtail flounder in Div. 3LNO: biomass and abundance estimates from research vessel data.

Canadian stratified-random fall surveys (1990-91). The estimate of abundance from the fall survey in 1991 was about 15% higher than the fall 1990 value. As in the spring surveys, ages 5-8 were dominant in the catches, with few yellowtail flounder younger than age 4 observed. In both years, the indices of total abundance were lower in the fall surveys than in the spring.

Canadian juvenile flatfish surveys. From 1985 to 1991, annual fall stratified-random surveys have been conducted in Div.3LNO, directed at juvenile American plaice and yellowtail flounder. Most of the population of juvenile yellowtail flounder (ages 1-5) is located in the Regulatory Area. The biomass estimate for Div. 3N has shown a steady increase since 1988 and was estimated to be 40% higher in 1991 than in 1990.

In the 1990 and 1991 surveys the 1985 and 1986 year-classes dominated the catches. As well, the 1988 year-class appeared to be the largest in the time series at age 3, contributing 31% to the overall abundance in 1991. It was also the second largest estimate (to the 1985 year-class) at age 2. Yellowtail flounder aged 7+ showed an increase in abundance in the 1991 survey due to the contribution of the 1984 year-class. In the 1991 survey the majority of the 1986-89 year-classes, ages 2 to 5 years, were found in the Regulatory Area, which is the usual pattern for juvenile yellowtail flounder in Div. 3NO.

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 STACFIS 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. The 1992 preliminary estimate of abundance is likely to be lower than in recent surveys, given the decrease in the preliminary biomass estimate in 1992. All indices still show the population to be at a relatively low level compared to historic values, with the exception of the juvenile survey, which is only a six-year time series.

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 and possibly the 1988 year-class, are stronger than their immediate predecessors, although they are not as strong as most of the 1970s year-classes at ages 4 and 5. Comparisons with the earlier period are somewhat difficult, given that the juvenile surveys did not begin until 1985, and that relatively large numbers of the recent year-classes have been caught at younger ages compared to earlier cohorts.

Both the Canadian groundfish survey and the CPUE indices of abundance at ages 5-7 showed slight increases until the most recent year. In 1991, the CPUE was the lowest value in the time series, and the results from the spring 1992 survey also suggest a decline in abundance. The increase in catch from 1989 to 1991 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 a substantial portion of the 1990 and 1991 catches. The decline in CPUE in 1991 and survey biomass in 1992 suggest that these year-classes are no longer strong and have likely been reduced to below-average levels.

d) Catch Projections and Prognosis

STACFIS concluded that the stock is still at a relatively low level. TACs of 5 000-7 000 tons in 1989-91 have not been very successful in restricting the total catches from the stock, which ranged from 10 000 to 15 000 tons in the same period. Improved recruitment to the stock from the mid-1980s year-classes has not resulted in the expected growth of the stock, due to large catches from these year-classes by fisheries in the Regulatory Area. Unless catches are reduced from the present levels of about twice the TAC, it is unlikely that this stock will recover from its current state. STACFIS advises that the TAC for 1993 be maintained at 7 000 tons. Management of this stock will continue to pose severe problems if unregulated catches by non-Contracting Parties continue at the levels of recent years.

STACFIS reiterated its concerns about the catch of juvenile yellowtail founder in the Regulatory Area, where it is apparent that the effective mesh size being used in some fisheries remains well below the regulated size. Although still impossible to quantify, continuation of the current exploitation pattern in these fisheries will result in a loss in yield-per-recruit and slow any stock rebuilding. Discussions on regulation mesh size and minimum acceptable landing size held at this meeting were positive steps in identifying ways to reduce the fishing mortality on juveniles.

11. Greenland Halibut in Subareas 0 and 1 (SCR Doc. 92/22, 43, 45, 48, 51, 53; SCS Doc. 92/12, 17, 19)

a) Introduction

Between 1984 to 1989 most catches of Greenland halibut in Subareas 0+1 were taken inshore in the West Greenland fjords (Subarea 1). The fishery in Subarea 1 has been increasing during the 1980s (Fig. 33). Also in Subarea 1 a small offshore fishery for Greenland halibut has been executed since 1987. In 1990 and in 1991 Faroese longliners and USSR/Russian trawlers fishing in offshore areas in Div. 0B have caught significant amounts. Annual catches were previously around 9 000 tons and in the period 1984-1989 more than 80% of the yield came from Subarea 1. Before that time Div. 0B contributed about 45% of the annual catches. Recent catches are 19 914 tons in 1990 and 21 424 tons in 1991 with approximately 50% taken in each Subarea.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	-	-	-	25	25	25	25	25	25	25	25
Division 0B	4	5	+	1	+	+	1	1[1]	11[1]	11[1]	
Subarea 1	5	4	7	9	9	10	9	9[1]	9[1]	11[1]	
Total	9	9	7	10	9	10	10	10[1]	20[1]	22[1]	

[1] Provisional.

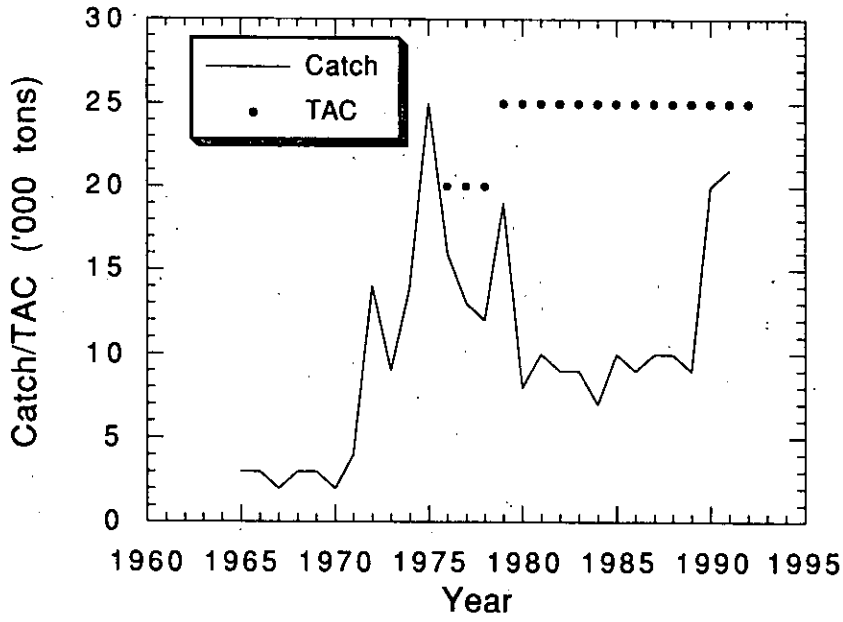

Fig. 33. Greenland halibut in Subarea 0 and 1: catches and TACs.

The fishery in Subarea 0. USSR prior to 1984, and in some years GDR, had in Div. 0B a trawl fishery offshore. Also Faroese longliners have regularly taken minor catches in this area. Since 1990 both the trawl in Div. 0B and longline fisheries have increased significantly. By 1991 Canada also entered this trawl fishery. Catches in Div. 0B jumped from 727 tons in 1989 to 10 570 tons in 1990 and 10 536 tons in 1991. Most of the fisheries took place during September-December in 1991. Catches by Faroe Islands in Div. 0B mainly by longliners averaged 350 tons in the period 1980-1987 and increased to 2 350 tons in 1991.

No catches were reported from Div. 0A.

The fjord fisheries in Subarea 1. Most of the total catches in Subarea 1 were taken in the fjords of Div. 1A by Greenland (92%). Three areas comprise the fishery: Ilulissat, Uummannaq and Upernavik of which Ilulissat makes up more than 50% of the catches. Catches increased from 9 344 tons in 1990 to 10 888 tons in 1991, mainly due to an increased fishery in Div. 1A by Greenland. The Greenland fishery is a small-scale gillnet and longline fishery carried out either by boats below 20 GRT or by means of dog sledges, typically in the inner parts of the fjords at depths of 500-800 m. Most catches are taken during the summer fishery. Since the mid-1980s gillnets became more common and in the period 1986-89 gillnets and longlines accounted equally for the catches in Div. 1A. Since then longline has dominated again and comprised about 83% of the inshore catches of Subarea 1 in 1991. This fishery peaks in March and again in July-September.

The offshore fisheries in Subarea 1: Japanese offshore trawl catch amounted to about 600 tons in 1991 (taken in Div. 1CD in August-November), which is a minor decrease compared to 1990 (861 tons). Minor catches (162 tons) derive from an offshore trawl fishery by Greenland (86 tons), Germany (3

tons by-catch in the cod fishery) and Faroe Islands (73 tons taken by one longliner).

b) Input Data

i) Commercial fishery data.

Few samples from the commercial inshore fishery in 1991 were taken preventing catch-at-age to be determined. No samples were available from the offshore fishery. STACFIS noted that Canada would present more information at the 1993 meeting.

ii) Research survey data

Bottom-trawl surveys have been conducted jointly by Japan and Greenland in Subarea 1 since 1987. In 1991 surveys were conducted in August/September and November. Estimated swept area biomass was 79 750 tons for Div. 1ABCD. The biomass estimate for Div. 1ABCD in 1991 is the highest in the period surveyed. However, since 1987 the surveys had differed somewhat in timing, area and depth coverage. The survey has demonstrated seasonal differences in distribution of the biomass, which may be due to within-year migrations. Thus it is not possible to interpret this apparent increase.

A bottom-trawl survey was carried out jointly by Germany and Russia in Div. 0B in October/November 1991, covering the depth range 200-1 500 m. The swept area biomass estimate for Div. 0B was 45 600 tons, which is a marked decrease compared to the former years.

In 1987, 1988 and 1990 both surveys covered Div. 1BCD and a first comparison suggests that the two research vessels swept area biomass estimates are comparable and hence that estimates for Div. 0B and Div. 1ABCD may be summed. This sum suggests a biomass around 125 000 tons for the offshore parts of Subareas 0B and 1.

Trawlable biomass estimates ('000 tons) from Greenland/Japan surveys and Germany/USSR-Russia surveys for the years 1987-91 by Divisions in Subareas 0+1 were:

	Germany/USSR-Russia		Greenland/Japan		
Year	0B	1BCD	1ABCD	1BCD	0B+1ABCD
1987	37	56	54[1]	54[1]	81
1988	55	47	63	53	118
1989	79	no survey	63	63	142
1990	72	88	56[2]	53[2]	128
1991	46	no survey	79	no survey	125

[1] Survey did not cover the depth stratum 1 000-1 500 m.
[2] Average values of two surveys.

A trial longline fishery was conducted in Div. 1CD in August 1991 by a Faroese vessel. High CPUE values were obtained throughout the surveyed area below depths of 900 m. Length distributions of the catches ranges between 40 cm and 120 cm, with peaks at 60 cm and 85 cm, representing two unimodal distributions for males and females, respectively.

The two research fisheries with trawl and longline overlap in Div. 1D in August 1991. As expected trawl was more efficient for the smaller length groups (approximately 50 times for the lengths 42-47 cm), while longline was more efficient for the larger length groups (approximately 30 times for the lengths 96-101 cm). This difference in efficiency is such that the trawl estimate for Greenland halibut should possibly only be interpreted as representing lengths up to about 60 cm. Noting that similar studies previously presented indicate similar results, STACFIS recommended that *further studies of the selectivity of research trawling for sampling large Greenland halibut in deep waters be undertaken and all available information be tabled for review at the 1993 meeting.*

Abundance indices of Greenland halibut were derived from the shrimp surveys carried out off West Greenland. These surveys cover the area between 62°N and 72°N, from the 3-mile limit to the 600 m depth contour line in July-August 1988-91. Length distributions of by-catches of Greenland halibut showed peaks at 11 and 18 cm, representing age-groups 1 and 2. Abundance estimates dropped from a level of 140 million in 1988 to 36 million in 1990 and increased to 70 million in 1991. The time series is too short to estimate the average level of recruitment (age 1+2) in these areas.

The shrimp survey in 1991 also included Disko Bay. The survey area was between 68°42'N and 70°38'N at depths 150-550 m in September 1991. Length distributions confirm that parts of Disko Bay are important nursery grounds for Greenland halibut. The estimated biomass of age groups 1, 2 and 3 was estimated to 2 100 tons for the surveyed area in Disko Bay compared with the estimate for the same ages of 5 000 tons for the offshore areas in Subarea 1.

c) Prognosis

Greenland halibut seem to be rather evenly distributed in the area, possibly with a component at depths not yet accessible to the fishery.

For the fjord areas in Subarea 1, catches increased somewhat from 1990 to 1991 probably due to an increase in effort. There are no indications that the stock is adversely affected by this increase.

Biomass estimates from the Germany/USSR-Russia and Greenland/Japan surveys indicate a biomass around 125 000 tons for the offshore areas of Div. 0B + Subarea 1 during the last 3 or 4 years.

It is not known to what extent the surveys cover the stock area; particularly there is no information for Div. 0A and the length range properly estimated by research trawls is under discussion. Given the considerable difference in the size distributions taken by trawl and longline there are still questions concerning the representativeness of the trawl survey data. The age composition of the most recent catches in Div. 0B is not known and a reliable catch-at-age matrix cannot be constructed. Hence any analytical assessment is not possible at this point in time. STACFIS noted that more biological information will be presented by Canada in 1993.

Based on the survey information available STACFIS advises that the present TAC level of 25 000 tons be maintained. STACFIS also notes that the increase in exploitation of this stock has been directed towards the offshore components in line with advice previously given by STACFIS. The present exploitation is close to the TAC level and there are only limited scope for a further increase in the catches.

d) Greenland Halibut in Subareas 0, 1, 2 and 3.

Canada and Denmark (Greenland) concurred in requesting the Scientific Council to provide an overall assessment of the total stock and comment on its management (see Agenda, Annex 2 and 3).

Scientific discussions on this problem took place at the Special Session in September 1987, and again at STACFIS in June 1990 and reported at that time "from a biological point of view there was no reason to maintain two separate assessments for the area". Further STACFIS concluded that "At present, practical limitations impede such a combined assessment". The main problem recognized was that the inshore areas in Subarea 1 and the coastal areas in Subarea 2 and Div. 3KL, where most of the fishery between 1984 to 1989 occurred, is not covered by the surveys.

Since STACFIS made this statement the offshore fisheries in Div. 0B and in Div. 3LM have developed drastically.

STACFIS still does not have sufficient data to carry out an analytical assessment of the total stock. Until such time it can advise on a single TAC it is most likely that STACFIS will recommend suballocations by geographic areas. This is because the fishing fleets which exploit Greenland halibut offshore are highly mobile and STACFIS is concerned that this effort could be concentrated on a single component of the Greenland halibut stock in

Subareas 0-3. Even though Greenland halibut forms a single stock throughout this area, the stock does not totally mix within a year and STACFIS advises that TACs be set for each Subarea/Division to ensure that effort be spread fairly evenly over the stock area, and hence that no stock component be exposed to disproportionately high fishing mortalities.

For management purposes it may be considered to establish separate allocations for inshore and offshore areas. The main recruitment to the inshore areas is from Davis Strait as no spawning in the fjords had been found. Taggings have shown that the inshore West Greenland stocks are isolated between fjords. The proportion of these Greenland halibut which return to Davis Strait is uncertain because the offshore exploitation was low when these taggings were done. Age distributions in the fjords do not indicate a large sudden emigration out of the fjords. It may therefore be considered to establish separate allocations between inshore and offshore areas, and the main objective when calculating such inshore allocations should be to make optimal use of the growth potential of Greenland halibut.

Data availability may be summarized as follows. Catch and effort statistics do not cover all fisheries, particularly no data were presented for the fisheries in Div. 0B. STACFIS was also only able to provide a range for Div. 3LM catch in 1991. Data not previously published but available in Canada will be presented at the June 1993 meeting. The available survey data for 1991 are summarized in SCS 92/22. There are surveys directed for Greenland halibut in Div 0B, Subarea 1 (offshore), Subarea 2 and in Divs. 3KL. These surveys generally range down to 1 500 m but are in several cases not made on a regular basis and therefore do not constitute a time series and further also vary in timing. Information on young Greenland halibut are obtained from shrimp surveys and from surveys directed for cod. These surveys only cover up 500 to 700 m depth.

Coverage of the fishery with both surveys and sampling is inadequate for a combined assessment. STACFIS recommends that *steps be taken to achieve better coordination between Greenland halibut surveys while also encouraging that comparative studies of the relative fishing power between research vessels be undertaken.*

Recognizing the importance of the fishery developed in the vicinity of the Div. 3L and 3M border. STACFIS recommends that *all available data for Greenland halibut in Div. 3L and 3M be compiled and be presented to STACFIS in 1993 for discussion of stock delineation and stock structure.* STACFIS further recommends that *sampling and other biological studies of this stock component be initiated.* STACFIS noted that previous compilations on Greenland halibut have been presented (e.g. SCR Doc. 87/76, 86; 90/35).

12. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 92/22, 27, 28, 41, 82; SCS Doc. 92/12, 13, 14, 17)

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. 34). From 1985 to 1989, catches exceeded 20 000 tons only in 1987. In 1990, an extensive fishery developed in the deep water (down to 1 500 m) in the Regulatory Area, around the boundary of Div. 3L and 3M, resulting in an increase in total catch to about 47 000 tons. The total catch estimated by STACFIS for 1991 was somewhere in the range of 55 000 to 75 000 tons. The major participants in the fishery in the Regulatory Area were EEC-Spain and EEC-Portugal, as well as some non-Contracting Parties such as Panama. STACFIS considered that catches from Div. 3M were from the Subarea 2 + Div. 3KL stock and should therefore be included in the assessment of this resource. It was also noted that EEC-Portugal reported about 3 000 tons of Greenland halibut from Div. 3N in 1991, although it was not known in which part of Div. 3N these catches were taken.

The Spanish fishery in the deepwater area began in 1990, and exists mainly in the boundary area between Div. 3L and 3M. In 1990, most of the fleet consisted of large vessels (>1 000 GRT), but in 1991 were joined by many smaller vessels, with ships <600 GRT being dominant. The fishery also takes an important by-catch of grenadiers which increased from 3% of the Greenland halibut catch in 1990 to 30% in 1991.

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 negligible in 1991. USSR/Russian catches increased from about 1 100 tons in 1988-90 to 8 200 tons in 1991, the largest catch by this fleet since 1975. EEC-Portugal and Japan have taken catches from this stock each year since 1984. Canadian catches have been between 8 200 and 13 500 tons in each year from 1985-91. At 10 900 tons in 1991, the Canadian catch was 1 100 tons higher than in 1990.

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. The gillnet catch in 1991 of 3 500 tons was the lowest since the fishery started in the 1960s. In recent years, some of the gillnet effort has shifted from inshore to offshore areas.

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 7 400 tons in 1990, which is the highest level since 1982.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC[1]	55	55	55	75	100	100	100	100	50	50	50
Catch	26	28	25	19	16	31	19	19[2]	47[2,3]	55-75[3,4]	

[1] TAC for Div. 2J+3KL only for 1977-84.
[2] Provisional.
[3] Includes estimates of misreported catches.
[4] STACFIS could not reliably estimate total landings.

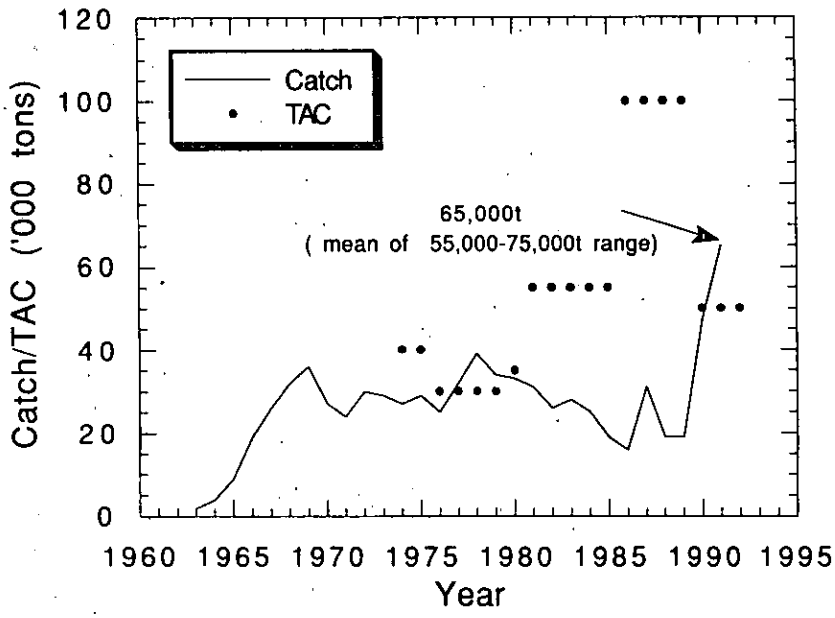

Fig. 34. Greenland halibut in Subarea 2 and Div. 3KL: catches and TACs.

b) Input Data

i) Commercial fishery data

Considering the nature of the trawl fishery and the migratory behaviour of this species, it is not possible to obtain catch-rate data which are representative of the total stock. However, data from the Portuguese trawler fleet in Div. 3LM showed a gradual decline in catch rate from 1989 to 1991. Catch and effort data from the Spanish

fishery requires further analysis prior to interpretation. It was noted that these analyses will be presented in 1993.

Age compositions were obtained from the Canadian fishery in 1991, and length frequency data were available from the Portuguese and Spanish fisheries in the Regulatory Area in Div. 3LM in 1991. Ages 6-8 years dominated in the catches of the Canadian inshore and offshore fisheries in 1991, as is usually the case. The peak length group in the Canadian catch was 46 cm, which agreed with the length frequencies from the Portuguese catches in Div. 3L, where the bulk of the catch was comprised of fish between 40 and 50 cm. The mean length of Greenland halibut in the Portuguese catch decreased from 1990 to 1991. Length frequency data from the Spanish fishery in Div. 3LM showed the peak length groups to be between 50 and 60 cm, which suggested that the main ages in this fishery were 7 to 9. This was similar to the 1990 fishery. It was noted that the mean length of the catch and percentage of females in the Spanish catches increased with depth.

The mean weights-at-age in the Canadian fishery in 1991 were slightly higher than those calculated for 1990 but well within the range of recent values.

STACFIS noted that there was a substantial amount of sampling data from other fleets for the period 1989-91 and recommended that *these data be analyzed and presented at the next assessment of this stock.*

ii) Research survey data (Fig. 35)

Canadian stratified-random groundfish surveys. Estimates of biomass from Canadian autumn stratified-random groundfish surveys in Div. 2J (1977-91 down to 1 000 m), Div. 3K (1978-91 down to 1 000 m) and Div. 3L (1981-91 down to 732 m) were reviewed, with values for missing strata estimated using a multiplicative model. STACFIS noted that these surveys do not cover strata deeper than 1 000 m, where Greenland halibut are known to inhabit. Thus the estimates from these surveys are not indicative of the total abundance and biomass in Div. 2J+3KL. The results can only be interpreted as an index of the population in the strata less than 1 000 m. Although there was no apparent movement of Greenland halibut to the deeper waters covered in the surveys, it was not possible to determine if there had been some movement to waters beyond 1 000 m.

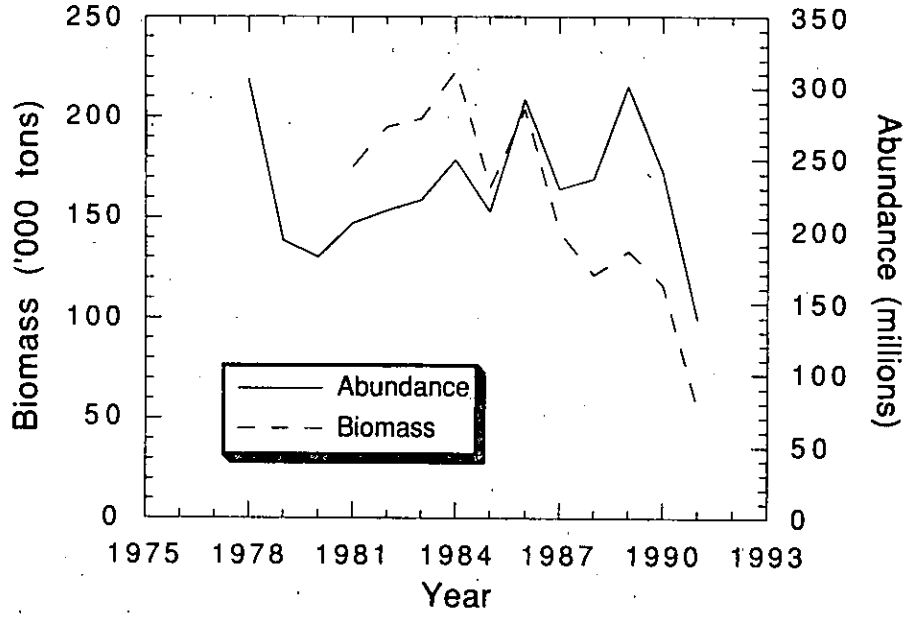

Fig. 35. Greenland halibut in Subarea 2 and Div. 3KL: biomass and abundance estimates from Canadian RV data.

The biomass index showed a decline in recent years, particularly in Div. 2J and 3K, while the abundance had increased up to 1990, with 1989 and 1990 being among the highest estimates in the 1981-90 period. However, in 1991 the estimates of biomass and abundance both declined sharply to the lowest levels observed. These declines were present in all 3 Divisions. The abundance of age 7-9 year old fish, which form the bulk of the fisheries in most years, was also at its lowest level in 1991, continuing the downward trend observed in recent years. The index of abundance of older fish dropped very sharply from 1990 to 1991, with age 9+ numbers in 1991 being about one-fourth of the 1990 estimate and about one-sixth of the values in 1988-89. Abundance of fish aged 4-6 years, which was at its highest in 1989 and 1990, declined to near average in 1991. Recent surveys had suggested that the 1984-86 year-classes were 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 1991 however, the estimates of these year-classes declined to about the lowest values in the series at ages 5, 6, and 7.

Div. 2GH was surveyed by Canada in 1991, but coverage was sparse in Div. 2G and did not extend below 500 m in either Division. Surveys done in Div. 2GH in the late-1980s indicated a decline in biomass from the estimates obtained in the late-1970s and early-1980s. It was noted that surveys in the earlier period were post stratified, and coverage was generally greater than in the more recent period.

USSR/Russian stratified-random groundfish surveys. The Russian stratified-random groundfish survey in 1991 did not cover Div. 3K because of ice conditions. The mean abundance from 1987-90 was similar to the mean from the Canadian surveys during this time. These surveys did not cover depths greater than 1000 m and thus are indicative only of the population shallower than this.

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 is. Results from the 1991 survey in Div. 3L were not available.

The results of the joint German/Russian stratified random survey conducted in Div. 2GH in 1991 showed that the abundance and biomass of Greenland halibut in this area were greatly reduced from levels observed in the early-1980s. The survey in 1991, which covered all strata to 1500 m, showed a decline of more than two-thirds from 1989, despite an increase of 50% in the surveyed area in 1991. STACFIS noted that fish in spawning condition have been observed in these surveys and recommended that *available information on sexual maturity and spawning from these surveys be made available to STACFIS in 1993.*

EEC stratified random surveys-Div. 3M. These surveys indicated that Greenland halibut biomass on Flemish Cap in depths to 730 m ranged from 4 300 tons in 1989 to 8 000 tons in 1991. The estimates from these surveys are not indicative of the total biomass in Div. 3M and can only be interpreted as an index of the population in depths to 730 m.

Canadian shrimp surveys. STACFIS noted that the estimates from previous surveys were presented in 1991 and that these surveys had consistently indicated that the 1984-86 year-classes were relatively strong. As well, the shrimp surveys suggested that 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. The shrimp survey conducted in 1991 was not comparable to those of previous years due to changes in the survey design. Thus there were no comparable estimates of Greenland halibut abundance for 1991.

Canadian deepwater line transect surveys. In August-September 1991, two separate surveys were conducted - one in Div. 0B and 2GHJ and one in Div. 3KLM. Both surveys used a line transect design and most

in Div. 3KLM. Both surveys used a line transect design and most fishing sets were in depths from 750 to 1 500 m. In Div. 3LM, many of the survey tows were done in the region of the commercial fishery in the Regulatory Area. In the northern survey, the abundance of Greenland halibut was highest in Div. 2H and lowest in Div. 2G, although it was noted that only a few sets were done in each of the areas surveyed. In the southern survey, where coverage was much better, Greenland halibut were more abundant in Div. 3K and less abundant in Div. 3L. In all 3 Divisions, fish were generally more abundant from 750 to 1 050 m than in the deeper water, but mean fish size increased with depth. Ages 7 to 9 comprised the bulk of the catches in most areas, with older fish being more prominent in the deeper water. STACFIS noted that additional information from this survey, including data on sexual maturity, would be made available at the next meeting.

iii) Biological studies

Information on sexual maturity and spawning of Greenland halibut was collected from the Spanish fishery in Div. 3LM in 1991. About 20% of females observed in July and August were determined to be in spawning condition, i.e. contained hydrated eggs, while the percentage in other months ranged from 0 to 7. The size at M_{50} ranged from 67 to 73 cm. The deepwater survey in this area in September found very few fish in a spawning condition but a substantial percentage of spent females was observed.

c) Estimation of Parameters

STACFIS again noted that an analytical assessment of this stock was not possible. Although the available 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. There was a further increase in the catch in 1991 to a level which may be as high as 25 000 tons above the TAC. At present, little is known of the population of Greenland halibut in this area, particularly the abundance and its relation to the rest of the stock. However, results from the deepwater survey show that the density of Greenland halibut in this area was lower than in Div. 3K. Almost all fisheries on this stock are catching individuals which are mostly immature. In many previous years, STACFIS has cautioned about concentrating fishing effort on one part of the stock. With catches in the developing fisheries in Regulatory Area as high as 30 000 to 50 000 tons in the last 2 years, these concerns must be reiterated.

The current assessment shows that virtually all indices of abundance declined in 1991, in some cases to the lowest levels in the time series. The higher levels of abundance in 1989-90 were attributed to the recruitment of the 1984 to 1986 year-classes. However, 1991 surveys show a marked decline in their abundance. The decrease in biomass in the recent period compared to the mid-1980s was caused by a decline in the number of older (age 9+) fish in the population. The recent declines in abundance and biomass which can not be fully explained by the fishery, are still a cause for concern.

STACFIS again noted that the previous advice has been for the entire stock area in Subarea 2 and Div. 3KL. There is no evidence available at present to suggest that the new fishery in the Regulatory Area in Div. 3LM is not being conducted on this same stock. STACFIS concluded that current information was not sufficient to advise a change in the TAC but that as a precautionary measure catches in 1993 should not exceed the current TAC of 50 000 tons. This should apply to the entire stock, including the part located in the Regulatory Area in Div. 3LM. STACFIS also pointed out that until more is known of stock structure, precautionary measures to prevent concentration of effort on one segment of the stock should be considered. One such measure would be to distribute the TAC over the various Divisions inhabited by the stock.

The response to the concurrent requests from Canada and Denmark (Greenland) regarding an overall assessment for the total Greenland halibut stock from

Subareas 0+1 to Subarea 3, was addressed in the report of the assessment on Greenland halibut in Subareas 0 and 1 (see Section 11.d).

13. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 92/9, 48, SCS Doc. 92/12, 17, 18, 19)

a) Introduction

A total catch of only 155 tons has been reported to date for 1991, compared with 156 tons reported for 1990. Catches since 1978 continue to be restricted to by-catches in the Greenland halibut fishery (Fig. 36). By-catch taken by Japan in the Greenland halibut fishery is reported in the "others" category which totaled 97 tons in Div. 0B and 116 tons in Subarea 1.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Catch	0.1	0.1	0.1	0.1	0.1	0.4	0.5	0.05[1]	0.16[1]	0.16[1]	

[1] Provisional.

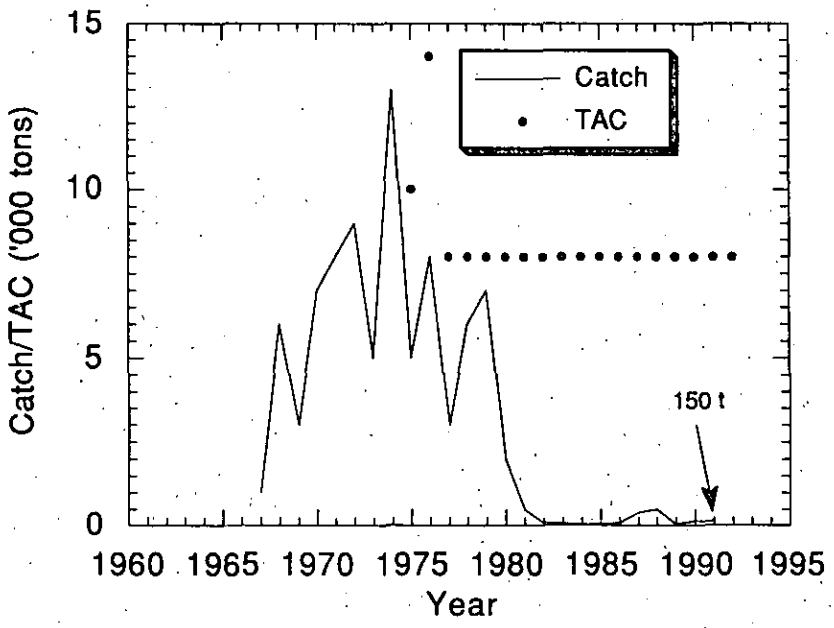

Fig. 36 . Roundnose grenadier in Subareas 0 and 1: catches and TACs.

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, p. 72) was possible.

ii) Research survey data

Japan in cooperation with Greenland conducted a bottom trawl research survey in Subarea 1 in August/September 1991. The trawable biomass in Div. 1CD for the depth range 600-1 500 m were estimated as follows:

Year	1987	1988	1989	1990	1991
Trawable biomass (tons)	45 800	44 000	5 700	20 300	41 700

The 1989 and 1990 surveys gave substantially lower estimates than the other three years in this time series. There are indications of an immigration into the survey area during early summer and of an emigration during the winter. This migration pattern makes timing of the survey critical. The estimates refer to August/September, surveys at other times of the year gave much lower estimates. Only a few roundnose grenadier were taken at depths less than 600 m. The size of the fish increased with depth and in the direction from north to south.

A bottom trawl survey carried out in Div. 0B at depths between 200–1 400 m in November 1991 by EEC-Germany/Russia gave small catches at depths less than 1 000 m. The largest catches were taken between 1 300–1 400 m. The size of the fish increased with depth. This survey has occasionally covered Divs. 1BCD in previous years but not so in 1991. STACFIS noted that data from this survey is partly reported as aggregates over all subareas and recommends that *all information to be presented from the German/Russian groundfish surveys including that for roundnose grenadier be broken down by Subarea and Division.*

c) Prognosis

It was observed previously (NAFO Sci. Coun. Rep., 1987, p. 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 about 20% of the biomass estimates from the Japanese surveys. The surveys do not cover the entire stock area as roundnose grenadiers also occur deeper than 1500 m and Subarea 0 is not included in the estimate. Hence the trawable biomass is an underestimate. STACFIS advises that the 1993 TAC should remain at the 1991 level of 8 000 tons.

14. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 92/9, 28, 82; SCS Doc. 92/12, 14)

a) Introduction

Nominal catches prior to 1979 averaged 26 000 tons. Since 1979 catches have averaged about 5 000 tons. The provisional reported catch for 1991 is 4 600 tons. STACFIS estimated the actual 1991 catch to be within the range of 9 000–14 000 tons, an increase of at least 5 000 tons from the 1990 catch of about 4 000 tons (Fig. 37). The EEC (primarily Spain and Portugal) accounted for most of the catch as by-catch in a Greenland halibut fishery mainly in Div. 3LM. The catch by EEC-Portugal increased from about 300 tons in 1989 to about 3 000 tons in 1990, compensating for the cessation of the fishery by the GDR fleet and a substantial reduction in the catch by the USSR fleet from 2 200 tons in 1989 to 500 tons in 1990.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	27	11	11	11	11	11	11	11	11	11	11
Catch	4	4	4	5	7	8	6	5[1]	4[1]	9–14[1,2]	

[1] Provisional.
[2] Includes estimates of misreported catch which could not be determined precisely.

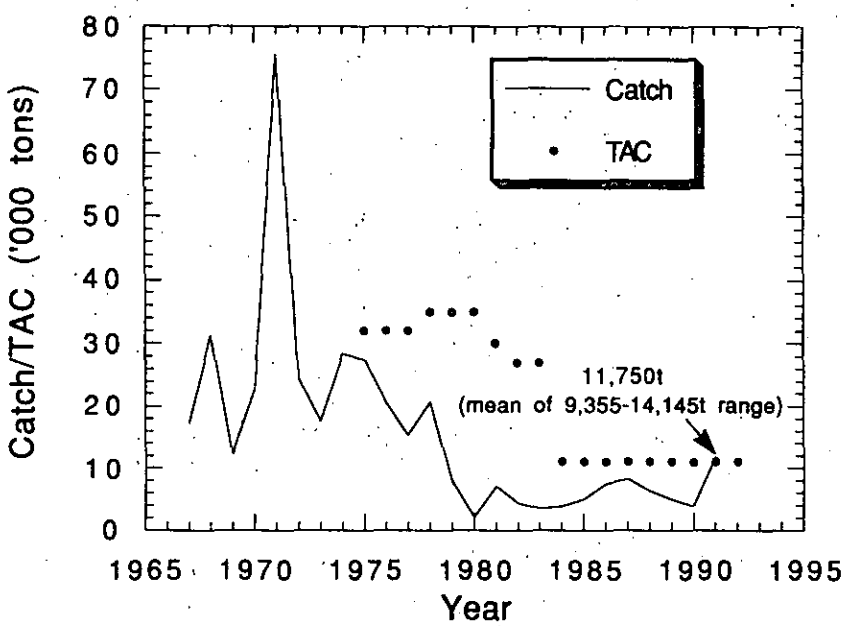

Fig. 37. Roundnose grenadier in Subareas 2 and 3: catches and TACs.

Prior to the increase in EEC 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 with about 50% of the total being taken during the March to May period.

b) Input Data

i) Commercial fishery data

There was no commercial fishery data to evaluate other than information relating to catches.

ii) Research survey data

The results of a joint EEC-Germany/Russian research survey in Div. 2GH and 3K in 1991 were presented. Fishing was carried out in depths of 201-1 500 m. There were little or no roundnose grenadier caught in depths <701 m in any Division. They dominated the catches in depths >1 200 m. The highest densities were found in Div. 2GH. Larger fish were caught in deeper waters, and the mean overall total length was about 50 cm.

In 1991 surveys were conducted by Canada in Div. 2GHJ (northern area) and Div. 3KLM (southern area) by different vessels utilizing different gears and towing distance. Fishing was conducted in depths from 750-1 700 m. The highest densities in the northern area occurred in Div. 2G. In the southern area the highest densities occurred in Div. 3K. A general increase in size of fish with increasing depth was evident throughout the surveyed area.

c) Prognosis

In 1991, STACFIS concluded (NAFO Sci. Coun. Rep., 1991, p. 88) that there were insufficient data upon which to base an assessment, and until such data were forthcoming it will not be possible to assess the status of this stock. This situation remains unchanged and STACFIS therefore advises that the precautionary TAC (11 000 tons) be maintained for 1993. STACFIS does not anticipate that the pre-requisite data will be available in the foreseeable future.

15. Capelin in Division 3L (SCR Doc. 92/57; SCS Doc. 92/1, 12)

a) Introduction

The status of this capelin stock in 1991 and prognosis for 1992 were discussed during the Special Meeting of the Scientific Council held in St. John's during 3-6 March 1992 (SCS Doc. 92/1). During the present meeting, the results of the Special Meeting were reviewed, new data were discussed, the 1992 prognosis was re-addressed in light of new data, and a preliminary prognosis for 1993 was conducted.

Recent TACs and catches ('000 tons) are as follows (Fig. 38):

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Advised TAC	-[1]	60	38	60	130	283	90	335	350	-[2]	-[2]
TAC	30	30	26	26	55	25	45	46	56	56	32
Nominal landings	27	25	33	25	48	19	53	52[3]	48[3]	21[3]	

[1] No STACFIS advice.
[2] STACFIS concluded that a catch of 50 000 tons as in recent years would be well below a 10% exploitation rate.
[3] Provisional.

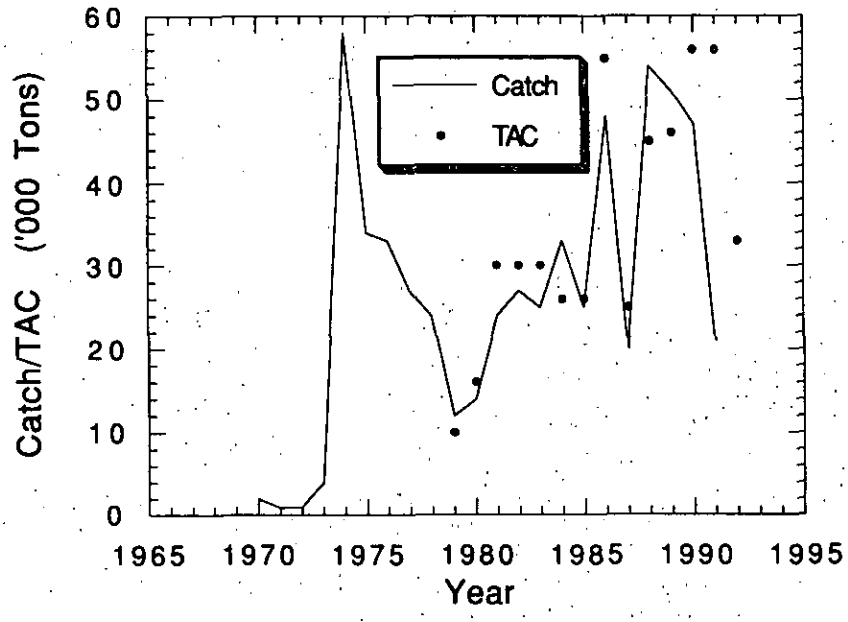

Fig. 38. Capelin in Div. 3L: catches and TACs.

b) Input Data

i) Research survey data

An acoustic survey conducted by Canada during 6-26 May 1992 covered a wider geographical area than previous surveys. Strata between 47°N and 48°N were extended 160 km east to the 500 m isobath, because of indications from groundfish surveys that capelin regularly occurred in the area. One planned transect in the northern stratum could not be surveyed because of ice. It was noted that the highest biomass estimate occurred in that stratum suggesting that more capelin occurred to the north of the survey area. The 1992 biomass estimate of 206 000 tons was approximately double the 1991 estimate of 116 000 tons but much lower than estimates between 1985 and 1990 which ranged from 2.6 (1987) to 7.0 (1990) million tons (Fig. 39).

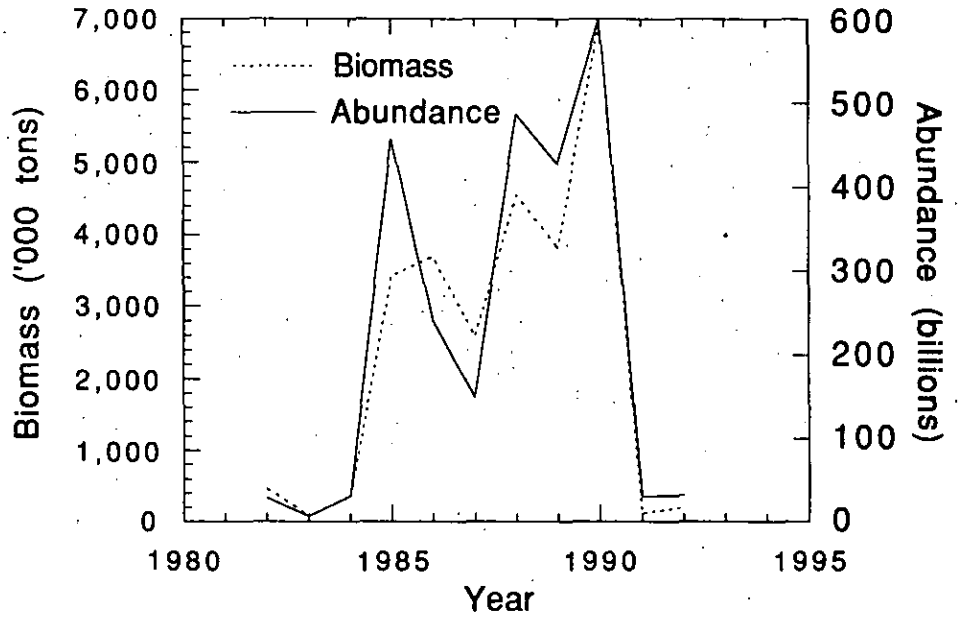

Fig. 39. Capelin in Div. 3L: biomass and abundance estimates from Canadian acoustic surveys.

The 1990 year-class at 19 billion individuals predominated in the 1992 survey and was only about 5% of the abundance of the 1983 and 1986 year-classes, which have been the strongest during the 1980s.

A Russian trawl survey of 0-group capelin during 15-30 November 1991 indicated the 1991 year-class was average.

c) Prognosis for 1992

Previous advice from STACFIS indicated that a catch of 50 000 tons during 1992 would not exceed 10% of the projected spawning stock biomass. This would imply that the spawning stock in 1992 would have to be at least 500 000 tons. Although availability of capelin to the acoustic survey during 1992 may have again been a problem, STACFIS noted that mature biomass estimated from the acoustic survey was only about 130 000 tons, well below 500 000 tons. Consequently, STACFIS concluded that its previous advice was probably optimistic. Based on the demonstrated relationship between mature biomass estimated during the acoustic surveys and trap catch rate the same year (see Fig. 2, SCS Doc. 92/1), STACFIS concluded that the trap catch rate in 1992 will likely be comparable to catch rates during the 1982-84 period. During 1983 and 1984 (no advice was provided in 1982), the advised TAC was 60 000 tons and 38 000 tons respectively, based on a 10% exploitation rate. During 1982-84, nominal landings ranged between 25 000-33 000 tons. Canadian acoustic estimates of mature fish ranged from approximately 50 000 tons to 400 000 tons during the same years. Based on the above considerations, STACFIS concluded that catches of 30 000 tons during 1992 would more closely approximate a 10% exploitation rate than the previously advised catch of 50 000 tons.

d) Prognosis for 1993

The major contributions to the mature population in Div. 3L during 1993 will be the 1989 and 1990 year-classes. STACFIS performed a projection using estimates of year-class strengths for immature and mature capelin derived from the May 1992 Canadian survey. Spawning mortality and proportion mature were the same as used in previous assessments (Table 4). The weight-at-age vector used was derived from inshore sampling data (1982-89) and was the same as used in the most recent assessment. Catches of mature capelin in 1992 were assumed to be 30 000 tons.

Table 4. Capelin in Div. 3L: parameters used in the projections of stock size.

Age (yr)	Spawning mortality	Proportion mature[1]	Mean wt. (g)
3	1.39	0.47	28.3
4	1.69	0.87	36.0
5	2.23	0.93	34.3

[1] Used to calculate mature biomass in 1993.

The results of the projections, using the estimates of year-class strength and parameters as outlined above, together with M = 0.30 and a spawning date of 1 June are given in Table 5.

Table 5. Capelin in Div. 3L: projections of stock size in 1993.

Age (yr)	Number of Fish (millions) June 1992 Mature	Immature	June 1993
2	988	18 012	
3	5 824	676	12 638
4	696	4	1 355
5	450	0	84
	Biomass (tons) of mature fish		213 000

STACFIS continues to recommend a 10% exploitation rate for capelin and based on the above projection a catch of 21 000 tons in 1993 would correspond to this exploitation rate. STACFIS noted that a considerable body of data will be available from research activities in the inshore during 1992. These data will permit validation of the prognoses for 1992 and allow further evaluation of the prognoses for 1993 based solely on the 1992 acoustic surveys.

STACFIS was concerned about the decline in the capelin stock but noted no evidence had been presented to alter its previous conclusions at the March 1992 Meeting of the Scientific Council and the September 1991 Meeting of the Scientific Council (NAFO Sci. Coun. Rep., 1991, p. 130) namely, that fishing has not contributed to the decline. STACFIS had previously concluded that the anomalous hydrographic conditions during late-1990 and 1991 probably contributed to the discrepancies in survey results between 1990 and 1991. Low biomass estimates are probably also occurring because of lower survival rates during recent years and STACFIS recommended that *additional research be conducted to address both the reasons for low survival rates and decreased availability. Specific areas of research should include the relationship between the distribution of capelin and hydrographic conditions and the role of the environment and predators on the survival of capelin. In the latter instance, special attention should be paid to the impact of seals, the populations of which have increased during the last decade.*

16. Capelin in Divisions 3N and 3O (SCS Doc. 92/12)

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.

Recent TACs and catches ('000 tons) are as follows (Fig. 40):

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Advised TAC	-[1]	0	0	0	0	10	10	28	30	30	30
TAC	0	0	0	0	0	10	15	28	30	30	30
Catch	0	0	0	0	0	1	7	5[2]	21[2]	+[2]	

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

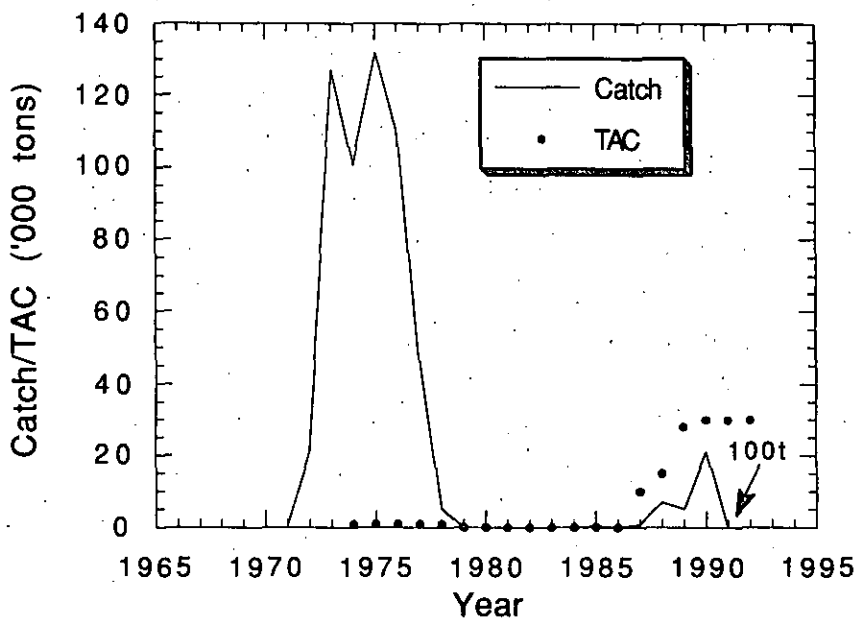

Fig. 40. Capelin in Div. 3NO: catches and TACs.

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 1991 was 117 tons.

b) Input Data

i) Commercial fishery data

A group of six Russian BMRT-class vessels scouted for capelin during May in Div. 3N in the Regulatory Area. Only occasional small catches (0.5 tons per tow) of pre-spawning capelin were reported.

ii) Research survey data

STACFIS at its meeting in March 1992 considered the results of an USSR acoustic survey in Div. 3NO. The biomass estimated for Div. 3O as part of a larger survey in Div. 3LNO during 5 June and 6 July 1991 was 82 000 tons. The 1989 year-class predominated in northern Div. 3O followed by the 1988 year-class. In southern Div. 3O, prespawning fish of the 1988 year-class predominated while the 1989 and 1987 year-classes were next in abundance.

An USSR acoustic survey carried out on the spawning grounds in Div. 3N during the second half of June 1991 did not detect capelin. Given the late spawning on beaches in Newfoundland, this lack of capelin in Div. 3N was most likely related to abnormal hydrographic conditions. STACFIS concluded that this survey probably occurred prior to any arrival of ripe fish on the spawning grounds.

c) Prognosis

As in past assessments of this stock, STACFIS has no data on which projections can be based. Similar patterns in year-class strength and biomass have been observed in capelin stocks in the Northwest Atlantic and since the spawning stock of capelin in Div. 3L is expected to show a decline in 1993 to about 5% of levels in 1989 and 1990, STACFIS concluded that the Div. 3NO spawning stock will also decline to very low levels. STACFIS is very concerned about the probable low biomass levels in this stock because of the implications for future recruitment to the stock and because of its importance as a forage species for cod and flatfish. Based on the above

considerations, STACFIS recommends that *this stock be given maximum protection and accordingly advises that no capelin fishing be allowed in Div. 3NO during 1993.*

17. Squid in Subareas 3 and 4

a) Introduction

Catches increased rapidly during the 1970s, reaching 162 000 tons in 1979, and then decreased to 111 tons in 1986 (Fig. 41). Research activities on squid ceased at the same time as the drop in the squid catch. The catch in 1991 declined to 600 tons after increasing in 1989 and 1990.

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TAC	150	150	150	150	150	150	150	150	150	150	150	150
Catch	33	13	+	1	1	+	2	1	7[1]	11[1]	1[1]	

[1] Provisional.

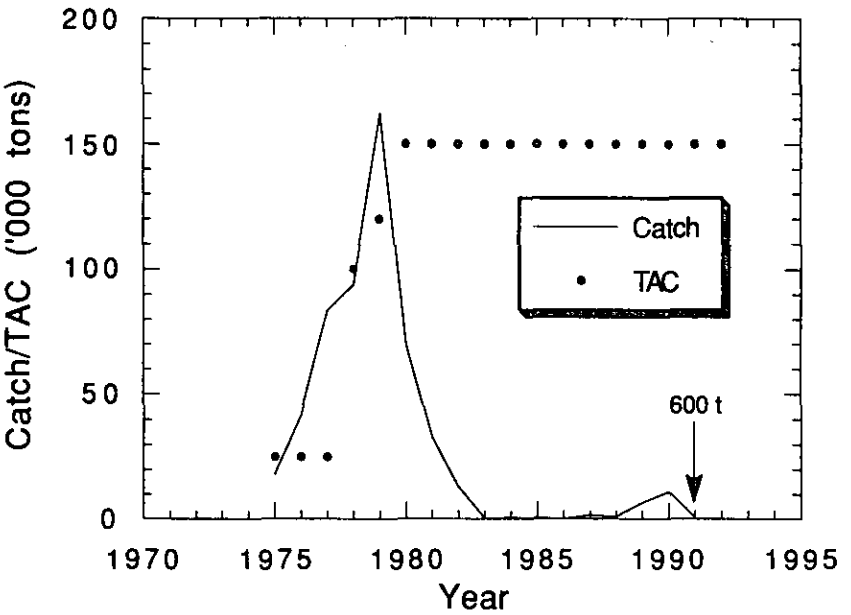

Fig. 41. Squid in Subareas 3 and 4: catches and TACs.

In recent years, there has been no advice on squid due to little information on the stock status. 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, although catches in 1991 dropped from the 1990 level. In addition, a recent trend of increasing abundance from surveys in Subareas 5+6 and the Flemish Cap appears to have stopped. Without up-to-date information on the squid stock, especially for recruitment, STACFIS is not able to provide updated advice and this situation will remain as long as there is no research effort.

18. Shrimp in Subareas 0 and 1 (SCR Doc. 92/46, 47, 54, 55, 56, 58, 65, 67).

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 stabilized around a level of 44 000 tons during 1985-88. Preliminary statistics for 1990 and 1991 indicate total catches of about 53 000 and 57 000 tons, respectively. The fishery has been regulated by TAC since 1977 (Table 6A and Fig. 42).

Table 6A. Shrimp in Div. 0A and Subarea 1: nominal catches and TAC (tons) included in TAC advice.

	1982	1983	1984	1985	1986	1987	1988	1989[1]	1990[1]	1991[1]	1992
Div. 0A Canada	858	2 030	448	233	126	3 252	6 087	7 235	6 177	6 788	
Denmark	946	2 627	526	916	1 208	529	-	-	-	-	
France	-	-	436	-	-	-	-	-	-	-	
Faroe Islands	-	756	730	142	530	2 359	-	-	-	-	
Greenland	8	-	2	1 349	1 131	-	-	-	-	-	
Total	1 812	5 413	2 142	2 640	2 995	6 140	6 087	7 235	6 177	6 788	
SA 1 Offshore, South of 71°N											
Denmark	959	451	397	417	572	502	312	391	353	219	
France	408	404	416	535	596	423	420	400	228		
Faroe Islands	530	1 583	360	471	481	474	421	476	223	159	
Greenland	32 016	30 929	32 129	37 788	39 537	37 998	35 947	40 961	45 620	49 938	
Norway	838	483	451	455	464	450	459	448	-	-	
Total	35 015	33 854	33 741	39 547	41 589	40 020	37 562	42 696	46 596	50 544	
0+1 offshore catch[2]	36 827	39 267	35 883	42 187	44 584	46 160	43 649	49 931	52 773	57 332	
0+1 advised TAC[2]	29 500	29 500	29 500	36 000	36 000	36 000	36 000	44 000	50 000	50 000	50 000
0+1 effective TAC[2,7]	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[3]	46 225[6]	44 200[6]

[1] Provisional.
[2] Offshore 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.
[7] Not including catches from vessels <75 GRT.

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 both 1990 and 1991 the nominal catches by larger vessels in divisions south of Div. 1B were higher than in Div. 1B.

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 also the case in 1991.

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 steadily to about 1 077 tons in 1991. This fishery normally occurs from June to November.

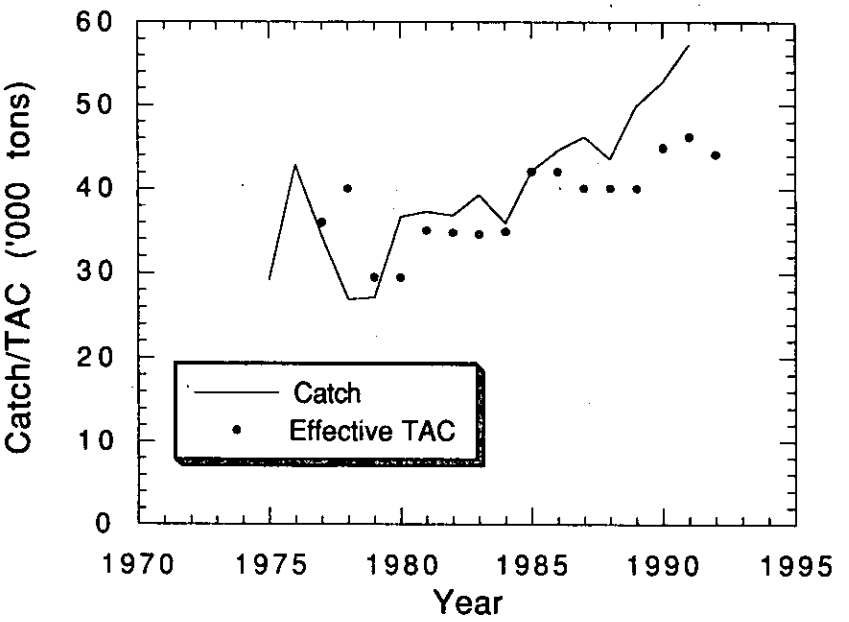

Fig. 42. Shrimp in Subareas 0 and 1: catches and TACs in offshore Subarea 1 (south of 71°N) and adjacent areas in Subarea 0 (Div. 0A). Effective TACs from 1977 to 1980 for Subarea 1 only.

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). Since 1988 catches have been increasing. Preliminary statistics indicate a total catch of 17 900 tons in 1991.

Total catches (tons) for all Subarea 1 are shown in Table 6B.

Table 6B. Shrimp in Subarea 1: total nominal catches.

	1982	1983	1984	1985	1986	1987	1988	1989[1]	1990[1]	1991[1]
SA 1 offshore (south of 71°N)	35 015	33 854	33 741	39 547	41 589	40 020	37 562	42 696	46 596	50 544
Greenland (N of 71°N)	-	-	-	4 349	11 045	10 700	6 660	2 522	2 121	1 077
Greenland (Inshore[2])	7 500	7 500	7 500	7 500	7 500	6 921	10 233	13 224	15 386	17 891
SA 1 Total	42 515	41 354	41 241	51 396	60 134	57 641	54 455	58 442	64 103	69 512

[1] Provisional.
[2] Inside 3-mile limit. Inshore component of total catch 1980-86 was estimated.

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE (Fig. 43). Catch and effort data from the shrimp fishery in 1991 were available from Canadian vessel logs for Div. 0A and from French and Greenlandic logbooks for Subarea 1.

An overall increase in effort was observed from 1987 to 1991. While it fluctuated in Div. 1A and 1B, it increased in Div. 0A, 1C, 1D, 1E, and 1F.

Based on Canadian vessel logs from Div. 0A from 1981 to 1991 unstandardized, weighted (by-catch) yearly catch rates were calculated. Because of seasonality in the catch rates and changes in

the fleet over time, the same data were analyzed using a multiplicative model to produce standardized yearly catch rates. Both series show fluctuating catch rates but the standardized rate reveals an overall declining trend over the period. From 1987 to 1989 there was a decline in CPUE followed by some stabilization between 1989 and 1991.

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. This series was discontinued in 1990. From 1987, logbook data from 22 Greenland trawlers, which record the shrimp catch by size category in the logbook, were used in a multiplicative model to establish a CPUE index for large shrimp >8.5 g (mainly females), for which discard is unlikely or at least at a low level. 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 1991, shows a decrease from 1987 to 1989 and stability from 1989 to 1991. Preliminary estimates of catch rates for January to April 1992 were significantly lower than estimates for the same period in 1991.

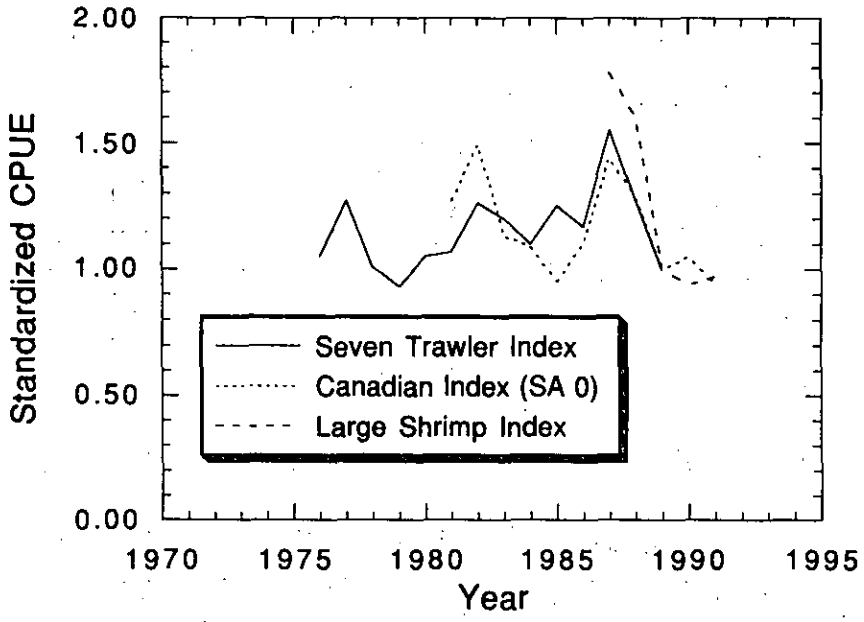

Fig. 43. Shrimp in Subarea 0 and 1: standardized CPUE indices from Div. 0A and Div. 1B compared to nominal offshore catches (excluding catches north of 71°N in Subarea 1).

Length and age composition. Length frequency data from the fishery in Davis Strait in 1990 and 1991 are consistent in that they show the importance of the 1985 year-class in both years and the decrease in the proportion of females in the catches. Canadian data showed that other male components in the length frequency distributions were obscured by the prominence of the 1985 year-class, but it appears that the incoming year-classes are substantially weaker.

Indications of a recruiting year-class at 17-18 mm (the 1987 year-class) were found in samples from Div. 1B, 1C and 1D, but it appears to be much less abundant than the 1985 year-class when it recruited to the fishery at the same carapace length in 1989. In Div. 1A, a dominant mode of large shrimp (at 27 mm CL) was present both in 1990 and 1991, while there was no indication of significant recruitment of small shrimp.

The catch-at-length data from the Canadian fishery in Div. 0A from 1981 to 1991 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 45% from 1984 onward.

Shrimp discards. The only usable discard data were those available from the Greenland study onboard trawlers processing at sea, which was initiated in 1990 and continued in 1991. Two types of discard were distinguished, namely size discard (small shrimp of low market value) and quality discard (shrimp of low quality, due to e.g. soft or broken shell). Levels of size discarding in Div. 1A to 1D from this fleet component were estimated at approximately 20% (11 000 tons) in both 1990 and 1991. Quality discard was estimated in 1990 at 6 to 7%, but was not evaluated in 1991. The discard data showed that the 1985 year-class was heavily discarded in both 1990 and 1991, but to a lesser extent in the latter year.

By-catches. Observer data from the Canadian fishery in Div. 0A from July to November 1991 showed that the percentage by-catch by weight ranged from 17% to 38% of the total catch weight of all species. By-catch species composition was similar to that observed in recent years. Redfish was the most abundant fish species, accounting for approximately 8 to 20% of the total observed catch weight. Greenland halibut comprised 4% or less of the catch in each month. As usual the incidence of Greenland shark increased in November.

ii) Research survey data

Abundance estimates. In July-August 1991 a stratified-random trawl survey was carried out by a Greenland trawler in Div. 0A and offshore Div. 1A-1E. The area covered was the same as in 1990, extending further to the south in Div. 1D and 1E compared to 1988 and 1989. In those years, however, data from the commercial fishery showed very low abundance of shrimp in the southern areas, and biomass estimates are therefore considered comparable between years.

The trawlable biomass estimates are as follows:

Biomass ('000 tons)	1988	1989	1990	1991
South of 71°N	138	185	142	100
North of 71°N	25	12	10	5

The corresponding numbers of shrimp in the total areas surveyed are shown in the following table by sexual stage and year:

No. of shrimp (billions)	1988	1989	1990	1991
males (age < 7)	19.8	34.0	19.4	12.5
prim.fem. (age 7)	3.5	2.6	3.3	1.3
mult.fem. (age 8+)	4.6	3.7	3.4	3.4
total fem. (age 7+)	8.1	6.3	6.7	4.7
Total	27.9	40.3	26.1	17.2

The abundance of male shrimp increased significantly from 1988 to 1989, when the 1985 year-class entered the fishable stock, and decreased again in 1990 and 1991. The number of female shrimp decreased from 1988 to 1989, increased slightly in 1990, and then decreased in 1991 to the lowest number observed. From 1988 to 1990, the abundance of multiparous females decreased, and remained stable between 1990 and 1991.

Abundance of shrimp was higher in the southern areas in 1989, where males (1985 year-class) were found in shallower water. In 1990, abundance was higher on the northern slopes of Store Hellefiske Bank in deeper water, reflecting the growth and behaviour of the 1985 year-class. The shift in abundance towards deeper water continued in 1991. North of 71°N, abundance decreased steadily over the four years.

In September 1991 a stratified-random trawl survey was conducted for the first time in the most important inshore fishing areas in Subarea 1 (Disko Bay and Vaigat). Biomass of shrimp was estimated at 44 800 tons. Biomass was highest in the southernmost areas, where the densities of both male and female shrimp were high. The overall size composition of shrimp in the survey area was similar to that from the offshore survey. However, in the inshore area, there was a higher proportion of younger male shrimp with modal length of 17 mm, likely the 1987 year-class.

c) Assessment Results

Indices from the commercial fishery show that the abundance in 1989-91 was lower than in 1987-88. The higher index for 1987-88 can be explained by the recruitment to the female component of at least two strong year-classes around 1987. The decrease in 1989-91 can be explained by mortality (fishing and natural) of these year-classes while recruitment was lower. The research survey index showed an increase from 1988 to 1989 followed by a decline to 1991. The increase in 1989 was due to the 1985 year-class which resulted in an increase in biomass in the southern areas and maintained the biomass level in the central areas. The decrease in biomass in 1990 from the 1989 level appears to be due primarily to mortality of the male shrimp since female abundance remained fairly constant. The further decrease in 1991 appears again to be due to mortality of males, a lack of recruitment and the apparent weakness of the 1984 year-class (primiparous females).

d) Prognosis

At the June, 1991 meeting, STACFIS advised that the TAC for 1992 'should not exceed recent levels, i.e. about 50 000 tons'. This was based on stability in catch rates between 1989 and 1990 and a potential for improved recruitment in 1991 and 1992 due to the strong 1985 year-class which recruited to the fishery around 1990. However, this year-class has been subjected to high discarding in both 1990 and 1991 and therefore might not contribute as much as expected to either the catch rates or the spawning stock. It is further noted that the TAC in 1991 (50 000 tons) was exceeded by almost 7 000 tons and that catch rates in the beginning of 1992 were low.

In contrast to the 1987-88 situation, the success of the fishery and the level of the stock is dependent in 1992 and 1993 on only the 1985 year-class, since the 1987, 1986 and 1984 year-classes all appear to be much weaker. There is concern that the spawning biomass will be reduced to the lowest level observed since 1981. Although a stock-recruitment relationship could not be defined, STACFIS agreed that some reduction in TAC would be required both in 1992 and 1993 as a conservation measure. STACFIS being unable to calculate a precise catch reduction, recommends that *the 1993 TAC should not exceed 40 000 tons representing a minimum reduction necessary to have any noticeable positive effect on the spawning biomass. The TAC for 1992 should, by the same argument, also be reduced to 40 000 tons.* Such reductions might, however, not be sufficient to prevent the spawning biomass from declining further. Discards have in recent years been around 10 000 tons preventing rational management of this resource. STACFIS therefore recommends that *measures to reduce discarding should be established, e.g. increase in mesh size, and that shrimp discarding should be closely monitored.*

e) Stock Structure in Subareas 0 + 1

Available commercial and survey samples from Div. 0A and Subarea 1 both north and south of 71°N and inshore in Div. 1A show the occurrence of similar modes in the length distributions, and that the 1985 year-class is prominent in all areas. Although differences were observed in the abundance of size groups between areas, it was agreed that the areas might constitute

parts of a single population. STACFIS therefore recommends that *studies be undertaken to determine the relationships between shrimp from the different areas, e.g. by genetics, growth, migration and recruitment studies.*

f) Future Studies

i) A study demonstrating an increase in length-at-age with depth suggested potential problems for the identification of year-classes and estimating their abundance. STACFIS recommends that *studies be undertaken to establish the significance of variation in mean length-at-age for the analysis and interpretation of length frequency data.*

ii) A study on sampling procedures on offshore vessels showed no significant difference in samples obtained prior to sorting. It was noted, however, that handling procedures on certain vessels might create some differential segregation of shrimp in relation to size and condition.

iii) Natural mortality of shrimp was estimated in the inshore areas of Disko Bay (Div. 1A) by comparison of abundance at age in research samples taken prior to the commercial fishery. The data also inferred the possibility of recruitment from the offshore areas to the inshore.

iv) In relation to the 1991 recommendation that studies on selectivity using a 60 mm mesh be carried out it is noted that the results of such a study will be presented at the 1992 September meeting.

19. Shrimp in Denmark Strait (SCR Doc. 92/17, 49, 56, 62, 64, 77)

a) Introduction

The fishery was initiated in 1978 and catches increased rapidly to 1980, decreased and remained stable from 1981 to 1983, increased steadily from 1983 to 1988 (12 500 tons) and then decreased again to 1991 (Fig. 44). In 1990 the nominal catch of the Danish, Faroese, French, Greenlandic, Icelandic and Norwegian vessels decreased to about 10 300 tons. In 1991 the total nominal catch was about 8 700 tons.

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

Nation	1982	1983	1984	1985	1986	1987	1988	1989[1]	1990[1]	1991[1]	1992
Denmark	740	204	443	353	500	555	444	366	390	358	
Faroe Islands	737	443	668	674	727	595	679	595	843	1 007	
France	414	291	500	642	780	1 030	494	381	51	118	
Greenland	1 115	1 467	2 250	2 596	5 781	6 627	7 456	5 976	6 211	4 202	
Iceland	-	43	742	1 794	1 150	1 330	1 424	1 326	281	465	
Norway	1 896	1 727	2 128	2 051	2 026	2 041	2 052	2 098	2 500	2 504	
Total	4 902	4 175	6 731	8 110	10 964	12 178	12 549	10 742	10 276	8 654	
Total catch eastern side	0	43	742	1 794	1 150	1 330	1 424	1 326	281	465	
Total catch western side	4 902	4 132	5 989	6 316	9 814	10 848	11 125	9 416	9 895	8 189	
Advised TAC	4 200	4 200	4 200	5 000	...	...	...	10 000[2]	10 000[2]	10 000[2]	8 000
Effective TAC western side	4 500	5 725	5 245	6 090	7 525[3]	7 725[3]	8 725[3]	9 025[3]	14 100	14 500	13 000

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

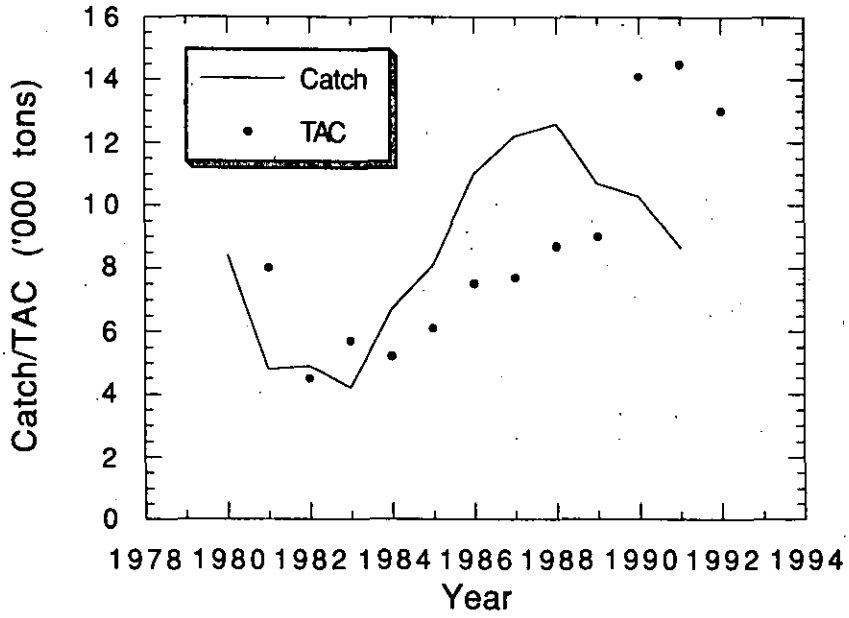

Fig. 44. Shrimp in Denmark Strait: catches and TACs.

The fishery takes place primarily in the area of Strede Bank and Dohrn Bank as well as on the slopes of Storfjord Deep. The availability of fishing grounds at any 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. Effort values corresponding to the activity of the three most important fleets (Greenland, Norway and Iceland) indicated a variable pattern. Greenlandic data showed an increase in effort over the years for both spring (January-June) and autumn (July-December) fisheries. The Norwegian effort was fairly stable during the spring fishery but has increased substantially since 1986 during the autumn fishery. Although the overall pattern over the years is quite variable for the Icelandic fishery, the autumn fishery has become more important since the mid-1980s.

Norwegian observer data from 1982 to 1991 indicated a mean by-catch rate of 0.6 fish caught per kg of shrimp. Redfish was the most abundant species in the by-catch.

b) Input Data

1) Commercial fishery data

Fishing effort and CPUE. Catch and effort data from logbooks were available from Greenland, Norway, Iceland and EEC-France since 1980.

Total effort values showed the same pattern as catch. Between 1980 and 1989, effort increased from about 35 000 hours to more than 100 000 hours, declining thereafter to about 92 000 and 95 000 hours in 1990 and 1991 respectively. The fishery from July-December became more important by the end of the 1980s, with effort increasing from about 26% to about 50% of the annual total.

Both unstandardized and standardized catch rate series were calculated (Fig. 45). Catch rates were without trend from 1981 to 1987 followed by a substantial decline to 1989. Values for 1990 and 1991 were similar to the low 1989 level. The 1989-91 level was about 50% of that seen during the period of relative stability from the early- to mid-1980s. The 1978 and 1979 catch rates correspond to very low effort and, therefore are considered unreliable.

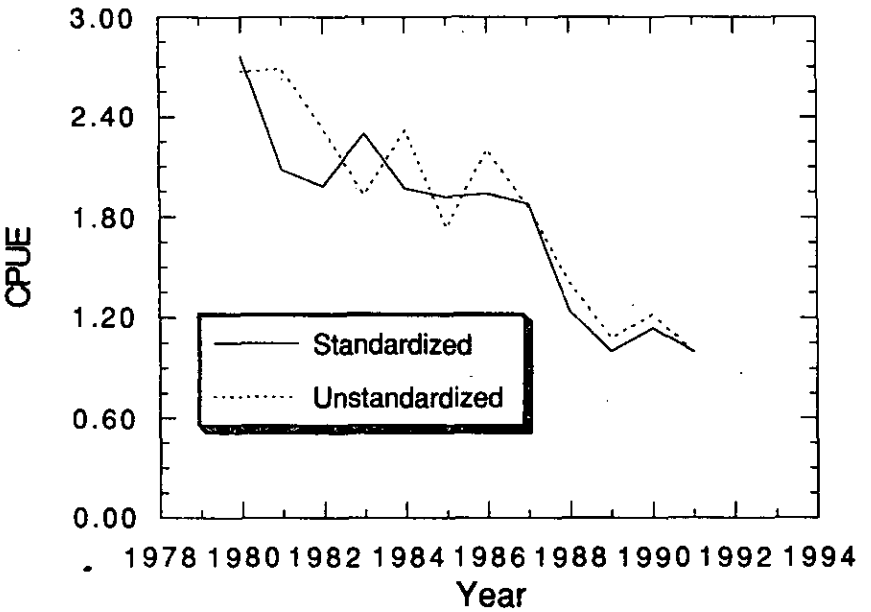

Fig. 45. Shrimp in the Denmark Strait: catch rates.

Biological data. The Norwegian observer samples of shrimp from 1981 to 1991 are usually obtained in the period February-March. In all years there is a dominant peak at the size of about 30 mm carapace length (CL). In 1981, 1984, 1990 and 1991, the occurrence of males in the Norwegian samples (<27 mm) was estimated at 20, 29, 34 and 38% respectively, compared to less than 10% in the remaining years. Icelandic and Greenlandic samples agree well with the Norwegian samples in that the mode of female shrimp continues to dominate. Catches in 1990 and 1991 comprised a larger proportion of small (male) shrimp as compared to previous years. The proportion of males was, however, higher in the eastern part of the area. The data show a decrease in female abundance and no strong year-classes were evident.

The occurrence in the Icelandic samples in 1990 of a component of female shrimp with a mode at 25-26 mm suggested that sex change occurred at younger age than normal. The 1991 and 1992 samples also included small females but they were not as numerous as in the 1990 data.

Discards in the shrimp fishery. Norwegian observer data indicated a mean discard rate of 2% for the 1982-1991 period. However, estimates are from only one vessel fishing in a limited location for a short period of time each year.

An observer program carried out by Greenland to estimate shrimp discarding from vessels processing at sea was initiated in 1990 and continued through 1991. In 1990 discarding based on quality was estimated at 6 to 7% but was not evaluated in 1991. Discarding of small shrimp was estimated at 9% (1 034 tons) of the catch by certain Greenlandic and Norwegian trawlers in 1990 and 13% (840 tons) in 1991 by the same Greenlandic vessels. These rates are considered to be more reflective of overall fleet operations.

c) Assessment Results

As interpreted in 1991 the abundance of the resource on the fishing grounds is thought to be at a lower level than it was during the period of relative stability. The higher proportion of shrimp changing sex at smaller size in 1990 now appears to have been anomalous and therefore, cannot be considered indicative of a trend towards earlier sex change within the population. The

surveys conducted in 1985-89 showed a change in the distribution of the stock in 1989 in that it appeared more widespread, and that the sexes were well mixed throughout the survey area. The 1990 and 1991 fishery data indicate that this is still the case.

d) Prognosis

The abundance in recent years has been reduced to a low level, primarily due to a decrease in the abundance of females. Prospects for 1992 and 1993 appear to be poor in that no strong year-classes are evident from the 1991 and the preliminary 1992 fishery data. These conditions appear to be related to fishing pressure, but might also be caused by a change in distribution of the stock, as inferred from the Norwegian survey results in 1989, or a combination of the two. Preliminary 1992 catch and CPUE data from January through April (historically the most important fishing period) are significantly lower than for the same period in 1991. It is likely that the total effort in Denmark Strait in 1992 will be substantially reduced, which together with the low abundance will result in catches well below the advised TAC of 8 000 tons, possibly less than 5 000 tons.

In 1991, STACFIS advised an arbitrary reduction of the TAC from 10 000 tons to 8 000 tons in response to the recent low levels of biomass. Based on the continued depressed condition of the stock, STACFIS advises that the TAC for 1993 should be further reduced to about 5 000 tons.

STACFIS anticipates that this TAC level of 5 000 tons will have to be maintained for several years in an attempt to provide protection for the spawning biomass and rebuild the stock.

Discard rates observed in 1990 and 1991 indicated that these removals are significant and STACFIS recommends that *discarding should be monitored closely.*

20. Other Finfishes in Subarea 1 (SCR Doc. 92/40, 43, 48)

Based on the annual EEC-Germany groundfish survey (1982-91) off West Greenland a drastic decline in total fish biomass indices was observed beginning in 1988. In 1991 the overall decrease in biomass amounted to 66% in comparison with the last 1990 estimate, whereas the abundance estimate increased slightly. The ecologically important fish species (American plaice, wolffishes and starry skate) contributed significantly to this negative trend.

In September 1991 a stratified-random trawl survey was conducted for the first time by Greenland in the inshore areas of the Disko Bay (Div. 1A) at depths between 150 m and 550 m to assess the trawlable biomass of shrimp and the by-catch fish species. The results of the calculated biomass indicated a higher portion (about 60%) of other finfishes (mainly Polar cod) compared to important commercial fishes like Greenland halibut, roundnose grenadier and cod in the investigated depth range.

During the annual joint Greenland/Japan survey (1987-91) covering the depth range between 400 m and 1 500 m in the Div. 1A,B,C,D with emphasis on Greenland halibut, roundnose grenadier and redfish, the portion of other finfishes amounted to about only 20%.

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. 92/68)

The Scientific Council was again requested 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 was also requested on the age composition of that portion of the stock occurring in the Regulatory Area.*

The stock separation issue has been reviewed previously (NAFO Sci. Coun., Rep. 1986) and it was then concluded that it was appropriate to assess cod in Div. 2J, 3K and 3L as a single stock complex. There is currently no additional information to change this conclusion.

Estimates of the proportion of the cod biomass in Div. 3L in the Regulatory area were updated to include the 1991 research vessel survey data. The results for autumn surveys were similar to those presented previously, although the 1991 spring survey estimate of biomass in the Regulatory area (10.8%) was the highest in that time series. The results from the survey series used are as follows:

Season RV survey conducted	Years RV survey conducted	Range of proportions of Div. 3L biomass occurring in the Regulatory Area (1991 value in brackets)	Average proportion (%)
Winter	1985-86	23.8-26.8	25.3
Spring	1977-91	0.4-10.8 (10.8)	3.5
Autumn	1981-91	0.5-7.7 (2.9)	3.0

The proportions observed are estimates for the months in which the surveys were conducted and may not represent distributions in non-surveyed months. Although only two winter surveys have been conducted, the proportion of biomass in the Regulatory Area at that time appears to be substantially higher than at other times. This pattern is also supported by the occurrence of a commercial fishery in the area, mainly during the winter months. The higher proportion of biomass in the Regulatory Area during the spring of 1991 may have also occurred during winter as cod catch rates by fleets fishing in the Regulatory Area during winter were higher than usual.

Results of the autumn surveys 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 was as follows:

Division	Relative proportion of Div. 2J+3KL biomass (%)
2J	36
3K	36
3L	28

Survey data indicated that the proportion of total stock biomass occurring in the Regulatory Area was less than 10% in winter, less than 5% on average in spring and autumn, and there were no annual trends. However, information available from research vessel surveys and the commercial fisheries in Div. 2J+3KL in recent years (1989-91) suggests that there has been a shift in distribution in a southerly direction and as well to deeper waters. If changes in the stock distribution pattern continue, predicting future proportions will be difficult.

Age compositions derived from spring and autumn surveys in Div.3L indicate that for most years there was a higher proportion of younger cod in the Regulatory Area. Estimates for winter surveys showed that age compositions were similar in both areas. Age compositions for the entire Div.2J+3KL cod research vessel survey biomass were similar to those which occurred in Div.3L inside the 200-mile fishing zone.

2. Squid in Subareas 3 and 4

With respect to squid in SA 3 and 4, the Scientific Council was asked to: examine *all data available to it and if possible to present options for management of the stock that are based on the NAFO principles of optimum utilization and conservation.* The Council was also asked to: *provide information on the distribution throughout the year of the stock and on the factors that determine whether the resource becomes available within the NAFO area.*

STACFIS noted that as in the recent past, no new information pertaining to squid in SA 3 and 4 was available for review at this meeting. The resource only occurs in the NAFO area during summer through migration from more southern areas. Availability has been extremely variable. No research is planned for 1992 or future years, and STACFIS will not be able to provide any information to the Fisheries Commission pertaining to squid in SA 3 and 4 until this situation changes.

3. Capelin in Divisions 3NO

With respect to capelin in Divisions 3NO, the Scientific Council was requested to: *advise on the most rational level of management, 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. Management options such as maintaining minimum spawning biomass, a 10% and a 20% exploitation rate should be evaluated in terms of both maintaining stock size and the impact on the ecosystem.*

STACFIS noted that it had responded to the extent that the scientific information allowed to a similarly worded request in 1991 (NAFO Sci. Coun. Rep., 1991, p. 101-104). No further analyses have become available since that meeting and STACFIS had no reason to alter the conclusions in that report. In view of the potential for large variances associated with projections for capelin stocks and its importance as a prey species especially for commercially important predators such as cod and flatfish, STACFIS reiterated its recommendation of a conservative approach to management. Currently, there is a lack of data for this stock but the available information indicates that the stock is probably very low in abundance. Consequently, STACFIS recommended that a *closure of the commercial fishery in 1993 be placed to provide maximum protection for the stock.*

STACFIS was concerned about the lack of response from the Fisheries Commission to its answer to the 1991 request, except for a repeat of the question by Fisheries Commission with only minor word changes. Some comments on the previous response would have been useful in formulating a response to the present request.

4. Standard Mesh Size for Otter Trawling

The Scientific Council was requested to :

- *review further the question of a standard 130-mm mesh size for otter trawling in the Regulatory Area, and particularly to consider the species for which derogation would be required. The Council is asked to include consideration of area and season in this review, to advise on appropriate mesh sizes for fisheries for which the 130 mm would be too large, to advise on appropriate by-catch limits for other species (in aggregate or individually) in fisheries using small mesh sizes and to report on any interactions between the various fisheries.*

- *analyze the various technical measures which could permit the elimination of massive catches of juvenile flatfishes in the NAFO area. This should cover the implementation of minimum legal sizes and the introduction of a single basic mesh size. Special attention should be paid to multispecies analyses and especially technical interactions.*

- *consider the question of a minimum fish size for cod in the different parts of the Regulatory Area, both in terms of the current regulation of mesh size in otter trawls and in terms of increasing yield per recruit.*

- *with respect to cod in Div. 3M, the Scientific Council is requested to provide advice on means of improving the utilization (yield-per-recruit) of the resource.*

- *with respect to redfish in Div. 3M, the Scientific Council is requested to provide advice on means of reducing the harvest of juvenile fish, including such factors as the seasonality of fishing.*

At its Special Meeting of 11-14 May 1992, the Fisheries Commission agreed to forward an additional request for scientific advice from the Scientific Council. The following text was agreed at that meeting:

> *"In addition to the request in paragraph 9 of NAFO/FC Doc. 91/10 on a standard 130 mm mesh size, the Scientific Council is asked to evaluate the effect of introducing one uniform mesh size, irrespective of material, thus deleting note 2 in Part V - Schedule IV of the NAFO Conservation and Enforcement Measures."*

STACFIS decided to provide a single response to these requests since the problems which they imply and the possibilities for amelioration are common to all of them.

i) Standard 130 mm mesh size for otter trawling

At present, NAFO regulations permit the possibility of using either 120 mm or 130 mm mesh size depending on the material with which the net is constructed. (FC Doc. 91/7, Part V, Schedule IV). STACFIS is of the opinion that the between-haul selectivity of fishing gears is such that it is unlikely that the expected selectivity of trawl nets made of different materials is significantly different. A standard mesh size of 130 mm, irrespective of material used in the construction of the net, should be adopted.

ii) Derogations from the use of 130 mm mesh size

The only trawl fisheries in the Regulatory Area for which a derogation from the use of 130 mm are justified are those for capelin and squid. For these fisheries a lower legal minimum mesh size should be permitted. At present, the legal minimum mesh size for fishing for squid in the Regulatory Area is 60 mm. There is, at present, no legal minimum mesh size for fishing for capelin in the Regulatory Area.

STACFIS is, at present, not in a position to comment on consider-ations of area and/or season which might be relevant in this context.

Fisheries for either squid or capelin in the Regulatory Area are not known to catch any other species. In principle, therefore, there should be a zero by-catch limit for other species. There is no known technical interaction between the capelin and squid fisheries or between fisheries for squid or capelin and fisheries for other species.

Consideration should be given to adopting a one-mesh size rule for those vessels wishing to use meshes less than 130 mm. If this condition is not imposed there is considerable risk that fishermen will deliberately exploit species other than capelin and squid with nets of less than 130 mm mesh but, when their catches are inspected, will claim that 130 mm mesh was used to take these catches.

iii) Reduction in the catches of juvenile fish

- Flatfish.

  At present, catches of large quantities of juvenile flatfish of lengths less than 25 cm occur in fisheries by mobile gears for American plaice and yellowtail flounder on the Grand Banks (Div. 3NO). Four possibilities for reducing these catches by the implementation of technical measures were considered.

  Closed areas. Areas of high density of juvenile American plaice and yellowtail flounder have been identified on the Grand Banks. Closure of such areas to fishing by mobile gears would undoubtedly reduce catches of the juveniles. However, adults also inhabit the areas of high juvenile density and hence catches of adults would also be severely affected.

  Closed seasons. The majority of information on the distribution of juvenile American plaice and yellowtail flounder comes from surveys carried out in August and September and therefore the distribution of juveniles at other times of year is not as well known. However, limited information from Spring surveys indicates that juveniles do not change their distribution seasonally and the probable effectiveness of seasonal closure is therefore dubious.

  Modification of the rigging of towed gears. In principle it may be possible to reduce the numbers of juveniles which enter towed nets by specifying towing speeds, size of bobbins, bridle angles etc. In practise, the extent of knowledge on the effect of such factors is limited and it would be difficult to draft regulations in such a way that the required rigging could be enforced.

  Improvement in codend selectivity by increase in mesh size or effective mesh size. The selection factor of both American plaice and yellowtail flounder lies between 2.2 and 2.4. and the selection range (L50-L25) is about 3 cm. Enforcement for mobile gears of a mesh size of 130 mm, free of attachments, should therefore result in the

capture of a very low proportion of individuals of these species of lengths less than 25 cm. The fact that this is currently not the case indicates that real mesh sizes are considerably lower than 130 mm and/or various means (legal or otherwise) are being employed to significantly reduce the selectivity of the nets.

STACFIS is of the opinion that rigorous enforcement of legally rigged 130 mm mesh size offers the highest probability for reduction in catches of juvenile American plaice and yellowtail flounder while maintaining fisheries on the adults.

- Improving the utilization (yield-per-recruit) of cod in Div. 3M

The selection factor for cod lies between 3.4 and 3.7 and the selection range (L50-L25) is approximately 4 cm. On this basis it would be expected that very few cod of length less than 40 cm should be caught in otter trawl fisheries. In fact, various fisheries by mobile gears for cod in Div. 3M are known to catch cod of sizes well below those expected, if the participating vessels employ legally-rigged 130 mm mesh. STACFIS therefore reaches the same conclusion for cod in Div. 3M as that for flatfish on the Grand Banks i.e. rigorous enforcement of legally rigged 130 mm mesh should eliminate most or all of these catches and thereby increase yield-per-recruit of cod.

- Reduction of the harvest of juvenile redfish in Div. 3M

The selection factor and selection range of redfish for those gears used in its fisheries are not well defined. However, it appears highly probable that enforcement of legally rigged 130 mm mesh would lead to reduction in the harvest of juvenile redfish.

STACFIS is not able, at present, to comment on such factors as seasonality (or regionality) of redfish fisheries which might be relevant in the present context.

- Other effects of enforcement of 130 mm mesh size

STACFIS also notes that there are a number of other fisheries which exhibit symptoms similar to those described above (e.g. Div. 3LN cod and redfish). For all of these fisheries, enforcement of legally-rigged 130 mm mesh would result in increased yield-per-recruit. In addition, the state of the stocks of species caught as by catch in various areas would also be improved (e.g. American plaice in Div. 3M).

iv) Minimum legal landing sizes

Minimum legal landing sizes should be instituted as an adjunct to effective enforcement of 130 mm legal minimum mesh size. The main purpose of such a measure is to discourage fishermen from attempting to reduce the selectivity of their gears.

Initially, legal minimum landing sizes should be established for those species of highest importance in the otter-trawl fisheries. STACFIS suggests that the legal minimum landing sizes should approximate the 25% retention length for each species and that a single value for each species should be applied universally throughout the Regulatory Area. The legal minimum landing sizes should lie within the range of values indicated below. (A range is presented to accommodate the various estimates of selection factors for each species).

Cod	40-45 cm
American plaice	25-28 cm
Yellowtail flounder	25-28 cm

At present, no advice can be given for other species because of the lack of information on selectivity parameters.

v) Non-Contracting Parties

Fleets registered in non-Contracting Party countries and fishing for cod and flatfishes in the Regulatory Area are assumed to employ mesh sizes well below 130 mm (possibly as low as 60-70 mm). These vessels are not bound by

NAFO regulations and are unlikely to be affected by any measures implemented by NAFO to improve the selectivity of trawls.

If the selectivity of trawlers of NAFO members is improved, the numbers of young fish caught will be reduced leading to an immediate increase in the numbers and biomass of young fish in the sea. This will give rise, at a later date, to an increase in the numbers and biomass of fish of all ages. Non-Contracting Parties will benefit both immediately and in the longer term from this increase and it is possible that they will take much of the expected gain in yield and that increase in biomass will be less than that achievable if all trawlers adhered to NAFO regulations.

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The eleventh meeting of the Subcommittee on Environmental Research was held on 9 June 1992 with M. Stein (EEC) as Chairman. Annex 1 contains the detailed report of the meeting.

2. Review of Environmental Studies in 1991

A total of 12 documents dealing specifically with environmental issues and another two papers which used environmental data for analysis were reviewed.

Warmer than normal sub-surface temperatures were in evidence in the West Greenland region, whereas the Labrador region was characterized by anomalously low temperatures. In the southerly regions, Subareas 4 to 6, generally warmer-than -normal conditions were found both for the surface and the near bottom waters, but below normal on the Scotian shelf.

The possible role of climate change in the reduction of West Greenland cod stocks was discussed. During the last twenty years temperatures in this area have been decreasing. Since most of the good year classes of cod caught occurred during warm conditions such as between 1940 and 1965, the recent decline in temperature suggests unfavourable environmental conditions for cod stocks.

3. Overview of Environmental Conditions (SCR Doc. 92/73)

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 is the tenth in a series of annual overviews that began in 1982. Extremely cold air temperatures were observed over southern Labrador and Newfoundland especially in winter due to an intensification and westward shift in the position of the Icelandic Low. The number of icebergs to reach south of 48°N during 1991 was the highest in the past 6 years. There was more CIL (cold intermediate layer) water present from southern Labrador to the Grand Banks than normal. The coldest temperatures in over ten years were reported in the deep waters of the Scotian Shelf, and over twenty years in the Laurentian Channel at Cabot Strait.

STACFIS noted the recommendation of the Subcommittee that *in future the Environmental Subcommittee should meet at the beginning of the regular June Meeting of the Scientific Council Meeting, i.e. on the Thursday of the first week.* It was agreed that the timely variability of environmental data for inclusion during assessment discussions is becoming increasingly important. As such, STACFIS endorsed this recommendation.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Reports on Methods of Ageing Silver Hake Otoliths

a) A study of microstructure of silver hake otoliths was reviewed. Daily growth increment zones were counted in fish of lengths from 3.75 cm to 25.0 cm. Linear regressions for age determination in terms of days in fish of 4-25 cm length were presented. Precularities of the first annulus were examined and radii length of all otolith growth zones were obtained. The results were in agreement with Canadian ageing and indicated fish between 20 and 25 cm comprise both ages 1 and 2.

b) Results of *a Macrourus berglax* ageing and growth study were presented based on data collected in Divs. 0B, 2G, 2H and 3K in 1985. *Macrourus berglax* were aged using scales. Linear growth was expressed by an exponential function and von Bertalanffy formula, and weight growth by an exponential function and Gomperts formula. The results confirmed the relatively slow growth and multiaged structure of the *Macrourus berglax* population in the study area.

2. Reports on Otolith Exchange

a) Age-reading Workshop

The Report of the Workshop on Age Determination of Greenland Halibut and American Plaice, held in St. John's, Newfoundland, Canada from 3-12 December 1991, was presented to STACFIS (see Annex 2). This workshop brought together people from many countries, representing a wide range of expertise in ageing flatfish. It was noted that some differences in the ageing of these species still existed between readers of various countries, but that certain previously-defined differences had been settled. Otolith exchanges for American plaice from Div. 1B, 3L, 3M, 3N and 3Ps were started, as was an exchange of scales and otoliths from Greenland halibut from Div. 0B. As a result of the workshop, and following previous recommendations of STACFIS, an exchange of American plaice otoliths from Div. 3M, accompanied by photos, has been prepared in EEC-Portugal and will be circulated among workshop participants. Following all exchanges and subsequent tabulation of results, a further workshop may be necessary, with a focus on clearly defined ageing criteria and establishing inter- and intra-reader consistency.

VI. GEAR AND SELECTIVITY STUDIES

Results of studies were considered under Section III, Responses to Fisheries Commission Requests.

VII. REVIEW OF SCIENTIFIC PAPERS

STACFIS reviewed 10 research documents not reviewed elsewhere. The reviews are given below.

1. Comparisons of the Relative Fishing Powers of St. Pierre and Miquelon Trawlers From 1986 to 1991 in the NAFO Subdivision 3Ps. Limits in the use of a Multiplicative Model (SCR Doc. 92/34)

Standardization of the fishing activity of the trawler fleet from St. Pierre and Miquelon in Subdiv. 3Ps in the period 1986-91 has been conducted.

In addition to comparison of the efficiency of each trawler the purpose of this study was to determine the limits in using multiplicative models. It was concluded that the investigation of variograms is useful when interpreting the data.

2. Cod Migrations in the Gulf of St. Lawrence and South Area off Newfoundland (SCR Doc. 92/33)

During the years 1975, 1976, 1980 and 1982, tagging experiments were conducted by the IFREMER laboratory of St. Pierre et Miquelon to complement previous Canadian studies. In 1975 and 1976, tagging was carried out in the Gulf of St. Lawrence (Div. 4R) and neighbouring areas (Subdiv. 3Pn) and on the northern part of St. Pierre Bank (Subdiv. 3Ps.). In 1980 and 1982, they were exclusively conducted on St. Pierre Bank (Subdiv. 3Ps). It was observed that migratory activities of cod populations in the Gulf of St. Lawrence and waters south of Newfoundland were mainly a result of environmental conditions and were characterized by their high temporal variability. The cod population in the northern Gulf of St. Lawrence generally migrated in winter, from the central and the northern areas southward to areas both inside and outside the Gulf of St. Lawrence, with the reverse occurring in spring and summer. Some cod from the southern portion of the stock (Subdiv. 3Pn) also migrated to coastal areas of southwest Newfoundland. On St. Pierre Bank most migrations took place to and from offshore and inshore waters. A large portion of the cod populations on St. Pierre Bank remained in this area. Some exchange with the Grand Bank cod population (Div. 3NO) were indicated, although the amount of interchange seemed to be low.

3. Fishing Grounds Exploited in 1990 by Longliners Based in Canada's Scotia-Fundy Region (SCR Doc. 92/52)

A description of the grounds fished by the longline fleet of Canada's Scotia-Fundy region, based on reports gathered during an interview survey of boat captains, was presented. Maps showing the spatial distribution of the fleet in 1990, according to 4 vessel size categories, were described. This fleet works from the coast out to the 500 fm contour and from the Canada/USA boundary to the Flemish Cap. The grounds were divided into "inside grounds", within 60 km of the coast which are typically fished by boats of less than 35 ft in length, the "offshore banks" of Div. 4VWX and 5Ze that are fished mostly by boats of between 35 and 65 ft, and the "distant grounds" of Subarea 3 that are mostly fished by large longliners more than 65 ft long.

Boats less than 35 ft were primarily confined to the "inside grounds" extending from Cape North to Cape Sable. A limited number of these boats also fished the offshore banks including: St. Pierre, Banquereau, Western, Emerald, La Have, Baccaro, Browns, and Georges. Except for specialized hake grounds on the edge of Emerald Bank, cod were caught on almost all of the grounds fished by the under-35 ft boats. The 35-45 ft boats fished much the same grounds as did the under-35 ft class but with more emphasis on the offshore banks. As with the smaller class, these boats avoided fishing in the deep basins between the inside grounds and the offshore banks.

In the 45-65 ft class, nine vessels were found to fish a variety of grounds from the Bay of Fundy and Georges Bank to Sydney Bight and the southwest edge of the Grand Bank. The over-65 ft boats fished very different grounds from all but the furthest-ranging smaller boats. Apart from pelagic longlining for swordfish in summer, these boats only pursued one or more of three specialized longline fisheries: for big cod on the Grand Bank and some neighbouring banks, for deepwater halibut, and for hake on the continental slope.

4. The Results of Mackerel (*Scomber scombrus*) Study on the Scotian Shelf in June 1990 (SCR Doc. 92/38)

A trawl-hydrological survey was conducted by the USSR on the Scotian Shelf during June 1990. The survey included day/night half-hour hauls with a pelagic trawl, hydrological stations and mackerel biological analysis. No significant aggregations of mackerel were found. Mackerel in catches were represented mainly by specimens of age 2 and 3 and 27-33 cm in length. Results of these investigations suggested that in 1990 most of the prespawning mackerel migrated into the Gulf of St. Lawrence before the survey, i.e. they did not remain on the shelf as in relatively warm years. Such behaviour of mackerel was thought to be the result of increased cold water advection into the Scotian Shelf area in 1990.

5. Estimates of Consumption of Major Food Objects by Cod in Grand Bank Areas in Spring-Summer 1990 (SCR Doc. 91/121)

Results of cod feeding analysis made in spring-early summer 1990 during the annual bottom fish survey in Grand Bank areas were presented in the paper.

A relation between the estimated consumption rate and stomach fullness indices was highly correlated.

6. Distribution of Various Age-groups of Cod in the Newfoundland Area by the 1988-1990 Survey Results (SCR Doc. 91/124)

The paper presented data on cod trawl catches obtained from the USSR trawl surveys carried out during 1988-90.

Catches of cod at age 1 in Div. 3K were considerably lower compared with the other Divisions. At age 2 cod were distributed in more northerly areas of Div. 3K than at age 1.

7. Preliminary Results From Feeding Analysis for Abundant Commercial Fishes on the Newfoundland Bank in April-May 1991 (SCR Doc. 91/125)

Data on feeding intensity and stomach content of cod, Greenland halibut and American plaice obtained in spring-summer bottom fish surveys carried out on the Grand Newfoundland Bank were presented. Length composition of main food objects of abundant commercial fishes were examined. American plaice, along with cod and Greenland halibut, was shown to be an active consumer of capelin.

8. Identification of Redfishes (*Sebastes*, Scorpaenidae) in the North Atlantic (some recommendations) (SCR Doc. 92/42)

Eighteen different morphological features were recommended for use in identification of *S. viviparus*, *S. fasciatus*, *S. marinus* and *S. mentella* depending on size. It was reported that lateral line scale number, pectoral and anal fin ray number, vertebrae number, angles of 3rd and 6th preopercular spines, and caudal peduncle relative depth in adult and preadult fish could be used as features with no overlap. Other features can be used in combination only. It was found impossible to distinguish *S. marinus* from *S. fasciatus* of 1.5-2.5 cm TL and *S. marinus* from *S. mentella* of 1.0-1.5 cm TL.

9. The Fecundity of American Plaice (*Hippoglossoides platessoides*) From the South of the Grand Bank and Flemish Cap (SCR Doc. 92/26)

Analysis of the interannual variability of the fecundity of American plaice from the south of the Grand Bank showed little variability (2.7% for a femal of 45 cm). Comparisons between Flemish Cap and south of the Grand Banks showed some differences in fecundity (21.4% greater for 45cm female length on Flemish Cap).

The response of American plaice to changes in abundance with changes in growth rate, size and age of 50% maturity, and the slight variation in the relations of fecundity to weight and length in the south of the Grand Bank, indicate that the means by which fecundity may affect population size is not direct but associated with changes in growth and maturation.

10. Northern prawn (*Pandalus borealis*) Stock in Flemish Cap (SCR Doc. 92/66)

The study showed trawlable biomass estimates obtained from the EEC survey series increased from a mean level of 2 000 tons in the 1988-90 period to 8 200 tons in 1991. Unlike former years no ovigerous females were found in 1991. This may be attributed to the timing of the survey before the spawning period of shrimp. Prawns were also larger than in previous surveys.

VIII. OTHER MATERS

1. Review of Arrangements of Stock Assessments

In order to facilitate the assessment process, and in recognition of recent difficulties associated with obtaining catch information for many of the stocks, STACFIS recommends that *during the first day of future June meetings, under usual agenda 'General review of catches and fishing activity', all available information on catches for the various stocks should be reviewed so best estimates of catches can be determined before commencement of the assessment reviews.*

2. Special Session for 1992

A progress report on planning for the 1992 Special Session titled "State-of-the-Art in Fish Stock Assessment: a Tutorial/Workshop on Calibration Methods and Their Practical Use" was presented by R.K. Mohn (Canada), one of the co-convenors. It was noted that the session is now scheduled for 9-11 September 1992 at the NAFO Headquarters. The format will be to have lectures in the mornings with hands-on activities in the afternoons. Several instructors have been identified, and sufficient microcomputers will be available. To date, it appears that there will be about 35-40 people in attendance. A workbook will be produced for the workshop, and a preliminary draft of this was made available during the meeting.

3. Theme for Special Session in 1993

During the Special Meeting held in March 1992, it was noted that further consideration of possible Symposium topics should take place during the June meeting.

After discussion, it was decided that a Special Session titled "Gear Selectivity/Technical Interactions in Mixed Species Fisheries" be held along with the Annual Meeting of September 1993. Although a Symposium dealing with Selectivity was held in Norway during June 1992, the topic for this Special Session does not overlap. The Norway meeting dealt with technical aspects of selectivity whereas this Special Session will focus on the fishery aspects. STACFIS requests that the Secretariat approach S. Walsh (Canada) and O. R. Godø (Norway) to inquire if they would be willing to serve as co-convenors of this session. An information sheet will then be circulated by the Secretariat to invite participants.

4. Theme for Special Session in 1994

A number of general topics were proposed as possibilities for the 1994 Special Session. These included 1) marine mammal/fisheries interactions, 2) another tutorial/workshop on fish stock assessment, 3) the economic implications and consequences of biological advice on fishery management, 4) discards, 5) various species specific sessions, and 6) recruitment and the survival of young fish. Regarding topics 1 and 3, it was agreed that input from marine mammal experts and economists, respectively, would be required and national representatives are requested to carry out such consultations during the summer. It was also concluded that the results of the upcoming September 1992 tutorial/workshop should be evaluated before any decision is made concerning suggestion 2.

STACFIS agreed that a final decision should be made after further discussion at the September 1992 meeting.

5. Adjournment

There being no further business, the Chairman extended thanks to all the participants, and to the Designated Experts and reviewers of drafts in particular for their contributions and assistance throughout the meeting. The Executive Secretary, Assistant Executive Secretary and entire Secretariat staff were also thanked for their continuing invaluable assistance and hard work that enables the meetings to run smoothly. The social event organized by the Secretariat was also very much appreciated.

The Chairman noted that his term in the position is coming to a close in September. Since this was his last June meeting as chair, and because he may not have the opportunity to see everyone in September, he extended his gratitude to all participants for their continued support during his term. He indicated that he had enjoyed the work, but much of that enjoyment was a result of the good working relationships between all the NAFO scientists. He extended his congratulations and best wishes to the next Chairman, H-P. Cornus (EEC-Germany). The Chairman also indicated that it had been a great pleasure to work with the Secretariat during his term.

There being no further business, the meeting was then adjourned.

ANNEX 1. REPORT OF THE SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH

Chairman: M. Stein Rapporteur: K. Drinkwater

The Subcommittee met at the NAFO Headquarters at 192 Wyse road, Dartmouth, Nova Scotia, Canada, on 9 and 13 June 1992, to consider environment-related topics and report on various matters referred to it by STACFIS. Scientists attended from Canada, Cuba, Denmark (Faroe Islands/Greenland), EEC, Iceland, Japan, Russian Federation and USA.

The Subcommittee reviewed the following documents: SCR Doc. 92/6, 19, 20, 21, 32, 36, 40, 63, 69, 70, 71, 72, 73; 74; SCS Doc. 92/9, 12, 17)

1. Chairman's Report

After welcoming the Subcommittee members, the Chairman stated that he felt the Subcommittee should, in future, meet early during the Scientific Council Meetings allowing environmental information to be available prior to the assessment discussions in STACFIS. The Subcommittee recommended that, *in future the Environmental Subcommittee should meet at the beginning of the regular June Meeting of the Scientific Council Meeting, i.e. on the Thursday of the first week.*

2. Marine Environmental Data Service (MEDS) Report for 1991 (SCR Doc. 92/69)

During the last year MEDS has been busy implementing new quality control and duplicate checking programs. All of their historical ocean data archives have now been quality controlled and duplicates removed. Rebuilding of their data handling system is near completion and MEDS will shortly again be able to process ocean data routinely.

a) Data Collected in 1991

Data from 655 oceanographic stations sampled in the NAFO area were sent directly to MEDS in 1991. In addition data from 4 605 stations were received through IGOSS (Integrated Global Ocean Service System).

The number of stations sampled for which data have not been received by MEDS was 6 445, a 3-fold increase over last year.

The number of stations for which data had been received by MEDS was down by a factor of 5 from last year while the number of stations obtained through IGOSS increased by 1 000. Because of the rebuilding of the data handling procedures at MEDS over the past 2 years, direct transfer of data may have been delayed by some institutions until they were sure that MEDS was ready to accept it.

b) Historical Data Holdings

Data from 4 510 oceanographic stations collected prior to 1991 were obtained during the year, up by approximately 1 500 over last year.

c) Drift-buoy data

A total of 110 drift-buoy tracks were received by MEDS during 1991 representing 161 buoy months. This amounted to an increase of 28% in buoy tracks but only 5% in buoy months compared to last year.

d) Current-meter and Thermistor Chain Data

Data collected in 1991 within the NAFO area included 34 sites, 78 instruments and 3 959 mooring days. This is approximately a 3-fold increase from 1990.

e) Wave Data

This year almost 83 000 wave spectra were obtained, a substantial rise from last year due to an increase in the number of moored wave buoys in the area.

f) Environmental Conditions

A review of monthly sea-surface temperature anomalies in 1991 for the NAFO region based upon IGOSS data, National Oceanic and Atmospheric

Administration (NOAA) and Bedford Institute of Oceanography (BIO) monthly reports was presented.

Overall, sea surface temperatures tended to be below normal in northern areas. Subareas 0 through 3 all showed colder-than-normal temperatures during 1991. No particular tendency of above or below normal temperatures were observed in Subareas 4 and 5 and the inshore areas of Subarea 6. The offshore temperatures in Subarea 6 were above normal most of the year.

3. Review of Environmental Studies in 1991

a) Subareas 0 and 1 (SCR Doc 92/19, 20, 21, 32, 40, 63; SCS Doc. 92/12, 17)

PINRO obtained temperature and salinity measurements in Davis Strait, along the outer edge of the Labrador Shelf and around the Grand Banks between September and December (SCS Doc. 92/12). A particular feature was the large area of the Grand Banks that was covered with below normal bottom temperatures.

During the annual German groundfish survey to West Greenland a XBT transect was obtained between Greenland and Scotland (SCS Doc. 92/17). Also 5 standard sections were occupied around Greenland between October and November. Above normal temperatures were generally observed.

The effects of the environment on fish distributions were investigated in studies of 0-group redfish off southwest Greenland (SCR Doc. 92/32). Redfish were most abundant at the shallow shelf front between the cold, fresh water of the East Greenland Current and the warm, salty waters of the Irminger Current. Redfish were found at a temperature of 3°C and a salinity of 34 PSU (practical salinity units). Further to the north these fish were found slightly deeper in the water column and at the shelf break.

Fish abundance and biomass estimated from groundfish surveys off West Greenland have declined since 1988. SCR Doc. 92/40 suggested that these declines were not related to temperature which has been near normal during this period but were possibly related to fishing pressure.

SCR Doc. 92/19 discussed the possible role of climate change in the reduction of West Greenland cod stocks. During the last twenty years, temperatures in this area have been decreasing. Since most of the good year-classes of cod which were caught during warm conditions, such as between 1940 and 1965, the recent decline in temperature suggested unfavourable environmental conditions for cod stocks. The paper stressed the need for studies of the mechanisms linking environment and fish and for more information on the physical dynamics at different time and space scales.

High coherence has been observed in temperature and salinity between East and West Greenland (SCR Doc. 92/20). The pattern of hydrographic changes was most clearly seen off West Greenland. Off East Greenland the interaction between the Polar Water and the Irminger Water led to a reduction in coherence between stations on the same transect.

The relationship between hydrographic events off West Greenland and those off Newfoundland and Labrador were explored (SCR Doc. 92/63). A positive relationship was observed between temperature and salinity variability at Fylla Bank and the area of Cold Intermediate Layer Water (CIL, temperatures <0°C) on a transect off Bonavista Bay, Newfoundland with a lag of 7 months.

Between the autumn of 1990 and 1991 a cooling of waters over the Baffin Island shelf and a rise in temperature near the mouth of Hudson Strait had taken place (SCR Doc. 92/21)

b) Subareas 2 and 3 (SCR Doc. 92/21, 36, 74)

Surface layer temperatures from Russian surveys in Subareas 2 and 3 were near to normal except in August when very cold conditions were observed (SCR Doc. 92/21). Near bottom waters on the Grand Banks were cold in spring and autumn with the autumn temperatures being the coldest in the last 7 years.

Sea surface temperatures over the Grand Banks were low in 1991 especially in the spring and summer (SCR Doc. 92/36). By autumn these had warmed to above normal values. In the Labrador Sea there was more variability with a slight tendency towards below normal values.

Earlier studies had shown a relationship between salinity and cod recruitment in Div. 2J+3KL from VPA analysis for the years 1958-76 in southern Labrador and Newfoundland. Predictions based on this relationship were made to determine how well it has performed (SCR Doc. 92/74). The general fluctuations in cod recruitment were well predicted although the mean abundance levels were lower than predicted. Because of problems with VPA analysis the cod-salinity relationships were reanalysed using recruitment indices derived from research vessel surveys. For Div. 2J+3KL as well as Div. 3NO and Subdiv. 3Ps there is evidence that summer salinity remained strongly correlated with cod recruitment. The mechanism is unknown.

c) Subareas 4, 5 and 6 (SCR Doc. 92/16, 36, 71, 72)

Monthly monitoring of sea surface temperatures on a transect across the mid-Atlantic Bight showed generally warmer-than-normal conditions by upwards of 1°C (SCR Doc. 92/16). In the Gulf of Maine SSTs varied throughout the year, being above normal in the spring and summer and below normal in autumn. Surface salinities were higher-than-normal in the mid-Atlantic Bight but above average in the Gulf of Maine. Bottom temperatures on the mid-Atlantic Bight were generally above normal through most of the year but below normal along the slope. In the Gulf of Maine bottom temperatures were slightly above normal but below normal on the Scotian Shelf.

The Subcommittee recommended, that *USA observers be encouraged to report on the variation in the position of the shelf water front between Georges Bank and Cape Hatteras and on anticyclonic warm-core Gulf Stream rings as they have in past years.*

Sea surface temperatures on the Scotian Shelf were reported to be above normal in 1991 (SCR Doc. 92/36). The fronts between the shelf and slope waters and the north wall of the Gulf Stream were suggested as being further south this year than the last. It was not clear from the paper, however, as to the quantity or type of data that were used to derive the frontal indices and upon which the above conclusions were based.

Eleven years of satellite-derived SST data from the Bay of Fundy showed that there was high correlation between stations over the length of the Bay (SCR Doc. 92/71). The SSTs were indicative of changes throughout the water column because of the strong tidal mixing. Temperatures over the past 5 years had generally been declining slightly but had near the long-term (1951-80) mean. The paper noted that since 1985 St. Andrews temperatures relative to Prince 5 had decreased by 0.8°C. This date corresponded with the reconstruction of the wharf at which the temperature recordings were taken.

As part of a Bedford Institute of Oceanography study of climate variability on the Scotian Shelf and in the Gulf of Maine, a database of monthly and annual oceanic, atmospheric and hydrological data sets is being assembled (SCR Doc. 92/72). Also all historical temperature and salinity data have been collected for the region, are being quality controlled, and the data will be used to investigate which are the important space and time scales of variability. Initial monitoring of the waters in deep basins and off the shelf break in the region has begun on an opportunistic basis using research vessels from BIO.

4. Overview of Environmental Conditions in 1991 (SCR Doc. 92/6, 73)

Review papers were 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 3 are listed below.

a) Extremely cold air temperatures were observed over southern Labrador and Newfoundland especially in winter due to an intensification and westward shift in the position of the Icelandic Low.

b) Ice formed early, spread more rapidly, was of greater concentration and lasted longer than normal off southern Labrador, Newfoundland and in the Gulf of St. Lawrence. Onshore winds in March pushed the ice into the northern Newfoundland coast where it remained for 2 or more months.

c) The number of icebergs to reach south of 48°N during 1991 was the highest in the past 6 years.

d) Cold conditions were observed at Station 27 with the coldest surface temperature anomaly in 20 years. The near bottom waters were also below normal continuing a trend that has lasted nine years.

e) There was more CIL water present from southern Labrador to the Grand Banks than normal.

f) In offshore waters, cold SSTs extended throughout the Grand Banks, off northern and southeastern Newfoundland, and along the Labrador Shelf. This contrasted with warmer-than-normal temperatures south of the Laurentian Channel with the maximum amplitude on the mid-Atlantic Bight.

g) Annual coastal sea temperatures at Halifax and St. Andrews were slightly below normal and Boothbay Harbor above normal in 1991.

h) The coldest temperatures in over ten years were reported in the deep waters of the Scotian Shelf (Emerald Basin) and over twenty years in the Laurentian Channel at Cabot Strait.

5. National Representatives

The national representatives responsible for submitting oceanographic data to MEDS, including all changes, were reported as follows:

G. Glenn to replace R. Keeley (Canada), A. Rodin (Russia) to replace G.I. Luka (USSR), and Y. Koutarou to replace Y. Uozumi (Japan). The representative from France was asked to check on Mr. Francois who was previously listed. The Subcommittee was not informed of any other changes to the list of representatives: R. Dominguez (Cuba), E. Buch (Denmark), F. Nast (Germany), R. Leinebo (Norway), A. J. Paciorkowski (Poland) and G. Withee (USA). No name was available for the representative of the United Kingdom.

6. Discussion on the Role of Environmental Subcommittee

The Chairman led a discussion on the future role of the Environmental Subcommittee. He asked whether the environmental reviews were useful to the fisheries biologists and whether more work should be done on the linkages between the environment and fish. It was felt that indeed more work should be carried out on such linkages, such as the recent relationship observed between the area of the CIL at the Bonavista transect and cod recruitment in Div. 2J+3KL. Some members suggested that an index of CIL volume might be better than an area index. A note of caution on relationships such as the salinity-cod connection (SCR Doc. 92/74) was raised because of the lack of any mechanism. It was felt by others that even if we do not understand the mechanisms, they could still be used as indicators of recruitment. However, there is still the problem of how to incorporate such information into the assessment process. It was pointed out to the Subcommittee that more work needs to be done on the role of environment in determining fish distributions as well as recruitment. Measurements at various time scales from decades to days may be required. It was also noted that little information is presented on currents. Finally, it was generally agreed that the environmental reviews are useful as background for understanding and interpreting fisheries data. The Subcommittee will therefore continue such reviews but will encourage more work linking the environment to changes in fisheries.

7. Invited Lecture (SCR Doc. 92/70)

The Chairman introduced Mr. Charlie Ross from BIO. Mr. Ross gave a paper on recent current meter observations in the Davis Strait. The data presented clearly defined the southern outflow from Baffin Bay which extended over the western three-quarters of the Strait, with the northward branch of the West Greenland the eastern slope. Strong seasonal cycles were observed in the transport of the latter coinciding with seasonal temperature and salinity variability. The transport of both the southward and northward transports underwent large interannual variability.

8. Other Matters

A proposal for a Joint Russian/German Data Evaluation of Hydrographic data collected through ICNAF/NAFO times, was discussed on 13 June 1992. The Subcommittee realized that there are large oceanographic databases in various institutes of Contracting Parties, and proposed that analysis should be undertaken in the light of climatic time series, consistency of events and possible interrelationship with recruitment patterns in fish stocks.

In this respect the Subcommittee noted that data entry can be performed in the Institut für Seefischerei or in the NAFO Headquarters if information on the data is available at least on paper. The following information would be requested: ship, station number, position, date, water depth, meteorological data, standard depth data of: depth, temperature, salinity. As standard depths the Standard Depths of the North Atlantic Ocean are required. A pre-analysis would be performed in the Institut für Seefischerei. Based on this a bilateral publication is being aimed at.

The Russian representative agreed to explore the availability of the necessary data for this proposal, and to communicate with the Secretariat of NAFO and the Environmental Subcommittee Chairman on the results.

9. Acknowledgements

The Chairman closed the meeting and thanked the participants for their contributions and cooperation.

ANNEX 2. REPORT OF THE WORKSHOP ON AGE DETERMINATION OF GREENLAND HALIBUT AND AMERICAN PLAICE

Introduction

The need for a Workshop on age determination of Greenland halibut and American plaice was identified at recent Scientific Council meetings (NAFO Sci. Coun. Rep., 1991). There was a wide range of expertise among the participants at the workshop held at the Northwest Atlantic Fisheries Centre, St. John's, Newfoundland, Canada December 3-12, 1991 (listed below).

For some years, comparisons of Greenland halibut ages from otoliths and scales occurred between Canada, USSR, and GDR and exchanges of American plaice otoliths have occurred between Canada, EEC-Spain, and EEC-Portugal. Given the varying degrees of success of these exchanges, and the difficulties involved in establishing ageing criteria using photographs instead of the actual otoliths and scales, it was decided to hold a workshop involving the interested parties. An information note outlining the nature of the workshop was sent by the NAFO Secretariat to fisheries institutes in Canada, Denmark, France, EEC-Germany, EEC-Portugal, EEC-Spain, and the USSR.

The terms of reference were for participants to acquaint themselves with flatfish ageing in general by examining otolith and scale preparation techniques, interpreting ring structures, comparing different ageing materials, and organizing exchanges of scales and/or otoliths among interested parties. Experience in ageing flatfish otoliths or scales was not a prerequisite for participants, as one of the major goals of the workshop was to observe and discuss the various aspects of ageing.

The workshop was split into 2 equal parts, the first dealing with Greenland halibut and the second with American plaice. Not all participants took part in both sessions.

Materials and Methods

Greenland halibut

Otoliths. Both sagittal otoliths are usually removed from the fish and stored dry in small paper envelopes (e.g., coin envelopes). Some investigators prefer to keep the samples frozen after collecting; however, all otoliths examined in this workshop were kept at room temperature after collection.

The method for reading the otoliths was to put the whole otoliths in a dark watch glass, cover with alcohol, and place under a binocular dissecting microscope, illuminated by reflected light. It was often necessary to first polish the surface of the otoliths using an abrasive stone driven by a variable speed motor; this was usually done to enhance the clarity of the annuli, although it is also possible to reduce the clarity by excessive grinding. No other methods of otolith preparation or examination were reviewed.

Scales. Scales are usually collected from the pigmented or eyed-side of the fish above the pectoral fin, between the dorsal fin and the lateral line. Some investigators have found that scales from this region are often best for age-determination, although Krzykawski (1976) stated that scales from the caudal region were best for age and growth studies. Experienced scale readers have found that scales frozen after collection are easier to interpret than those kept at room temperature.

To read the scales, the preferred method is to clean them in a mixed solution of 5% ammonia and ethanol for about 10 minutes in a clear watch glass. The scales can be examined under transmitted diffuse light under a binocular dissecting microscope or in a simple microfilm reader. An alternate method is to mount cleaned, dry scales between two glass slides and read with the microfilm apparatus. This is the method used here because such samples were readily available and because the microfilm reader available could not accommodate wet scales in a watch glass.

In this workshop, otoliths and scales were examined from Greenland halibut caught during a research vessel survey in Div. 0B in November, 1990. Readers independently aged the scales and otoliths from 20 fish of various sizes (Table 7). The readings from the first set of samples were not kept by the agers while reading the second set. In all

cases, the length and sex of the fish was available to the reader upon request. Many otoliths from other areas and seasons were also examined by interested readers, but were for purposes of discussion and comparison only, and are therefore not presented.

Table 7. Ages of otoliths (O) and scales (S) of Greenland halibut collected in Div. 0B.

Sample			Reader																
			1		2		3		4		5		6		7		8		9
No.	Length	Sex	O	S	O	S	O	S	O	S	O	S	O	S	O	S	O	S	S
63	35	M	7	4	8	8	7	7	6	6	8	4	7	5	5	6	7	6	5
74	40	F	6	5	6	4	5	5	6	5	7	6	5	4	6	5	8	7	5
76	28	M	5	6	3	2	4	3	4	2	3	3	4	3	4	7	5	6	4
77	31	M	3	3	3	4	3	3	4	3	3	3	3	3	4	3	5	3	4
80	40	M	5	7	6	6	5	5	5	5	6	7	6	5	6	5	6	7	5
96	25	M	3	3	3	2	3	3	3	3	3	3	3	2	3	3	4	3	3
446	60	M	7	7	8	8	10	9	8	9	-	-	8	7	10	8	13	8	9
449	63	M	-	6	-	9	-	10	9	10	11	7	-	5	10	6	11	6	10
476	64	M	5	7	9	8	9	9	11	9	13	9	8	8	10	9	10	9	10
479	74	F	9	12	9	11	10	11	11	12	10	13	11	12	12	14	12	14	14
486	63	M	10	8	11	7	11	7	11	9	11	8	11	7	10	8	10	10	9
489	87	F	12	12	9	11	9	12	12	12	14	13	9	-	14	13	14	12	15
491	69	F	10	10	11	9	9	11	10	10	14	12	9	10	10	10	12	10	12
492	90	F	9	15	12	16	11	15	12	16	16	16	12	15	-	-	15	15	16
493	69	F	13	11	9	9	10	10	12	10	10	9	9	8	10	9	11	10	12
502	80	F	10	8	10	10	12	12	15	13	13	14	13	11	13	14	14	14	13
507	103	F	15	14	14	13	11	13	15	14	17	18	11	12	16	13	15	14	17
508	98	F	15	12	12	11	10	13	12	12	15	11	11	11	15	12	15	12	17
511	88	F	15	15	12	11	7	11	14	16	13	14	10	10	14	13	13	12	15
513	63	M	10	9	8	8	8	9	10	10	9	8	9	8	9	10	11	11	10

American plaice

The methodology used for collecting and ageing American plaice otoliths is virtually identical to that described for Greenland halibut. For all samples except those from Div. 1D, both otoliths from each fish were available for examination. The ageing in this workshop was done with whole polished otoliths and reflected light, although several other methods were discussed and otoliths prepared using some of these methods were examined. These alternative methodologies included:

- Mounting otoliths on a slide using a fast hardening resin "Lackside 70" (Ref. No. 40-8100, supplied by BUEHLER), with the left otolith sulcus-down and the right one sulcus-up. Otoliths were then polished using a variable speed ECOMET III polishing machine. The otoliths were examined with a binocular stereo-microscope, using reflected light against a dark background (Godinho, 1991).

- Otoliths are embedded in polyester resin blocks, black colour being used to avoid light interference during the reading. Blocks are then cut with a circular saw, in thin slices (0.4-0.7 mm). These sections cross the large axis of the otolith, through the middle of the nucleus (Bedford, 1983). Observations of the thin slices can be made with either reflected or transmitted polarized light. To give the best resolution in the picture, lighting is supplied by optical fibres which can be directed on any part of the otolith. A video camera is connected on the binocular and can be focused on any part of the otolith (ridge, centre, specific ring, etc.). The picture is displayed on a video monitor and viewing can be done by several readers, and discussed. A printer can also be connected and the image reproduced on paper.

- Examination of whole polished otoliths using transmitted (instead of reflected), polarized light.

In this workshop, otoliths from American plaice caught in NAFO Divisions 1D, 3L, and 3P (Subdivision 3Ps) were examined. Approximately 20 samples from each Division were aged by each reader, with the length and sex of each fish being available prior to ageing. The month of capture for the 4 groups of samples was as follows:

Area	Month
1D	November
3L	November
3M	June
3Ps	February

Results and Discussion

Greenland halibut

Most agers had little or no experience reading Greenland halibut scales, and only a few had read otoliths from this species previous to the workshop. Prior to reading the scale and otolith samples, participants were able to examine some other specimens and briefly discuss ageing criteria. For some, this represented the first real experience in ageing Greenland halibut. Thus it was decided to keep the sample sizes fairly small to allow additional time for readers to become familiar with the G. halibut scales and otoliths.

Eight readers independently aged both the scale and otolith samples, while a ninth reader examined the scales only. The results are shown in Table 7. As can be seen in Fig. 46 and 47, there was a tendency in most cases to count fewer rings on the scales than the otoliths. However, the reverse was often true for the very oldest fish. There was often a wide range in possible ages, although there was usually some agreement for most scales and otoliths.

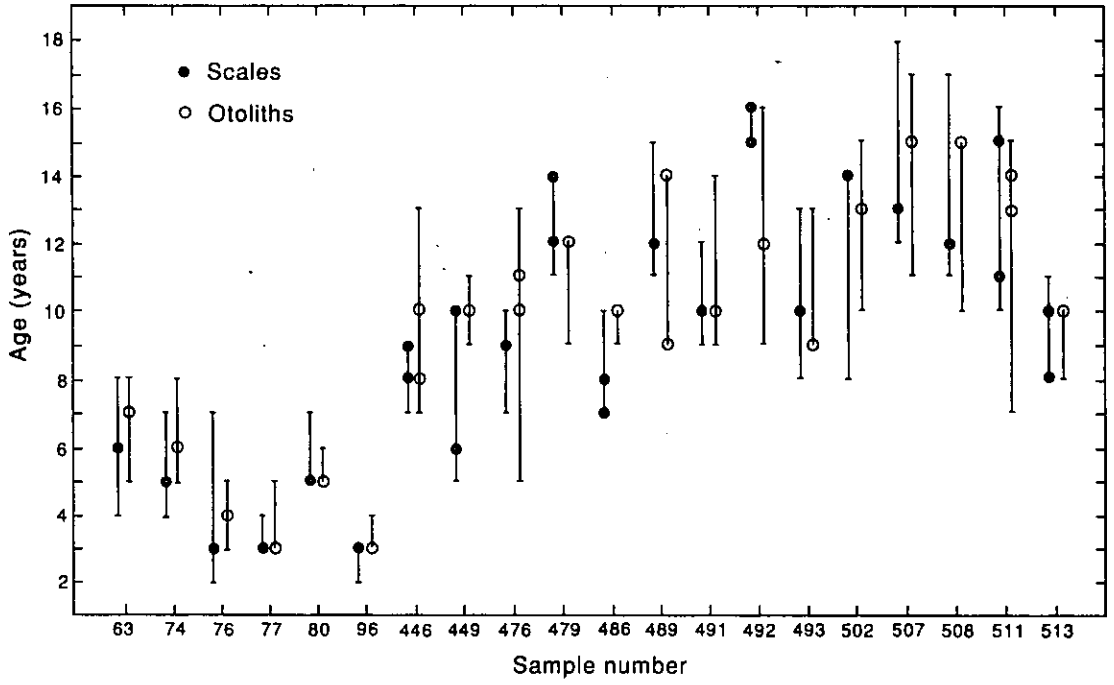

Fig. 46. Readings of Greenland halibut scales and otoliths from NAFO Div. 0B. Circles represent greatest agreement among readers on a particular sample.

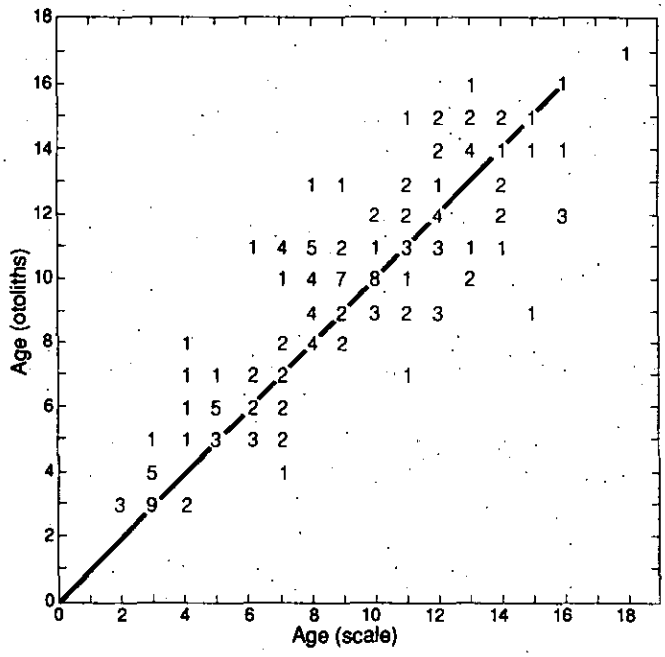

Fig. 47. Comparison of Greenland halibut scale and otolith readings of the sample from Div. 0B. The numbers represent the number of observations at each point. The straight line through the origin represents agreement for a reader on scale and otolith age.

The results from the workshop are not unlike those of an earlier exchange between Canadian otolith readers and German scale readers (Fig. 48), which showed a tendency to age small fish younger by scales and vice versa for larger fish, when compared to otoliths. The reasons for this were not fully explained at the time of that exchange, or in this workshop.

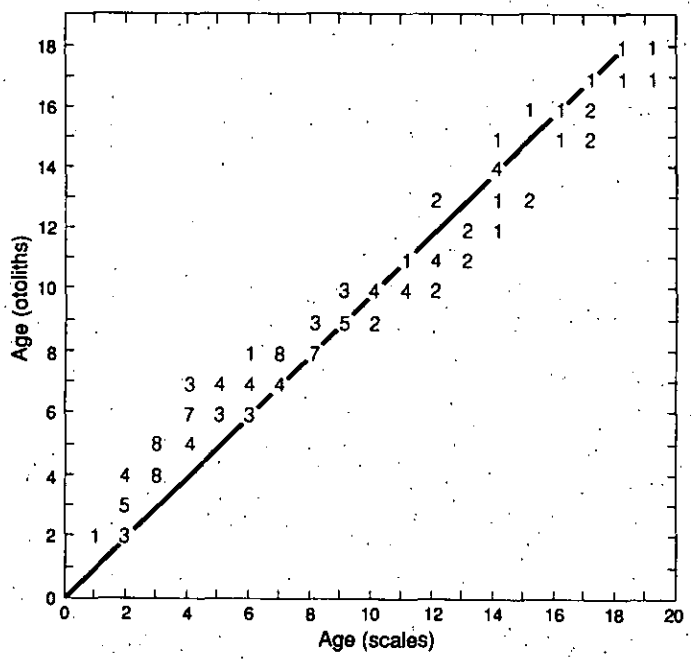

Fig. 48. Comparison of Greenland halibut scale and otolith readings from an earlier exchange between Canadian otolith reader and German scale reader.

After the scale and otolith samples were aged and the results compared, readers were able to reexamine a few of the samples and discuss differences in opinion. This was thought to be particularly helpful with the scale interpretation, as most readers were inexperienced in this technique. In any case, it was obvious that further work needs to be done in comparing Greenland halibut ageing, particularly between scales and otoliths. It was felt that the best technique for examining scales is the "wet" method described previously. However, the microfilm equipment available to read the scales could not accommodate this type of material, so dry slides were used, perhaps reducing the scale clarity.

American plaice

Five readers independently aged the 4 American plaice otolith samples, and the results are shown in Tables 8A-D. In general, agreement between readers was best for Div. 3M and worst for Div. 1D (Fig. 49). Most readers had previous experience with American plaice otoliths from Subarea 3 but had negligible experience in reading otoliths from Div. 1D. Thus there were several otoliths from this division which produced little or no agreement among agers.

Table 8A. Ages of otoliths of American plaice collected in Div. 1D.

ID	Length	Sex	Reader				
			1	2	3	4	5
1	35	F	7	7	7	8	9
2	31	-	8	9	7	8	8
3	30	F	9	10	6	8	8
4	34	F	11	11	7	11	10
5	33	-	11	12	8	12	10
6	36	F	8	8	7	10	10
7	38	F	12	13	9	11	11
8	39	-	11	-	9	9	10
9	40	F	9	9	9	12	11
10	42	-	11	12	10	11	12
11	44	F	10	10	10	13	11
12	45	F	8	8	10	14	11
13	46	-	-	-	11	17	12
14	47	-	-	-	11	16	13
15	48	-	8	9	12	17	13
16	50	F	-	-	9	16	14
17	52	-	10	12	12	16	15
18	29	-	7	7	7	7	7
19	27	-	11	11	8	10	8
20	25	-	8	7	6	7	8

Table 8B. Ages of otoliths of American plaice collected in Div. 3L.

ID	Length	Sex	Reader				
			1	2	3	4	5
51	35	F	11	11	7	7	10
52	29	M	8	9	6	9	8
53	33	M	8	8	7	10	10
59	34	F	9	8	7	9	9
67	47	F	10	12	9	10	12
69	39	M	10	10	9	13	11
72	38	F	9	9	9	13	9
76	42	M	10	10	9	10	10
77	18	F	5	5	4	5	4
81	44	M	10	9	10	10	12
82	45	F	9	9	9	12	13
83	46	F	10	11	10	11	12
84	52	F	12	12	12	13	13
90	48	F	10	10	11	14	14
92	43	M	7	7	9	8	8
93	40	M	8	8	10	10	9
94	16	M	3	3	4	3	4
95	17	M	4	4	4	3	4
96	50	F	13	13	12	14	15
97	54	F	13	13	12	13	16
91	49	F	10	10	11	16	14
61	36	F	11	10	8	13	12

Table 8C. Ages of otoliths of American plaice collected in Subdiv. 3Ps.

ID	Length	Sex	Reader				
			1	2	3	4	5
1	28	M	8	8	8	7	7
8	33	M	8	7	9	9	8
12	35	M	10	11	10	9	8
14	37	M	5	4	8	6	8
19	40	M	7	7	9	7	9
20	41	M	10	10	10	9	9
26	45	M	9	9	11	9	10
27	46	M	9	-	11	10	10
29	47	M	9	9	11	10	10
30	52	M	10	10	12	13	11
65	50	F	14	13	12	16	11
72	55	F	13	14	13	14	12
75	57	F	11	10	14	14	13
77	58	F	12	12	15	14	13
79	60	F	14	13	15	-	14
80	61	F	12	12	16	14	14
83	63	F	12	12	15	-	15
85	71	F	20	21	18	20	17
119	-	-	9	8	10	12	11
213	67	F	15	-	17	20	16

Table 8D. Ages of otoliths of American plaice collected in Div. 3M.

ID	Length	Sex	Reader				
			1	2	3	4	5
1	29	F	4	4	7	5	5
2	32	F	5	6	7	5	5
4	33	F	5	5	8	6	5
6	34	F	4	4	6	5	5
7	34	F	4	4	7	4	5
8	35	F	4	4	7	5	5
9	35	F	7	8	8	6	6
10	37	F	7	7	8	10	8
11	46	M	8	8	9	9	8
12	46	M	6	7	9	10	8
13	45	M	5	6	8	7	7
14	44	M	8	8	9	9	9
18	42	M	9	-	9	8	9
21	42	M	7	8	9	8	7
23	41	M	8	8	8	8	8
24	40	M	8	8	8	8	7
25	40	M	10	10	8	10	9
26	40	M	7	7	8	7	7
27	39	M	9	9	8	13	8
29	38	M	8	7	7	9	8

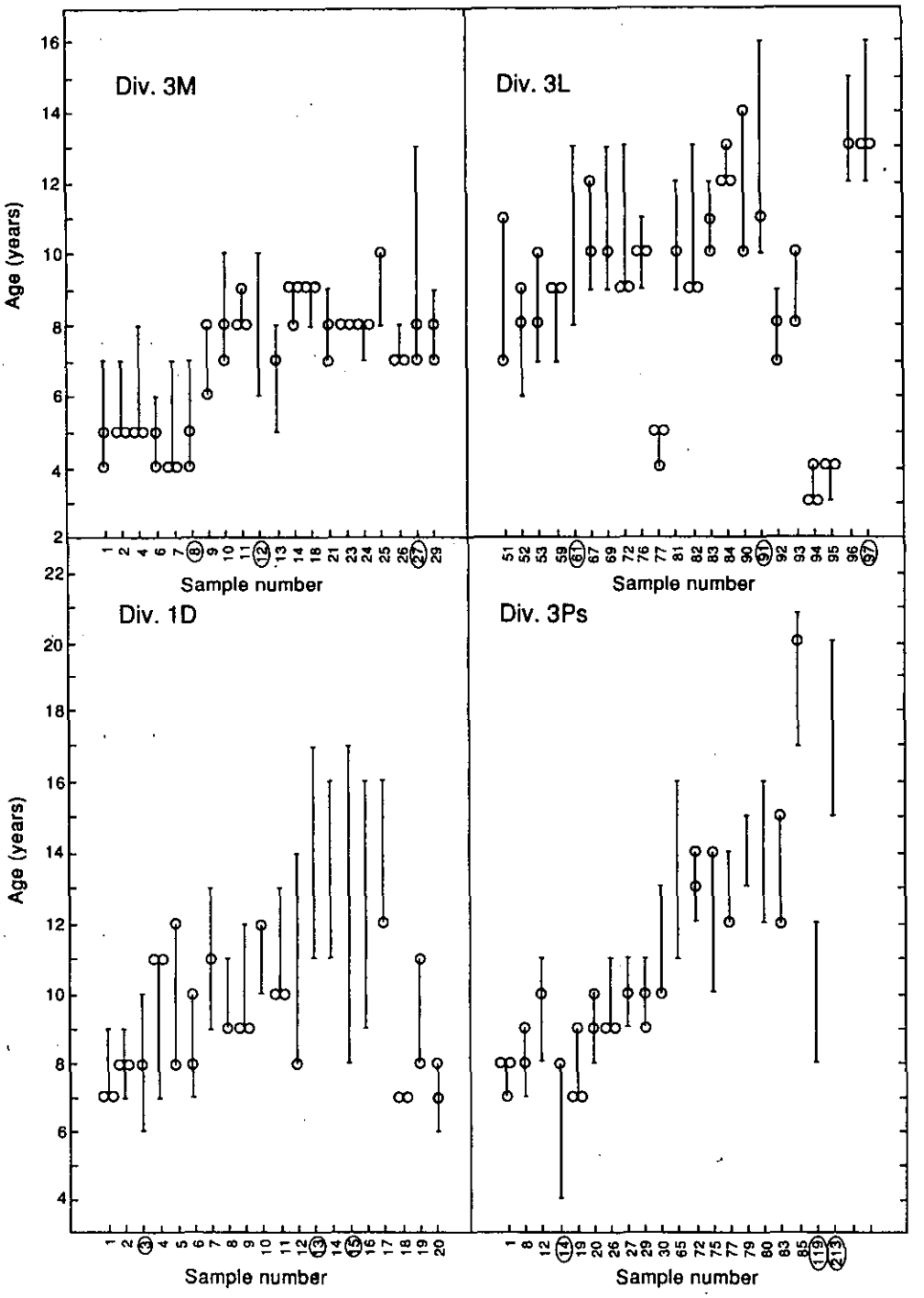

Fig. 49. Readings of American plaice otoliths from Div. 3M, 3L, 1D, and 3Ps. One circle indicates 40% agreement; two circles, 60%. Circled sample numbers represent otoliths chosen for further study and discussion.

In general, disagreement on the ages stemmed from interpretation of the nucleus or first ring, double or split rings, and the growth at the edge of the otolith, which are the typical problems observed in ageing studies. There was discussion on the amount of grinding of the larger otoliths necessary to bring out all the rings clearly. It was noted that other methods, such as the slicing technique described previously, sometimes allowed

a clearer view of an otolith. However it was also felt that these techniques had some disadvantages, such as the number of sections sometimes required to obtain a cut through the nucleus of the otolith. The relative merits of each method were discussed but no conclusions as to the 'best method' could be drawn because it was not possible to prepare and interpret otoliths using all methods. Regardless of the technique used to prepare and examine the otoliths, the decision on ageing ultimately depends on the interpretation of often complex ring structures.

In an earlier interchange of American plaice otoliths between EEC-Spain and Canada, there was poor agreement on the ageing of samples from Div. 3M (Zamarro and Brodie, 1990). This was thought to stem from differences in opinion on what formed the nucleus of the otolith. These differences were largely resolved at this workshop and better agreement was achieved with the otoliths from Div. 3M, although some differences still remain.

In the samples from each of the 4 areas, there were some otoliths which produced wide differences in opinion on their age (Fig. 49). These otoliths were selected for further study and discussion, and in most cases some agreements on age were reached. Workshop participants found this approach useful in settling differences in interpretation. These discussions and re-examination of otoliths were also useful in explaining biases, e.g., in many cases, one person consistently counted more rings than the other agers for most of the otoliths in a sample.

General

While it was possible to examine briefly materials from other areas or materials prepared with different methodologies, circumstances did not allow more detailed comparisons of ring patterns, methods, etc. Thus, as noted previously, it was not possible for the workshop to give definitive statements on which methods were best. However, the workshop did give participants an understanding of which techniques are widely used, and served as a forum for discussion and comparison of results. It is this exchange between participants that makes workshops such as these worthwhile.

Recommendations

Greenland halibut

An exchange of Greenland halibut otoliths and scales (from the same fish), collected in Div. 0B and Div. 2G in October-November 1991 should be carried out. Two samples of 55 sets of scales and otoliths (110 fish in total) should be exchanged as follows:

	Sample	
Participating lab	I	II
	Order of exchange	
Mont Joli, Canada	1	2
St. John's, Canada	2	1
Copenhagen, Denmark	3	3
Santander/Vigo, Spain	4	4
Lisboa, Portugal	5	5
Rostock, Germany[1]	6	6

[1] Will arrange for exchange with PINRO, Murmansk, Russia if possible.

All results will be compiled and tabulated in Rostock.

American plaice

An exchange of American plaice otoliths from various NAFO divisions should be carried out. A sample consisting of 50 otoliths from fish of various sizes will be prepared from each of the following divisions: 1D, 3L, 3N, 3M, and 3Ps. The order of exchange will be St. John's, Vigo, Lisboa, Copenhagen, St. Pierre, with all results sent to St. John's for compilation.

General

Following the exchange of ageing material for both species and subsequent investigation and discussion of differences, a further workshop should be held, probably

sometime in 1993. This would focus on the exchange results and would aim at establishing consistency in age determination of Greenland halibut and American plaice.

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Participants

Participants in the workshop on age determination of Greenland halibut and American plaice.

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

Chairman: A. Avila de Melo. Rapporteur: B.W.Jones.

The Committee met at NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada on 10 June and 13 June 1992. Representatives from Canada, Cuba, Denmark (Faroe Islands/Greenland), EEC, Iceland, Japan, Russia and an observer from USA were present.

1. Fisheries Statistics

a) Progress Report on Secretariat Activities 1991/92

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

STACREC continues to be greatly concerned about the delays in the national reporting of fishery statistics through the STATLANT system. Although the problem was usually with the submission of the STATLANT 21B reports, since 1989 there have been exceptional delays in STATLANT 21A submissions. The deadline for the submission for the provisional statistics in STATLANT 21A reports for 1991 was 15 April 1992. So far data have been received from 14 countries (components) but are still outstanding from 9. These delays have affected both stock assessment work as well as the publication of the Statistical Bulletin. The Secretariat, in its customary role, regularly sends reminders to the statistical offices and sometimes to national representatives of Contracting Parties. The Scientific Council has also in 1991 brought this matter to the attention of the Contracting Parties through the Fisheries Commission. This process, however, did not result in any improvement in the situation.

ii) Publication of statistical information

The publication of *NAFO Statistical Bulletin* (Vol. 39) with STATLANT 21B reports for 1989 has been long overdue due to data still outstanding from France (M) and Norway.

The Secretariat completed the historical review of catches of selected species by stock area and country for the period 1980-90 (SCS Doc. 92/5) although no reports were received for either EEC-France(M) or France(SP) for 1990. It was also noted that the 1983-85 data had not been received separately for each component of the French catches. It was stated by the representative of EEC-France that these data should be made available shortly.

iii) Updating of fishery statistics database

In response to last year's recommendation of STACREC that EEC-Germany be requested to continue reporting the catches of the former GDR and FRG fleets as separate components, the German representative reported that there was a national legal requirement to report data as a single country. Nevertheless the Rostock fleet would in future continue to fish the national quota for redfish in Div. 3LMN, and those data could be identified for stock assessment purposes.

STACREC is aware that all stock assessments carried out by STACFIS currently use figures agreed to be the best estimates of the catches. Such estimates are usually based on information available from different sources, namely the STATLANT system, surveillance and sampling programs. STACREC also noted that other data useful to the calculation of those catch estimates are being collected through other NAFO Standing Committees such as STACTIC and STACFAC, namely the number of fishing days by fleet/month/Division (the Hail System), and catch levels for non-Contracting Party fleets. Therefore, STACREC suggested that the Scientific Council identify all the relevant data collected by other Standing Committees, and request that they be made available for use in stock assessments. The data should be submitted in as disaggregated a form as possible. These data could then be circulated by the Secretariat to members of the Scientific Council prior to the June meeting.

As reported to STACREC in June 1991, the Secretariat had updated the catch and effort database back to 1960, but was awaiting the disaggregated data from EEC-France(M) and France(SP) for the period 1983-85 before preparing the 30-year time series summary.

b) Review of Reporting Requirements for Submission of STATLANT 21A and 21B statistics

STACREC discussed at length the difficulties associated with the late submissions of STATLANT data. The problems for the stock assessments and the work of the Scientific Council were quite evident and a general agreement has been recorded about the need that Contracting Parties should make their nominal catch and effort data available prior to the June Meeting of the Scientific Council. The EEC-EUROSTAT representative commented that while welcoming, in principle, the requirement to submit statistical data prior to a stock assessment, any earlier deadlines proposed to satisfy the requirements of the assessment scientists will create difficulties as far as the Community's national statistical services were concerned. Discussions held with these services while developing the Community legislation covering the STATLANT 21A data had shown that the 30 June was the earliest realistic deadline for these data. He further stated that since the STATLANT 21A data were obtained by aggregating the STATLANT 21B data, a similar deadline for the STATLANT 21B data would appear appropriate.

While recognizing various difficulties in obtaining data on a timely basis from the representative statistical offices, STACREC noted the timely submission of fishery statistical data by the Contracting Parties was a serious matter which was not adequately reflected in the formal documents of NAFO provisions. In particular, STACREC recommended that *the Scientific Council consider the inclusion of a new Rule in the Scientific Council Rules of Procedure, to place a legal requirement for Contracting Parties to observe the deadlines for submission of STATLANT data.* In view of the data requirements before the June Meeting of the Scientific Council, STACREC proposes that the *deadlines should be 15 May and 30 June for STATLANT 21A and 21B data respectively.* STACREC felt the observance of these new deadlines would ensure that nominal catches would be available for use in the stock assessments at the June Meeting of the Scientific Council. STACREC recommended *that the Secretariat should contact the Contracting Parties to consult them about the practicability of meeting the proposed deadlines and that STACREC should review the responses at the next June meeting.*

In addition, to facilitate the work of the Designated Experts who prepare preliminary assessments before the June Meeting, STACREC conveyed the view that STACFIS should be in a position to request national representatives to provide preliminary statistical data to Designated Experts, on an informal basis, in good time for incorporation in the assessments.

c) Fifteenth Session of the CWP, July 1992

The Secretariat presented the customary document (SCS Doc. 92/11) which had been prepared for presentation to the 15th Session of CWP (8-14 July 1992). The document summarized the present state of data reporting and availability, and included an item on the high seas fisheries which reflected STACREC discussions of 1990. Progress in NAFO with respect to concerns of non-Contracting Party fisheries in the Regulatory Area, and the progress on the Hail System to monitor Contracting Party vessel activities were also reported.

STACREC noted that the Council was usually represented at the CWP Meetings by the Assistant Executive Secretary, Chairman of STACREC and any representatives from Contracting Parties. However, the Chairman informed STACREC that he would not be available because of research survey commitments. Considering alternates, STACREC recommended that *H. Lassen (EEC-Denmark) or H. P. Cornus (EEC-Germany) be requested to represent STACREC at the CWP Meeting.*

2. Biological Sampling

a) Progress Report on Activities in 1991/92

The Provisional List of Biological Sampling Data for 1990 was tabled (SCS Doc. 92/6).

Data for the 5-year publication, *Inventory of Sampling Data* for the period 1985-89, were received at the Secretariat in late-1991 and re-confirmed by the Secretariat by April 1992. The publication is now in the final stages of preparation and is due to be completed this year.

b) Forms and Deadlines for Submission of Data

No changes were proposed to either the forms or deadlines for submitting biological data.

c) Review of National Sampling Programs for the Second Half of 1992, and 1993.

STACREC reviewed the level of biological sampling of the fisheries in the Regulatory Area carried out by the national programs. It was noted that for 1991 no information on length/age compositions of the Russian commercial catches was available, and this situation will probably continue in 1992 and in the near future. As for EEC-Portugal, a full coverage of the various fisheries had finally been achieved in 1991. However, the Portuguese sampling program is partially supported by EEC funding only until the end of 1992, and a reduction in the level of sampling is to be expected in the program if funding is not renewed or replaced by funding from Portugal. Thus, for 1993 STACREC expected a severe drop in the amount of information from the commercial fisheries in the Regulatory Area. STACREC therefore requests the Scientific Council to urge all countries to maintain representative sampling of the fisheries in the Regulatory Area, by gear/season/Division, without which assessments for stocks in the Regulatory Area will be severely hampered.

3. Biological Surveys

a) Review of Survey Activities in 1991 (Table 1)

An Inventory of Biological Surveys conducted in 1991 was presented by the Secretariat, which STACREC reviewed before preparing the list for inclusion in the report of this meeting.

b) Survey Plans for 1992 and 1993, and their use in the 1993 Assessments (Table 2)

An inventory of surveys planned for 1992 and early 1993 was prepared by the Secretariat which STACREC reviewed before finalizing the tabulation in this report.

The representative of the Russian Federation announced that due to financial reasons there was a high probability that Russian surveys in the NAFO Area in 1992 and 1993 will be cancelled.

A discussion took place about the possibility of updating assessments made at the June meeting with survey data obtained later in the year. It was concluded that assessments would only be reopened if this appeared to be justified and if a Special Meeting was requested for that purpose.

c) Review of Stratification Schemes

There was nothing to report on this topic. STACREC agreed that this agenda item would not be necessary for next June's Meeting.

d) Coordination of Surveys in 1992-93

The offshore fishery for Greenland halibut had increased since 1990 in Subarea 0B and in Div. 3LM. The information available for assessment of the entire stock in Subareas 0-3, particularly the surveys data, were rather incoherent because most of the surveys were directed towards other species

with information on Greenland halibut as a by-product. STACREC therefore recommends that *descriptions of these surveys be compiled and that the possibility for a better coordination of these surveys be investigated. If problems of comparing survey results are identified, comparative studies should be undertaken.*

A proposal was made for creating a special project for surveys to be undertaken funded by NAFO using Contracting Party research vessels with international scientific crews. STACREC recognized the importance of biological surveys in the assessment process, however, it was considered that a useful series of survey data can only be provided by a long-term commitment. The Committee was of the view that the main priority was to maintain the existing surveys rather than to initiate a new program.

It was noted that some of the surveys currently being carried out may not be continued in the future and this may have adverse affects on the assessments. STACREC suggested that if this situation was expected, the Designated Experts should anticipate it and should indicate to the Scientific Council that an assessment might not be forthcoming if essential survey data were not available.

STACREC noted that the date of the ICES/NAFO Workshop on methodology of surveys for Harp and Hooded Seals had been changed to 5 to 12 October 1992 to avoid a clash with the NAFO Annual Meeting. The Report of that Meeting would be forwarded to the Scientific Council, and would be available for review in June 1993.

4. Other Matters

a) List of Fishing Vessels for 1989

The triennial publication of the *List of Fishing Vessels* for 1989 was published in January 1992. It was agreed that the Secretariat should now request data for the next compilation of the list for 1992.

b) Tagging Activities Reported for 1991

A list of tagging activities in 1991 had been compiled by the Secretariat (SCS Doc. 92/8). Representatives were requested to submit corrections or omissions during the course of this meeting.

c) Review of Relevant SCR and SCS Documents not Considered in Items 1 to 3 Above

No further documents were presented.

d) Discrepancies Between NAFO and FAO Statistical Database

The EEC representative reported that following the request by the Scientific Council in 1991, EEC-EUROSTAT was conducting an analysis of the databases.

e) Other Business

A suggestion was made that it could be useful in the stock assessments, to have information on the amount of effort directed towards the main species. It was proposed that an additional field could be added to the log books in which the target species could be recorded. The Committee agreed to consider this matter further and to return to it during the September 1992 Meeting.

5. Acknowledgements

The Chairman thanked the rapporteur and the participants, and extended special thanks to the NAFO Secretariat for their assistance in preparation of information for the meeting.

There being no further business the meeting was adjourned.

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1991.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
				STRATIFIED-RANDOM SURVEYS	
0	B	SUN/DEU	11	G. halibut, grenadier temperature, salinity	59
0,1	B ABCDE	GRL	7- 9	Shrimp, bottom trawl, hydrography	260
1	ABCD	GRL	8,9	G. halibut, grenadier bottom trawl	139
	A-D	JPN	8-9	Bottom trawl survey on G. halibut	164
	BCDEF	DEU	10-11	Cod, bottom trawl	97
	B	GRL	9,10	Shrimp, bottom trawl, fish stomachs	29
	DE	GRL	10	Shrimp, bottom trawl, hydrography	15
2	G	SUN/DEU	10-11	G. halibut, grenadier, temperature, salinity	139
	H	SUN/DEU	11-12	G. halibut, grenadier,	51
	GS	CAN-M	11-12	Groundfish	
	J	CAN-M	5,7-8	Groundfish	
2+3	JK	CAN-M	6	Larval fish	
		CAN-M	7	Shrimp	
		CAN-M	10	Capelin	
		CAN-M	10-11	Hydroacoustics	
		CAN-M	11-12	Groundfish	
	JKL	CAN-M	1-2	Hydroacoustics	
		CAN-M	4,7-8, 11	Oceanography	
		CAN-M	6	Larval fish	
		CAN-M	9-10	Pelagic	
3	K	CAN-M	12	Groundfish	
	KL	CAN-M	5	Oceanography	
		CAN-M	10	Cod/capelin	
		CAN-M	5-6	Hydroacoustics	
	KLNO	CAN-M	10	Salmon	
	L	CAN-M	1,5,11, 12	Groundfish	
		CAN-M	3	Cod tagging	
		CAN-M	3,10	Pelagic (herring)	
		CAN-M	4,5, 6,8 9,10,11	Crab	
		CAN-M	4,5,6, 8,9	MUN	
		CAN-M	4	Gear trials	
		CAN-M	5	Hydroacoustics	
		CAN-M	5,7	Larval fish	
		CAN-M	5,6-7	Capelin	
		CAN-M	7	MUN/Oceanography	
	LN	CAN-M	4	Gear trials	
		CAN-M	5	Groundfish	
	LNO	CAN-M	6	Flatfish	
		CAN-M	8	Redfish	
		CAN-M	11	Groundfish	
		SUN	4-6	Groundfish, temperature, salinity	261
	LNOPs	CAN-M	5	Capelin	
	LO	CAN-N	8	Juvenile flatfish	
	M	E/ESP	7	Groundfish	120
		SUN	4-5	Groundfish, temperature salinity	107
	NO	CAN-M	8-8	Juvenile flatfish	
		CAN-M	10	Groundfish	
	O	CAN-M	4	Groundfish	
	OPs	CAN-M	4	Crab	
	P	CAN-M	2	Groundfish	
		CAN-M	9-10	Hydroacoustics	
	Ps	CAN-M	4,8-9	Scallops	
		FRA-SP	2-3	Bottom trawl	109
3+4	PnRS	CAN-M	1	Groundfish (IML)	
	PRV	CAN-M	8	Redfish	
4	R	CAN-Q	5	Migration - cod	66
	RST	CAN-Q	9	Shrimp - redfish	227
	S	CAN-Q	3-12	Growth - crab	8 surveys/ 9 sets
		CAN-Q	10	Assessment - scallops	100
	T	CAN-G	4	Groundfish migration, distribution	86
		CAN-Q	4-10	Migration - crab	4 surveys/ 180 traps
		CAN-Q	5-8	Assessment - crab	4 surveys/ 20 traps
		CAN-Q	7-8	Assessment - scallop	2 surveys/ 65 sets
		CAN-G	7-11	Bottom trwal for crab biomass estimation (NB, NS, Gaspe penninsula and PEI)	214
		CAN-G	8	Juvenile cod	47
		CAN-G	9	Groundfish abundance	198
	TVn	CAN-G	10	Herring acoustic	20
	Vn	CAN-Q	5	Mackerel - acoustic	
	VsN	CAN-SF	3	Groundfish	75
	VWX	CAN-SF	5	Scallop	5
		SUN	10-12	Juvenile silver hake	80
	N	CAN-M	1	Hydroacoustics	
4+5	VWXZe	CAN-SF	7	Groundfish	225
5	Z	CAN-SF	2	Groundfish	132
		CAN-SF	8	Scallop	147

Sub-area	Div.	Country	Months	Type of survey	No. of sets
				OTHER SURVEYS	
1	A	GRL	2,4, 5,10	White whale, sampling	
		GRL	8,9	Harp seal, sampling	
	AB	GRL	4	White whale, aerial	
		GRL	11	G. halibut, small redfish bottom trawl	51
		JPN	11	G. halibut, redfish - juveniles	51
	ABC	GRL	7	Trawl gear selection studies	77
	BDF	GRL	7	Young cod - gillnet	200
	CDE	GRL	7	Large cetacean photo-id and biopsy sampling	
2+3	JK	SUN	11	Capelin, temperature salinity	11
3	K	SUN	9	G. halibut, grenadier, temperature, salinity	31
	LNO	SUN	5	Capelin, temperature, salinity	60
		SUN	11	Larval capelin, temperatur, salinity	60
4	R	CAN-G	5-9	Crab trap, plankton, diving (SCUBA), & trawl surveys on recruitment (Bonne Bay, Newfoundland) Newfoundland)	20 nets 10 dives 20 trawl tows 272 traps 916 plankton tows
		CAN-Q	11	Herring acoustics	
	RT	CAN-G	5,11-12	Bivalve parasite/pathology	7 sites
	RST	CAN-G	5-6, 8-10	Commercial sea sampling (lobster)	120 trips
	S	CAN-Q	9	Acoustics	
	T	CAN-G	1-12 6,9,11	Phyto- and zooplankton east PEI	100 sites/mo 67 other sites
		CAN-G	1-2	Sampling of smelt bycatch in Miramichi estuary	27
		CAN-G	4-6	Crab sea-sampling aboard commercial fishing vessels (NB, Quebec & PEI)	1121
		CAN-G	5-6	Sampling of gaspereau fishery in Miramichi River	20
		CAN-G	5-6	Sampling of gaspereau fishery in Margaree River	50
		CAN-G	5-6, 7-10	Crab sea-sampling aboard commercial fishing vessels (NS)	202 98
		CAN-G	5-8	Monthly research sampling in Miramichi estuary	127
		CAN-G	5-12	Monthly trawl survey on snow crab population characteristics (Baie des Chaleurs)	78
		CAN-G	6-7	Crab trap survey for catchability & selectivity study (Baie des Chaleurs)	40 traps
		CAN-Q	7	Mackerel eggs	138
		CAN-G	7-8	Inshore sampling of juvenile herring	42
		CAN-G	7-8	Inshore sampling of juvenile hake	103
		CAN-G	7-8	Lobster monitoring of biological characteristics by trawling	75
		CAN-G	7,10	Bottom trawl in Miramichi estuary	58
		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	122
		CAN-G	12	Juvenile herring	40
		CAN-G	12-3	Sampling of juvenile herring bycatch in smelt fishery in Restigouche River	5
	VsN	CAN-SF	1	Herring acoustics	n/a
		CAN-SF	10	Sealworm inventory	50
		CAN-SF	12	Herring acoustics	n/a
	VWX	CAN-SF	4	Gear trials	32
		CAN-SF	8	Gear trials	23
	X	CAN-SF	7,8	Herring acoustics	n/a
		CAN-SF	9	Herring acoustics	n/a
		CAN-SF	10,11	Herring larvae	160
4+5	XZe	CAN-SF	9,10	Ghost net survey	n/a
	XZ	CAN-SF	11	Zooplankton	10
		CAN-SF	8-10	Swordfish, tuna tagging	n/a
5	Z	CAN-SF	10,11	Herring larvae & acoustics	97

Table 2. Biological surveys planned for the NAFO Area in 1992 and early 1993.

Country	Area	Type of Survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1992	
CAN-G	4T	Bottom trawl survey for crab biomass estimation (NB, NS, Quebec & PEI)	Jun-Aug
		Juvenile cod	Jul
		Groundfish abundance	Sep
		Comparitive trawl	Sep
		Juvenile herring	Dec
	4TVn	Herring acoustic	Oct
CAN-N	2J+3KL	Groundfish survey	28 Oct-16 Dec
	3L	Crab	01-12 Jun
			03-18 Aug
			28 Sep-09 Oct
			02-13 Nov
	3LNO	Groundfish survey	21 Apr-03 Jun
			17 Aug-24 Sep
			19 Oct-14 Dec
	3Ps	Scallops	24 Aug-04 Sep
	3P+4V	Redfish	05-22 Aug
CAN-Q	3Pn+4RST	Groundfish survey	10-30 Jan
	4RST	Redfish - shrimp	20 Aug-17 Sep
	4R	Shrimp larvae	01-09 May
		Growth crab	10-21 May
		Scallop assessment	02-26 Jul
		Scallop Assessment	28 Aug-08 Sep
	4T	Rock crab survey	20 Apr-15 May
		Crab mortality	27 Apr-09 May
		Crab selectivity	12 Jun-22 Jun
		Crab recruitment	25 Jul-07 Aug
CAN-SP	4VsW	Groundfish	01-12 Mar
	4VWX	Scallop survey	06-22 May
	4VWX+5Zw	Groundfish	22 Jun-17 Jul
	5Z	Groundfish	08-26 Feb
		Scallop survey	11 Aug-04 Sep
GRL	0B+	Shrimp, bottom trawl, hydrography	15 Jul-21 Aug
	1ABCDE		
	1ABCD	G. halibut, grenadier bottom trawl	10 Aug-11 Sep
	1CD	G. halibut, grenadier bottom trawl	24 Nov-10 Dec
	1EF	Bottom trawl, fish	25 Aug-10 Sep
E/FRG	1BCDEF	Groundfish survey on cod	17 Oct-30 Nov
E/ESP	3M	Groundfish survey	Jul
FRA-SP	3P	Bottom trawl	17 Feb-25 Mar
JPN	1A-D	Bottom trawl survey on G. halibut	Aug- Sep
	1CD	Bottom trawl survey on G. halibut	Nov- Dec
SUN	4VWX	Juvenile silver hake	Oct-Dec
		OTHER SURVEYS - 1992	
CAN-G	4R	Crab trap, plankton, diving (SCUBA) and trawl survey (Bonne Bay, Nfld.)	Apr-Sep
	4RST	Commercial sea sampling (lobster)	May-Jun Aug-Oct
	4ST	Stimpson clam survey	Apr-Nov
	4T	Sampling of juvenile herring by-catch in fishery in Restigouche River	Jan-Mar
		Bottom- and midwater-trawl survey in Chaleur Bay to to monitor juvenile herring	Apr
		Crab sea sampling aboard commercial fishing vessels (NB, Quebec, PEI)	Apr-Jun
		Crab sea sampling aboard commercial fishing vessels (NS)	Apr-Jun Jul-Nov
		Crab trap survey for catch-ability and Selectivity study (Baie des Chaleurs)	Apr-Jul
		Monthly trawl survey on snow crab population charac-teristics (Baie des Chaleurs)	Apr-Nov
		Bottom trawling in Miramichi estuary	May
		Sampling of gaspereau fishery in Miramichi River	May-Jun
		Sampling of gaspereau fishery in Margaree River	May-Jun
		Monthly research sampling of ichthyo- and zooplankton in Miramichi estuary	May-Oct
		Bimonthly research sampling of salmonids in Morrell estuary	May-Oct
		Monthly research sampling in Miramichi estuary	May-Nov
		Bivalve parasite/pathology	May-Dec
		Phytoplankton dynamics, research surveys and inshore sampling (east PEI and Georges Bay)	Jun,Aug, and monthly
		Lobster monitoring of biological characteristics by tagging	Jul
		Inshore sampling of juvenile hake	Jul-Aug
		Inshore sampling of juvenile herring at night	Jul-Sep
		Study of dietary ration of flounder on Fisherman's Bank	Aug
		Lobster monitoring of biological characteristics by trawling	Aug
		Distribution and aggregative responses of winter flounder relative to herring spawn	Aug-Sep
		Herring spawning bed survey	Aug-Sep
		Distribution of benthic fish, Miramichi estuary	Sep
		Snow crab tagging study	Sep
		Tagging of juvenile hake in Miramichi estuary	Oct
		Biweekly sampling of bycatch in commercial smelt fishery in Miramichi estuary	Nov-Mar '93

Country	Area	Type of Survey	Dates
CAN-N	2J+3K	Shrimp	15 Jul-03 Aug
		Capelin acoustics	25 Sep-26 Oct
	2J+3KL	Plankton	14-26 Jun
		Cod acoustics	28 Jun-20 Jul
		Oceanography-acoustic profiling	02-24 Jul
		Cod/capelin plankton	12 Oct-02 Nov
	3KL	Ichthyoplankton	18 Apr-04 May
			06-20 May
			27 May-12 Jun
		Oceanography	15-31 May
			12-19 Sep
			13-30 Oct
		Capelin tagging	15 Jun-03 Jul
		Cod tagging	15 Jun-09 Jul
		Cod acoustics	28 May-20 Jun
		Oceanography-acoustic profiling	01-11 Jun
		Gear trials	06-13 Jul
		Oceanography	21-29 Jul
		Herring acoustics	02 Nov-18 Dec
		Demersal juvenile cod	11 Nov-03 Dec
	3L	Crab	10-16 Apr
			20 Aug-04 Sep
			07-21 Sep
		Oceanography	13-14 Apr
			22-28 May
			08-12 Jun
			06-08 Jul
			13-15 Jul
			20-24 Jul
			27-29 Jul
			27 Jul-07 Aug
			24-28 Aug
			31 Aug-09 Sep
			21-25 Sep
			19-23 Oct
			16-20 Nov
			14-18 Dec
		NCSP trawl impact	19 May-03 Jun
		Capelin acoustics	01-26 May
		Cod acoustics	22-26 May
		Gear trials	20-25 Jul
	3LNO	Juvenile flatfish	05-14 Jun
	3NO	Capelin acoustics	22 Jun-04 Jul
	3Ps	Capelin tagging	20 May-03 Jun
CAN-Q	4R	Cod migration	09-30 May
		Plankton - cod	16-29 Jul
		Herring acoustics	14-29 Nov
		Acoustics	08-18 Aug
	4T	Mackerel acoustics	27 May-07 Jun
		Experimental Crab	01 Jun-03 Jul
		Mackerel eggs	17-28 Jun
CAN-SP	4VsW	Herring acoustics	07-19 Dec
	4VWX	Observer training	01-06 Feb
	4W	Sealworm	04-09 Jun
	4WX+5Z	Zooplankton	19-25 Jan
	4X+5Z	Tuna tagging	04-09 Aug
			08-23 Sep
		Herring larvae	22 Oct-10 Nov
	5Z	Scallop larvae	23 Sep-10 Oct
		Herring larvae/adults	04-17 Nov
		Groundfish acoustics and trawling	18-31 Mar
GRL	1A	Polar bear, tagging	28 Apr-27 May
		Snowcrab, pots	29 May-19 Jun
		Narwhale, tagging	10 Aug-15 Sep
	1ABC	Trawl gear selection studies	1-15 Jul
	1ABCDEF	Minke and fin whale aerial study	21 Jul-21 Aug
	1B	White whale, sampling	1-15 May
	1BCD	Harp seal, sampling	10-28 Aug
	1BDF	Young cod, gillnet	22 Jun-17 Jul
	1CDE	Large cetacean, photo-id and biopsy sampling	21 Jul-07 Aug
	1E	A. plaice, longline	18-28 May
JPN	1A-D	Midwater trawl survey on G. halibut	Aug-Sep
		SURVEYS PLANNED FOR EARLY 1993	
CAN-N	2HJ+3KLNO	Cod tagging	05-28 Jan
	3KL	Cod tagging	27 Jan-05 Feb
	3L	Oceanography	11-15 Jan
		Herring acoustics	18-25 Jan
		Oceanography	15-19 Jan
			15-19 Mar
	3Ps	Groundfish (stratified)	05-25 Feb
CAN-Q	3Pn+4RST	Groundfish (stratified)	10-30 Jan
CAN-SP	4VsW	Herring acoustics	04-16 Jan

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

Chairman: H. Lassen Rapporteur: A. Vazquez

The Committee met at NAFO Headquarters at 192 Wyse Road, Dartmouth, Nova Scotia, Canada on 8 and 12 June, 1992. In attendance were H. Lassen (EEC) (Chairman), J.E. Carscadden (Canada), P. Kanneworff (Denmark/Greenland), V.A. Rikhter (Russia), M. Stein (EEC), A. Vazquez (EEC) and the Assistant Executive Secretary (T. Amaratunga).

1. Review of STACPUB Membership

There were no changes in membership since the last meeting.

2. Review of Scientific Publications Since June 1991

a) Journal of Northwest Atlantic Fishery Science

STACPUB noted Volume 12, containing 7 papers, 1 obituary and 3 notices (83 pages) was published as planned with the publication date of January 1992.

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 Mike Fogarty as convener, was still in preparation.

The next regular issue of the Journal (to be numbered subject to the progress of the above Special Session issue) had to date 5 papers which had been processed for galley preparation. It was hoped that publication would be possible by late 1992 when 2 or 3 more papers become available from the Associate Editors.

Ten papers from the Canadian - USSR bilateral scientific meeting on "Capelin in the Northwest Atlantic" held in St. John's in November 1990 had been submitted and reviews had been sent back to the authors for revisions of the papers. These papers will be considered for a special issue of the Journal with J. Carscadden as editor.

b) NAFO Scientific Council Studies

Studies Number 15, containing 7 papers and 3 notices (67 pages) was published May 1991.

Studies 16, containing 17 papers and 5 abstracts of 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 and 2 notices (189 pages) was published November 1991.

Seventeen of the 24 papers, presented at the Cod Symposium entitled "Changes in Abundance and Biology of Cod and Their Possible Causes" held 4-6 September 1991, had been received and were in various stages of preparation for the next issue of Studies. Publication of this issue was expected to be complete in late-1992/early-1993.

The next regular issue of Studies containing miscellaneous papers (to be numbered subject to the progress of the above Cod Symposium issue) had to date 5 papers in various stages of preparation. The issue will be finalized when about 2 more papers were submitted.

c) NAFO Statistical Bulletin

Despite the 30 June 1990 deadline for the submission of STATLANT 21B reports for 1989, as of April 1992, data were still outstanding from 4 countries or components. These data were long overdue and publication of *NAFO Statistical Bulletin* (Vol. 39) had been significantly delayed.

As of May 1992, STATLANT 21B reports for 1990 were still outstanding from 7 countries or components. The delay in the acquisition of final data will

again have impact on the timely publication of *NAFO Statistical Bulletin* (Vol. 40).

d) NAFO Scientific Council Reports

The volume (163 pages) containing reports of the 1991 meetings of the Scientific Council in June and September was published and distributed as planned in December 1991.

STACPUB discussed possibilities of making the NAFO publications more eye-catching. As one such element, as practised by many organizations, STACPUB recommended that *from now on, a photograph of participants at the June Meeting be included in one of the leading pages of the Scientific Council Reports.*

e) List of Fishing Vessels

The triennial publication of the *List of Fishing Vessels* for 1989 was published in January 1992 soon after the data became available to the Secretariat.

f) Inventory of Sampling Data, 1985-89

The final submissions from Contracting Parties for the *Inventory of Sampling Data* of 1985-89 were received in April 1992. Compilation for the publication were near completion and was due to be issued by late-1992.

g) Index and Lists of Titles

The provisional index and lists of titles of 125 research documents (SCR Doc.) and 21 summary documents (SCS Doc.) which were presented at the Scientific Council meetings during 1991 were compiled and presented in SCS Doc. 92/4 (22 pages).

3. Production Cost and Revenues for Scientific Council Publications

Production cost and the 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.

4. Promotion and Distribution of Scientific Publications

a) Publicity and Response Regarding the Journal

STACPUB noted there had been a noticeable reduction in the free distribution of NAFO publications as a result of a complete review of the mailing list by the Executive Secretary and the Assistant Executive Secretary. The subscription list, however, remained about the same.

STACPUB discussed possibilities of making the NAFO scientific publications more widely known. It was noted that there are certain journals which address scientific subjects as required by libraries and that it is possible to advertise in such publications. STACPUB believed that the name of the Journal was considered quite restrictive as it gave the impression of only accepting papers dealing with the Northwest Atlantic and only with fisheries. STACPUB recognized that this matter needed further consideration. In the interim STACPUB agreed one possible route to promote NAFO scientific publications was to send pamphlets describing the scientific scope of the Journal and Studies to as many relevant laboratories and libraries as possible. However, in order to have the best benefit it was evident that such a direct mail should be coordinated with for example a change of the name of the Journal. Also display of the NAFO publications at symposias and other major meetings of marine scientists should be considered.

b) Invitational Papers for the Journal

STACPUB was informed that 11 papers on West Greenland cod stock were under preparation to be considered for a special issue of the Journal including an invitational paper by Sv. Aa. Horsted. Two of these have already been

submitted for review, some others have been presented as SCR Doc., but the balance of the 11 papers are not expected to be submitted before early 1993.

The Assistant Executive Secretary was asked to extend his appreciation to STACPUB by M.D. Grosslein (USA) for the invitation to prepare a special paper and that he will submit a proposed title and theme after some consideration.

The NAFO secretariat was recently visited by the head of the Russian delegation, Dr. V. K. Zilanov. The Executive Secretary and the Assistant Executive Secretary were informed that there are many scientific papers in various Russian research institutes that could now be considered for submission to NAFO for publication. The Assistant Executive Secretary was hopeful that they would be submitted in the near future.

5. Editorial Matters Regarding Scientific Publications

a) Editorial Activities

At its meetings since 1980, STACPUB had nominated a total of 391 research documents as potential for publication in the NAFO Journal or Studies. This included 20 documents nominated at the June 1991 Meeting and 24 documents at the September 1991 Meeting.

Of the 20 paper nominated at the June 1991 Meeting, 5 papers had been submitted.

Of the 24 papers presented at the September 1991 Cod Symposium, 17 were submitted on schedule (leaving only 7 with unknown status).

In addition, 7 papers from outside of the STACPUB nomination process were submitted since June 1991.

STACPUB noted a total of 46 papers were published or were in their final stages of preparation (19 in the Journal and 27 in Studies) since June 1991.

In addition a total of 26 papers were currently in various stages of editorial review for the Journal.

All papers submitted for Studies were in their final stages of preparation. STACPUB noted that the editorial process for some papers had been ongoing for a very long time and considered that most of these papers will now be of little interest. STACPUB recommended that *the appointed Associate Editors for papers for which no response had been received from the authors after 31 December 1991 inform the authors that these papers will no longer be considered for publication unless the requested revisions are forthcoming within a month.*

Further to the concerns expressed at the 3-6 March 1992 meeting, STACPUB was pleased to note that most reviews on papers from the 1989 Special Session had now been received at the Secretariat. While some editorial work was needed from the Editorial Board on 3 papers, STACPUB was hopeful that the publication of the Journal issue would be accomplished by the end of 1992.

b) Review of the Editorial Board

Sv. Aa. Horsted joined the Editorial Board since the last STACPUB meeting and the committee welcomed him in his new capacity as Associate Editor for Vertebrate Fisheries Biology.

STACPUB also welcomed R. K. Misra in undertaking the new role as Associate Editor for Biomathematics in the Editorial Board.

6. Papers for Possible Publication

a) Review of Proposals Resulting from the 1991 Meeting

STACPUB was pleased that submission from the nominations made in 1991 had been good.

b) Review of Contributions to the 1992 Meeting

In total, 85 Research Documents and 22 Summary Documents presented to date to the Scientific Council were considered by STACPUB, and STACPUB nominated SCR Doc. 92/14 and 15 combined with 91/121 and 125, 92/19, 26, 33, 42, 54, and 74 be considered for the Journal and SCR Doc. 92/10, 20 combined with 63, 21, 41, 52, 55, 67 and 73 for consideration for Studies.

7. Microfiche Projects

STACPUB was informed that a total of 15 microfiche sets of ICNAF documents were sold until now, two of them in 1991.

On previous occasions STACPUB had considered making the NAFO documents since 1980 available in a similar form. The microfiche technique for scientific documentation was now considered obsolete by STACPUB, and among the systems available, the compact disk (CD) storage was thought to be one of the most attractive. The Assistant Executive Secretary as requested at last year's meeting had inquired into this technology. He informed STACPUB that none of the regional libraries (Department of Fisheries & Oceans and Universities) were currently using it. The price indications he had obtained showed that the equipment were still quite costly. However, he noted that the recent acquisitions in the computer system which included a scanner have provided the Secretariat with the capability of storing research documents on computer diskettes. Since at present only specific documents tend to be requested by readers, the Secretariat now has the capability to transmit them in that medium.

8. Other Matters

STACPUB recommended that *the revised station locations of the Standard Oceanographic Sections in the Northwest Atlantic (SCR Doc. 88/01) be printed with a hard cover and circulated to national institutes*, in view of the considerable importance of these data to scientists planning research surveys. STACPUB suggested that this publication could be made similar to the one circulated in 1978.

There being no further business, the Chairman thanked the members for their very constructive input to the meeting and adjourned the meeting.

APPENDIX IV. AGENDA FOR SCIENTIFIC COUNCIL MEETING, 3-17 JUNE 1992

NAFO Headquarters, Dartmouth, Nova Scotia,Canada

I. Opening (Chairman: V. P. Serebryakov)

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 1991

2. Stock assessments

a) Review of assessment methods to be used.

b) 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)
- Redfish (Div. 3LN; Div. 3M)
- American plaice (Div. 3LNO; Div. 3M)
- Witch flounder (Div. 3NO)
- Yellowtail flounder (Div. 3LNO)
- Capelin (Div. 3NO)
- Squid (Subareas 3 and 4)
- [Note also Annex 1, Item 3 concerning cod in Div. 2J+3KL, Item 4 concerning juvenile flatfishes in the NAFO area, Item 5 concerning cod in Div. 3M, Item 6 concerning redfish in Div. 3M, Item 7 concerning squid in SA 3 and 4, Item 8 concerning capelin in Div. 3NO and Item 10 concerning a minimum fish size for cod in the different parts of the Regulatory Area]

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

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

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

- Redfish (Subarea 1) (if possible, by species)
- Northern shrimp (in Denmark Strait and off East Greenland)
- Other finfish and invertebrates (Subarea 1)

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

- Greenland halibut (Subareas 0 and 1)
- Roundnose grenadier (Subareas 0 and 1)
- Northern shrimp (Subareas 0 and 1)

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

a) Chairman's report
b) Marine Environmental Data Service (MEDS) Report for 1991
c) Review of environmental studies in 1991
d) Overview of environmental conditions in 1991
e) National representatives
f) Invited lecture on Labrador Sea/Davis Strait research (tentatively)
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
   c) Review of a standard 130 mm mesh size for otter trawling in the Regulatory Area (see Item 9, Annex 1)

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
   b) Progress report on the 8-10 September 1992 Special Session on "State-of-the-Art in Fish Stock Assessment: a Tutorial/Workshop on Calibration Methods and Their Practical Use" (co-coveners R. K. Mohn, Canada and R. Cook, EEC)
   c) Consideration of a topic for a Special Session in 1993
   d) Theme for the 1994 Special Session
   e) Other business

III. Research Coordination (STACREC Chairman: A. de Melo)

1. Fishery Statistics

   a) Progress report on Secretariat activities in 1991/92

      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 1991/92
   b) Forms and deadlines for submission of data
   c) Review of national sampling programs for the second half of 1992, and 1993

3. Biological Surveys

   a) Review of survey activities in 1991
   b) Survey plans for 1992 and 1993, and their use in 1993 assessments
   c) Review of stratification scheme
   d) Coordination of surveys in 1992-93

4. Other Matters

   a) List of fishing vessels for 1989
   b) Tagging activities reported for 1991
   c) Review of relevant SCR and SCS documents not considered in items 1 to 3 above
   d) Other business

IV. Publications (STACPUB Chairman: H. Lassen)

1. Review of STACPUB membership

2. Review of scientific publications since June 1991

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

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 1991 meetings
   b) Review of contributions to the 1992 meetings

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 Procedure

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, 1992 and 1993

IX. Nomination and election of Chairman of the Standing Committee on Fishery Science.

X. Other Matters

XI. Adoption of Reports

1. Committee reports from this meeting (STACFIS, STACREC, STACPUB)
2. Scientific Council Report, June 1992 (receipt and adoption)

XII. Adjournment

ANNEX 1. FISHERIES COMMISSION REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1993 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 1992 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 1993:

   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 1993 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 1993 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 1993 over a range of fishing mortality rates (F) at least from $F_{0.1}$ to Fmax.
         - a graph showing spawning stock biomass at 1.1.1994 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. The Scientific Council should analyze the various technical measures which could permit the elimination of massive catches of juvenile flatfishes in the NAFO area. This should cover

the implementation of minimum legal sizes and the introduction of a single basic mesh size. Special attention should be paid to multispecies analyses and especially technical interactions.

5. With respect to cod in Div. 3M, the Scientific Council is requested to provide advice on means of improving the utilization (yield-per-recruit) of the resource.

6. With respect to redfish in Div. 3M, the Scientific Council is requested to provide advice on means of reducing the harvest of juvenile fish, including such factors as seasonality of fishing.

7. 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. The Council is asked also to provide information on the distribution throughout the year of the stock and on the factors that determine whether the resource becomes available within the NAFO area.

8. With respect to capelin in Div. 3NO, the Scientific Council is requested to advise on the most rational level of management, 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. Management options such as maintaining minimum spawning biomass, a 10% and a 20% exploitation rate should be evaluated in terms of both maintaining stock size and the impact on the ecosystem.

9. The Scientific Council is asked to review further the question of a standard 130 mm mesh size for otter trawling in the Regulatory Area, and particularly to consider the species for which derogation would be required. The Council is asked to include consideration of area and season in this review, to advise on appropriate mesh sizes for fisheries for which the 130 mm would be too large, to advise on appropriate by catch limits for other species (in aggregate or individually) in fisheries using small mesh sizes and to report on any interactions between the various fisheries.

10. The Scientific Council is asked to consider the question of a minimum fish size for cod in the different parts of the Regulatory Area, both in terms of the current regulation of mesh size in otter trawls and in terms of increasing yield per recruit.

At its Special Meeting of 11-14 May 1992, the Fisheries Commission agreed to forward an additional request for scientific advice from the Scientific Council. The following text was agreed at the meeting:

> "In addition to the request in paragraph 9 of NAFO/FC Doc. 91/10 on a standard 130 mm mesh size, the Scientific Council is asked to evaluate the effect of introducing one uniform mesh size, irrespective of material, thus deleting note 2 in Part V - Schedule IV of the NAFO Conservation and Enforcement Measures."

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1993 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1992 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1993:

   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 1992 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1993 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 and 1991 reports 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 1993 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 1993 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.

B. Rawson
Deputy Minister
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 3. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT OF CERTAIN STOCKS IN 1993

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO in advance of the 1992 Annual Meeting to consider the following stocks occurring in Subarea 1:

   i) Redfish (by species, if possible)
   ii) 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 1993 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 Greenland halibut the biological and practical implications of combining Subareas 0, 1, 2 and Divisions 3KL for stock assessment purposes should be considered.

   For Northern shrimp fisheries in Subareas 0+1 and in the Denmark Strait:

   a) Analysis of the effects on the stocks of actual catches and the magnitude and size distribution of shrimp discards should be continued 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. Also, effects of other possible means to minimize discards should be analyzed;

   c) the by-catch of small finfish (notably redfish and Greenland halibut) in the fisheries for shrimp should be evaluated, and the effect of the by-catch on these fish stocks should be analyzed if data so allow.

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.

Jens Paulsen
Grønlands Hjemmestyre, Erhvervsdirektoratet
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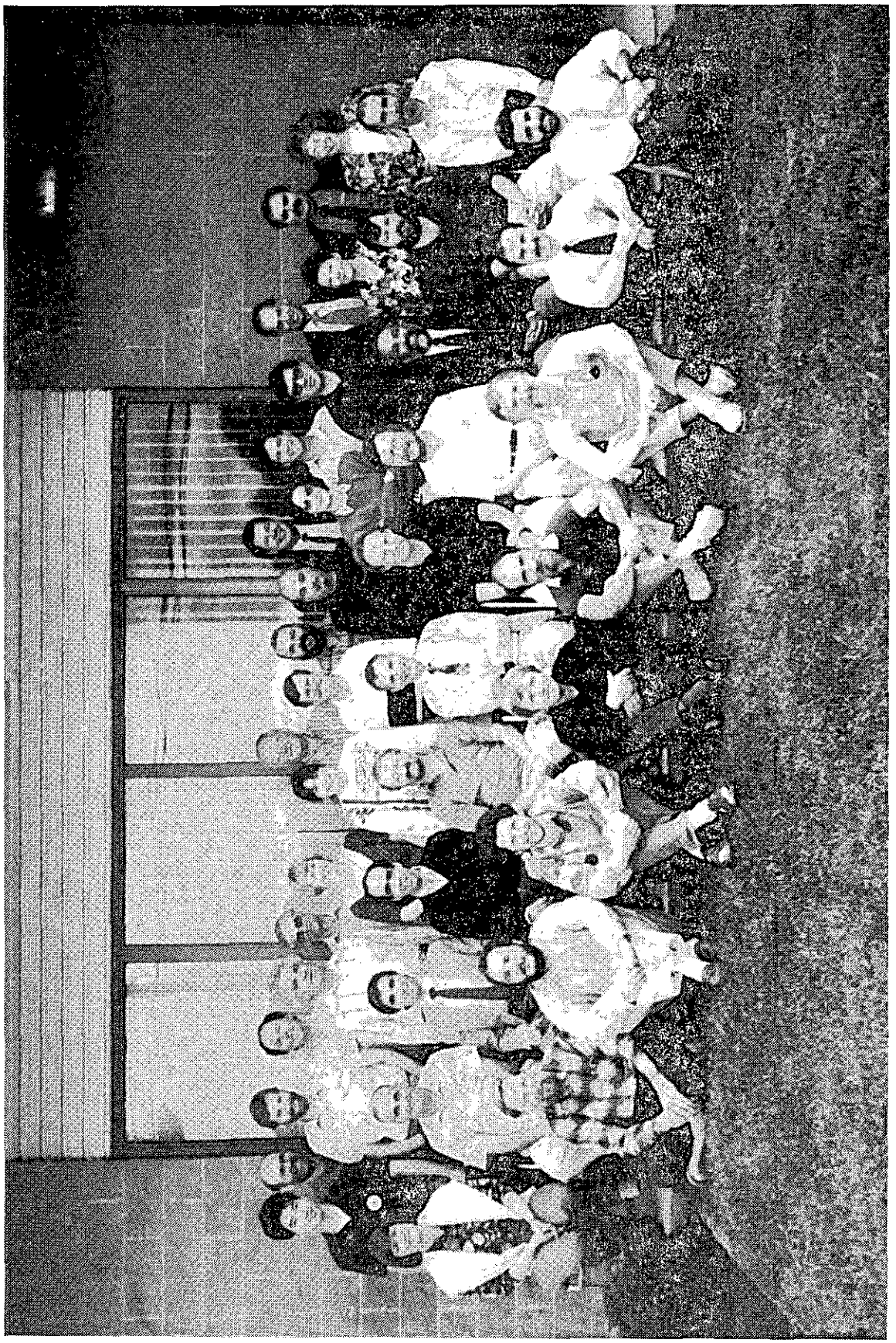

Participants of June 1992 Scientific Council Meeting

APPENDIX V. LIST OF PARTICIPANTS

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APPENDIX VI. LIST OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS (SCR)

SCR #	Ser. #	Author(s) and Title
92/1	N2034	Bakanev, V. S. Results from acoustic capelin surveys in Div. 3LNO and 2J+3KL in 1991.
92/2	N2035	Nakashima, B. S., and B. W. Slaney. Capelin (*Mallotus villosus*) egg deposition on fifteen spawning beaches in Conception Bay, Newfoundland in 1987-91.
92/3	N2036	Nakashima, B. S., and R. W. Harnum. The inshore capelin fishery in NAFO Division 3L in 1991.
92/4	N2037	Shelton, P. A., J. E. Carscadden, and J. M. Hoenig. Estimates of survival rates and risk evaluation of the 10% harvest rate procedure for capelin in NAFO Division 3L.
92/5	N2038	Nakashima, B. S. Results of aerial surveys of capelin (*Mallotus villosus*) schools using the compact airborne spectrographic imager (CASI).
92/6	N2039	Narayanan, S., S. Prinsenberg, and E. B. Colbourne. Overview of environmental conditions in NAFO Divisions 2J+3KL in 1991.
92/7	N2040	Lilly, G. R. Distribution of capelin on Grand Bank (Div. 3LNO) in the springs of 1987 and 1991, as inferred from bottom-trawl by-catches and cod stomachs examinations.
92/8	N2041	Lilly, G. R. By-catches of capelin in Canadian bottom-trawl surveys from northern Labrador to the southern Grand Bank (Div. 2GHJ3KLNO) in autumn 1991.
92/9	N2051	Savvatimsky, P. I. Distribution and biological characteristic of rock grenadier (*Coryphaenoides rupestris*) as shown by trawl surveys in the Northwest Atlantic in 1989-1991.
92/10	N2052	Savvatimsky, P. I. Age structure of *Macrourus berglax* L. in the Northwest Atlantic in 1985.
92/11	N2053	Savvatimsky, P. I., and S. A. Kuzmin. By-catch of cod in research redfish catch on the Flemish Cap Bank in 1988-1991.
92/12	N2054	Vaskov, A. A., and I. A. Oganin. Evaluation of redfish stocks in Divisions 3LN and 3M by the trawl-acoustic survey in 1991.
92/13	N2055	Kuzmin, S. A. Stock assessment of cod from NAFO Subarea 3 by the data from 1991 trawl-acoustic survey.
92/14	N2056	Albikovskaya, L. K., and O. V. Gerasimova. Feeding and trophic relations between cod and capelin of the northeastern Newfoundland (3K) in spring-summer.
92/15	N2057	Gerasimova, O. V., L. K. Albikovskaya, and S. A. Kuzmin. A study of trophic interrelations between cod (*Gadus morhua*) and capelin (*Mallotus villosus*) on the Newfoundland Shelf in spring and summer seasons of 1985-1991.
92/16	N2061	Benway, R. L., J. W. Jossi, and J. Prezioso. Surface and bottom temperatures, and surface salinities: New York to Gulf Stream, Massachusetts to Cape Sable, N.S. 1991.
92/17	N2062	Smedstad, O. M., and S. Torheim. Norwegian investigations on shrimp (*Pandalus borealis*) in East Greenland Waters in 1991).
92/18	N2063	Baird, J. W., C. A. Bishop, W. B. Brodie, and E. F. Murphy. An assessment of cod stock in NAFO Divisions 2J3KL.
92/19	N2064	Stein, M. Variability of climate - impact on cod recruitment off West Greenland.
92/20	N2065	Stein, M. On the consistency of thermal events in the East Greenland/West Greenland current system.
92/21	N2068	Borovkov, V. A., and I. I. Tevs. Oceanographic conditions in NAFO Subareas 0, 2, 3 in 1991.

92/22	N2069	Gorchinsky, K. V., and A. A. Vaskov. Trawl survey results on Greenland stock evaluation in NAFO Div. 0B and 2GH in October/December 1991.
92/23	N2070	Gasiukov, P. S. Status of silver hake stocks in NAFO Divisions 4VWX in 1991 and TAC for 1993.
92/24	N2071	Vazquez, A. Minimum landing size for cod and flatfish in NAFO area corresponding to a cod end mesh size of 120 millimeters.
92/25	N2072	Paz, J., and M. G. Larrañeta. Cod stock-recruitment relationship in NAFO Divisions 3NO.
92/26	N2073	Zamarro, J. The fecundity of American plaice (*Hippoglossoides platessoides*) from the south of the Grand Bank and Flemish Cap.
92/27	N2074	Vazquez, A. Results from bottom trawl survey of Flemish Cap in July 1991.
92/28	N2075	Junquera, S., S. Iglesias, and E. de Cárdenas. Spanish fishery of Greenland halibut (*Reinhardtius hippoglossoides*) in 1990-1991.
92/29	N2076	de Cárdenas, E., and Ph. Moguedet. Preliminary results from EEC cod tagging on Flemish Cap.
92/30	N2077	Cornus, H. P. 1991 assessment of redfishes (*Sebastes marinus* and *Sebastes mentella*) in NAFO Subarea 1.
92/31	N2078	de Cárdenas, E., Ph. Moguedet, and J. A. Pereiro. On the isolation of the cod population in Flemish Cap (Division 3M).
92/32	N2079	Wieland, K. Distribution of 0-group redfish (*Sebastes* spp.) off West Greenland in autumn 1991.
92/33	N2080	Moguedet, Ph. Cod migrations in the Gulf of St. Lawrence and south areas off Newfoundland.
92/34	N2081	Bez, N., and Ph. Moguedet. Comparison of the relative fishing powers of St. Pierre and Miquelon trawlers from 1986 to 1991 in the NAFO Subdivision 3Ps. Limits in the use of a multiplicative model (Robson, 1966).
92/35	N2083	Rikhter, V. A., and V. I. Vinogradov. On relationships between silver hake weight growth and abundance of fishery population of the Nova Scotian Shelf.
92/36	N2084	Sigaev, I. K. Anomalies of water temperatures and water-mass border indices in the Northwest Atlantic in 1990 and 1994.
92/37	N2085	Shcherbich, L. V., A. P. Senina, and Yu. A. Markov. Age determination methods for Nova Scotian hake.
92/38	N2086	Sigaev, I. K., V. A. Rikhter, and V. F. Turok. The results of mackerel (*Scomber scombrus*) study on the Scotian Shelf in June 1990.
92/39	N2087	Rikhter, V. A., and V. F. Turok. Distribution of hake, other fish species and short-finned squid on the Scotian Shelf in 1991, based on data of Soviet observers.
92/40	N2088	Rätz, H-J. Decrease in fish biomass off West Greenland (Subdivisions 1B-1F) continued.
92/41	N2092	Junquera, S., and J. Zamarro. Sexual maturity and spawning of the Greenland halibut (*Reinhardtius hippoglossoides*) from Flemish Pass area.
92/42	N2093	Barsukov, V. B., N. I. Litvinenko, and V. P. Serebryakov. Identification of redfishes (*Sebastes*, Scorpaenidae) in the North Atlantic (some recommendations).
92/43	N2094	Pedersen, S. A., and K. H. Nygård. Survey biomass of fishes in the Disko Bay area West Greenland-September 1991.
92/44	N2095	Pedersen, S. A., and P. Kanneworff. Survey biomass of redfish (*Sebastes* spp.) off West Greenland (NAFO Subarea 0+1), July-August 1988-91.
92/45	N2096	Kanneworff, P., and S. a. Pedersen. Survey biomass of Greenland halibut (*Reinhardtius hippoglossoides*) off West Greenland (NAFO Subareas 0+1), July-August 1988-91.
92/46	N2097	Hassager, T. K., and K. Lehmann. Investigation of sampling bias on length distribution of *Pandalus borealis* when sampling from the hatch.

92/47	N2098	Hassager, T. K. Do length-at-age vary with depth? The Northern Shrimp (*Pandalus borealis*) in Davis Strait (NAFO Division 1B).
92/48	N2100	Yano, K., and O. Jørgensen. Results of two stratified-random bottom trawl surveys at West Greenland in 1991.
92/49	N2101	Skúladóttir, U. The catch statistics of the shrimp fishery (*Pandalus borealis*) in the Denmark Strait in the years 1980-1991.
92/50	N2102	Waldron, D. E., M. A. Showell, and M. C. Bourbonnais. Status of the Scotian Shelf silver hake (whiting) population in 1991 with projections to 1993.
92/51	N2103	Boje, J. An assessment of the Greenland halibut stock component in NAFO Subareas 0+1.
92/52	N2104	Kenchington, T. J., R. G. Halliday, G. D. Harrison. Fishing grounds exploited in 1990 by longliners based in Canada's Scotia-Fundy region.
92/53	N2105	Jørgensen, O. A., and J. Boje. A comparison of the selectivity in trawl and long-line fishery for Greenland halibut.
92/54	N2107	Rønnow, B. Analysis of the catch curves for *Pandalus borealis* in Disko Bay, West Greenland.
92/55	N2108	Carlsson, D. M., P. Kanneworff, and K. H. Nygaard. Report on a stratified-random trawl survey for shrimp (*Pandalus borealis*) in inshore areas at West Greenland, NAFO Subarea 1, in 1991.
92/56	N2109	Carlsson, D. M., and P. Kanneworff. Estimate of shrimp discard from shrimp factory trawlers in Davis Strait and Denmark Strait in 1991.
92/57	N2110	Miller, D. S. Results of an acoustic survey for capelin (*Mallotus villosus*) in NAFO Division 3L in 1992.
92/58	N2111	Parsons, D. G., and P. J. Veitch. Analysis of the fishery data for northern shrimp (*Pandalus borealis*) in Division 0A, 1979-1991.
92/59	N2113	Power, D., and A. A. Vaskov. Abundance and biomass estimates of redfish (*S. mentella*) in Div. 3LN from Russian groundfish surveys from 1984-91.
92/60	N2114	Walsh, S. J. Juvenile flatfish fisheries on the Grand Bank: a discussion of conservation techniques.
92/61	N2115	Brodie, W. B., and S. J. Walsh. An assessment of the yellowtail flounder stock in Divisions 3LNO.
92/62	N2116	Skúladóttir, U. The Icelandic shrimp fishery (*Pandalus borealis*) in the Denmark Strait in 1991 and early-1992.
92/63	N2117	Stein, M. A note on the consistency of hydrographic events off Labrador and off West Greenland.
92/64	N2118	Carlsson, D. M., and P. Kanneworff. The commercial shrimp fishery in Denmark Strait in 1991 and 1992.
92/65	N2119	Carlsson, D. M., and P. Kanneworff. The shrimp fishery in NAFO Subarea I, 1991.
92/66	N2120	Mena, I. Northern pawn (*Pandalus borealis*) stock in Flemish Cap.
92/67	N2121	Carlsson, D. M., and P. Kanneworff. Report of a stratified-random trawl survey for shrimp (*Pandalus borealis*) in NAFO Subareas 0+1 in July-September 1991, and a comparison with earlier surveys.
92/68	N2122	Bishop, C. A., E. F. Murphy, and J. W. Baird. Cod in Divisions 2J+3KL - estimates of biomass and age composition for the portion of the stock in the NAFO Regulatory Area.
92/69	N2123	Keeley, J. R. Marine Environmental Data Service Report for 1991.
92/70	N2124	Ross, C. K. Moored current meter measurements across Davis Strait.
92/71	N2125	Drinkwater, K. F., P. C. Smith, and R. Pettipas. Spatial and temporal scales of temperature variability in the Bay of Fundy.
92/72	N2126	Drinkwater, K. F. AFAP climate studies in the Scotia-Fundy region.
92/73	N2127	Drinkwater, K. F., B. Petrie, and S. Narayanan. Overview of environmental conditions in the Northwest Atlantic in 1991.

92/74	N2129	Myers, R. A., K. Drinkwater, and S. Brown. The influence of salinity on 2J3KL cod recruitment.
92/75	N2130	Baird, J. W., C. A. Bishop, and E. F. Murphy. An assessment of the cod stock in NAFO Div. 3NO.
92/76	N2131	Brodie, W. B., and W. R. Bowering. Results for American plaice from Canadian surveys in Div. 3M, 1978-85.
92/77	N2132	Skúladóttir, U., L. Savard, D. Parsons, D. Carlsson, P. Kanneworff, and H. Siegstad. Assessment of shrimp in Denmark Strait.
92/78	N2133	Walsh, S. J. Distribution and abundance of juvenile and adult American plaice on the Grand Bank, NAFO Divisions 3LNO.
92/79	N2134	Brodie, W. B., J. W. Baird, and J. Morgan. An assessment of the American plaice stock in Div. 3LNO.
92/80	N2135	Power, D. An assessment of redfish in NAFO Divisions 3LN.
92/81	N2136	Brodie, W. B., and J. W. Baird. Data for the assessment of Greenland halibut in Subarea 2 and Divisions 3KLM.
92/82	N2137	Brodie, W. B., J. W. Baird, and D. Power. Analysis of data from deepwater surveys in Divisions 0B, 2GHJ, and 3KLM in 1991.
92/83	N2140	Parsons, D. G., L. Savard, D. M. Carlsson, P. Kanneworff, and H. Siegstad. Assessment of shrimp in Davis Strait Subareas 0+1.

SUMMARY DOCUMENTS (SCS)

SCS #	Ser. #	Title
92/1	N2042	NAFO. Report of Scientific Council, March 1992 Meeting.
92/2	N2043	Rawson, B. Canadian request for scientific advice on management in 1993 of certain stocks in Subareas 0 to 4.
92/3	N2044	Paulsen, Jens. Denmark (Greenland) request for scientific advice on management of certain stocks in 1993.
92/4	N2046	NAFO Secretariat. Provisional index and list of titles of Research and summary documents for 1991.
92/5	N2047	NAFO Secretariat. Historical catches of selected species by stock area and country for the period 1980-90.
92/6	N2048	NAFO Secretariat. Inventory of sampling data, 1985-89.
92/7	N2049	NAFO Secretariat. Notes on statistical activities and publications since June 1991.
92/8	N2050	NAFO Secretariat. Tagging activities reported for the Northwest Atlantic in 1991.
92/9	N2058	Koeller, P., J. S. Loch, M. M. Roberge, J-D. Lambert, and M. Bérubé. Canadian research report for 1991.
92/10	N2060	NAFO Secretariat. Report of the Joint ICES/NAFO Working Group on harp and hooded seals, Copenhagen, 14-18 October 1991.
92/11	N2059	Assistant Executive Secretary. Report to the CWP on NAFO Statistical Program, Publications and ADP.
92/12	N2066	Borovkov, V., S. Kovalev, P. Savvatimsky, V. A. Rikhter, and I. K. Sigaev. Russian research report for 1991.
92/13	N2067	Vazquez, A., G. Perez-Gandaras, J. Paz, J. Zamarro, and S. Junquera. Spanish research report for 1991.
92/14	N2082	Alpoim, R., M. Carneiro, L. Godinho, and A. Avila de Melo. Portuguese research report for 1991.
92/15	N2089	Stern, H., and F. M. Serchuk. United States research report for 1991. (Partial)
92/16	N2090	EC Group. Report of an EC group of experts. An assessment of the stock of cod in NAFO Divisions 2J3KL.

92/17	N2091	Cornus, H. P., P. Ernst, H. J. Rätz, and M. Stein. German research report for 1991.
92/18	N2099	Yokawa, K. Japanese research report for 1991.
92/19	N2106	Siegstad, H. Denmark/Greenland research report for 1991.
92/20	N2112	NAFO. Report of the Special Meeting of Scientific Council, June 1992.
92/21	N2128	REINERT, J. Faroe Islands research report for 1991.
92/22	N2138	NAFO Secretariat. Compilation of research vessel surveys on a stock-by-stock basis.
92/23	N2139	NAFO. Report of Scientific Council, June 1992 Meeting.