ISSN-0250-6416

NORTHWEST ATLANTIC FISHERIES ORGANIZATION

Scientific Council Reports 1986

Dartmouth, Canada
December 1986

PREFACE

This seventh issue of *NAFO Scientific Council Reports* contains the approved reports of three meetings that were held during the calendar year 1986: (A) Scientific Meeting during 14–20 January 1986; (B) Scientific Meeting during 4–19 June 1986; and (C) Annual Meeting during 3–12 September 1986. Part D of this volume contains the agenda, lists of research and summary documents, list of participants, and list of recommendations and proposals relevant to the three meetings.

The *NAFO Scientific Council Reports* series was initiated with the first issue in December 1980. It replaced *ICNAF Redbook* series which terminated with the last issue in 1979.

31 December 1986

V. M. Hodder
Assistant Executive Secretary

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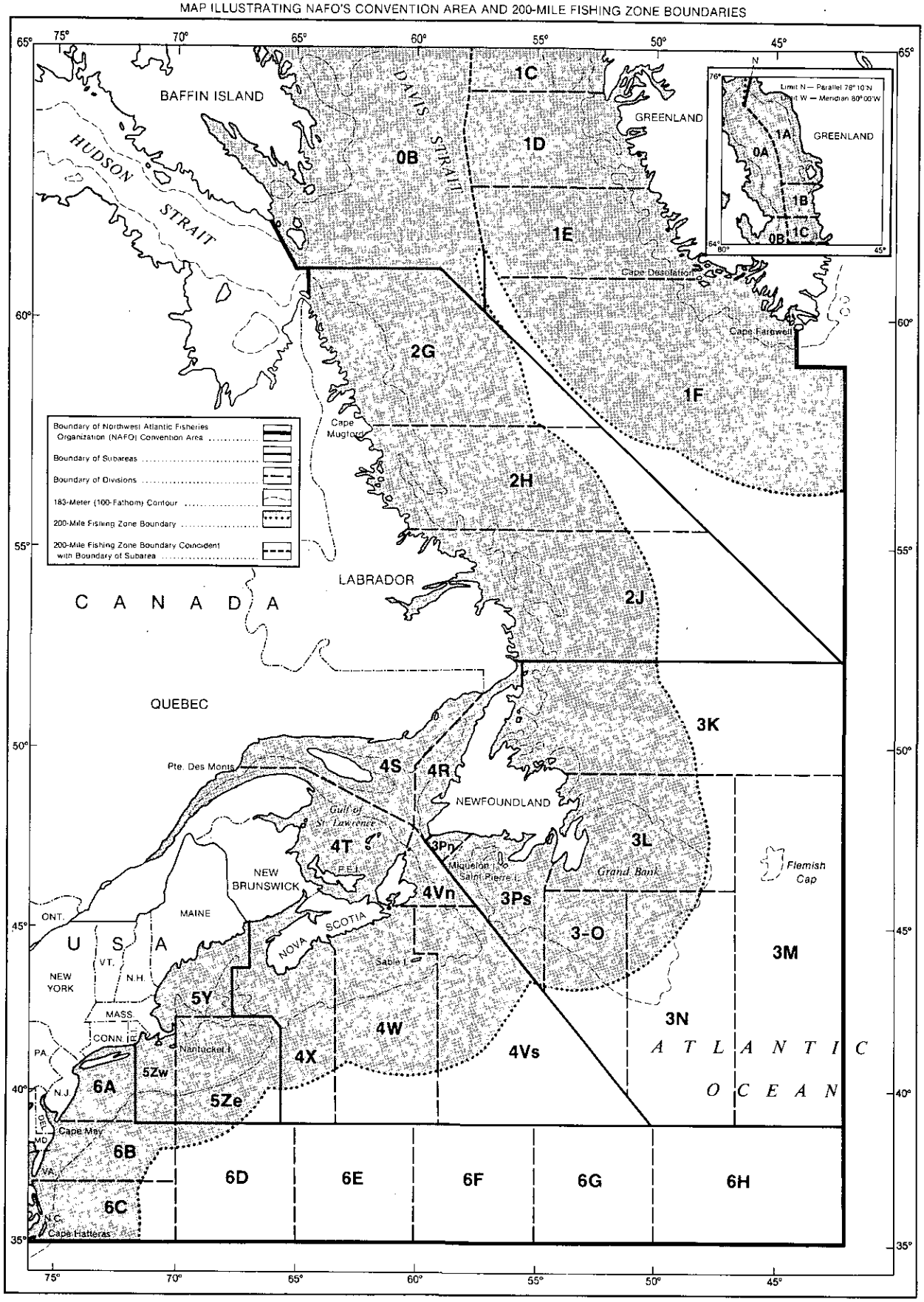

PART A

REPORT OF SCIENTIFIC COUNCIL

January 1986 Meeting

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REPORT OF SCIENTIFIC COUNCIL

January 1986 Meeting

Acting Chairman: J. S. Beckett Rapporteur: R. Noé

The Scientific Council met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 14-20 January 1986, to provide advice on the status of the shrimp stocks in Subareas 0 and 1 and on the scientific basis for their management in 1986 and as many years onward as the data allow for, as requested by Canada and by Denmark on behalf of Greenland, and, at the request of Denmark on behalf of Greenland, to provide advice on status of and management options for the shrimp stock off East Greenland. With reference to a new regulation on discards of small shrimp, the Council addressed specific questions by Denmark on behalf of Greenland.

With respect to the justification for a special meeting in January of each year, the agenda was expanded to include items that were mentioned in the Council's report of its June 1985 Meeting: (i) if quantitative estimates of recruitment are not available for 1986, when can STACFIS expect to have the information on which to base recruitment predication? and (ii) how big a change in assessment parameters, in particular commercial catch rates and photographic survey estimates of stock size, and recruitment estimates if such should be derived, would be required before this would be interpreted as indicating a significant change in stock abundance, and how might advice on the TAC change as a result?

In the absence of the Chairman, the Vice-chairman (J. S. Beckett) acted as Chairman for this meeting. Representatives attended from Canada, Denmark on behalf of Greenland, European Economic Community (EEC), Iceland and Norway.

The stock assessments were undertaken by the Standing Committee on Fishery Science (STACFIS) whose report, as approved by the Scientific Council at this meeting, is at Appendix I. The agenda, the list of relevant documents and the list of participants are given in Part D (this volume). Brief summaries of the stock assessments and other matters considered by the Council are given below.

I. STOCK ASSESSMENTS

1. Assessment of Shrimp Stock in Subareas 0 and 1

In 1979 and 1980, the offshore shrimp fishery in the Davis Strait region was regulated by an overall TAC (total allowable catch) of 29,500 tons with nominal catches of 27,000 and 37,000 tons in the respective years (Table 1). The same TAC was advised for 1981 to 1984, but the coastal states involved set respective TACs of 35,000, 34,800, 34,625 and 34,925 tons. The Council advised a TAC of 36,000 tons for 1985, but the coastal states implemented a combined TAC of 42,120 tons. Provisional satistics for 1985 indicate an offshore catch of 47,000 tons, the highest annual catch since the beginning of the fishery. This nominal catch, however, includes 4,300 tons of shrimp in a trial fishery by Greenland vessels north of 70°52'N, which was considered to be outside the fishing area for which advice on TAC has previously been given. The 1985 fishery was not hampered by ice as it had been during the 1982-84 period, and the fishing grounds were open to the fishery at the beginning of the year. Greenland vessels, which comprise the largest component of this fishery, fished Div. 1B, 1C and 1D throughout the year, with more effort being expanded in these areas than in earlier years. The fishing grounds north and west of Store Hellefiske Bank in Div. 1A and 1B were also exploited by Greenland vessels as early as April-May 1985.

Table 1. Nominal catches (metric tons) of shrimp in Subarea 0 and the offshore grounds in Subarea 1 in 1976-85 with advised and effective TACs for 1977-85.

	1976	1977	1978	1979	1980	1981	1982	1983	1984[1]	1985[1]
Catch	42,766	34,300	26,869	27,087	36,652	37,300	36,827	39,267	36,765	46,961[5]
Advised TAC	-	40,000	40,000	29,500	29,500	29,500	29,500	29,500	29,500	36,000
Effective TAC[2]	-	36,000	40,000	29,500	29,500	35,000[3]	34,800[3]	34,625[3]	34,925[3]	42,120[4]

[1] Provisional data.
[2] Total of Canada and EEC TACs.
[3] Includes TAC of 5,000 tons for Subarea 0.
[4] Includes TAC of 6,120 tons for Subarea 0.
[5] Includes 4,349 tons taken in trial fishery north of 70°52'N.

All available biological information on length distribution and sexual components of the catches, as well as trends in commercial catch rates and indices of abundance from photographic surveys, were examined before advising on management of the shrimp resources in 1986.

A decline in abundance was observed during the 1976-78 period, followed by a general upward trend in overall catch rates during 1979-82. Since that time, both catch rates and abundance indices from surveys have shown relative stability. It is believed, however, that these recent catch rates could be biased upwards due to possible influence of improved trawl designs since 1980 as well as the effect of possible influences of unfavourable ice conditions in the early months of 1982-84. Although the effects of these factors cannot be quantified, it is possible that they could account for the observed increase and subsequent stability since 1979.

A TAC of 40,000 tons was advised for 1977 and 1978. The advised TAC for 1979 was reduced by about 26% to 29,500 tons in recognition of the decrease in abundance from 1976 to 1978. Since 1979, an increase in the TAC was not advised because of interpretation of the catch-rate series and because of concerns about recruitment prospects for the stock. Despite continuing uncertainties about recruitment, catch rates have not decreased. Because of the apparent stability of the stock and the fact that higher-than-advised yields have been realized during this period of stability, the Council advised at its January 1985 Meeting that the overall TAC for the offshore grounds of Subarea 1 and adjacent parts of Subarea 0 in 1985 should not exceed 36,000 tons, which corresponds to the average catch during 1979-84. This stability is again apparent in the 1985 catch rates and survey data, subject to the uncertainties about bias in the commercial catch rates. Because of this apparent stability and despite the high catch in 1985, the Council advises that the overall TAC for the offshore grounds of Subarea 1 and Subareas 0 in 1986 should be set at the same level as advised for 1985 (i.e. 36,000 tons).

The response of specific questions by Denmark (on behalf of Greenland), regarding a regulation on discarding of small shrimp, is given in Section 1(d) of Appendix I. The need for more detailed data is emphasized.

2. Assessment of Shrimp Stock in Denmark Strait

The shrimp fishery in this area expanded rapidly from 1978 to 1980. The total catch on both sides of the midline between Greenland and Iceland declined sharply from about 8,300 tons in 1980 (Table 2) to 4,800 tons in 1981, when the fishery in the area west of the midline was regulated by a TAC of 8,000 tons, set by the EEC. TACs of 4,500, 5,725 and 5,245 tons were set by the EEC for 1982, 1983 and 1984 respectively. Catches in Denmark Strait in these years were 4,900, 4,200 and 6,700 tons respectively. Catches in 1985 totalled 7,500 tons while the effective TAC was set at 6,090 tons.

Table 2. Nominal catches (metric tons) of shrimp in Denmark Strait in 1978-85, with advised and effective TACs for 1981-85.

	1978	1979	1980	1981	1982	1983	1984	1985
Catch	363	1,285	8,260	4,792	4,902	4,175	6,731[1]	7,539[1]
Advised TAC	-	-	-	-	4,200	4,200	4,200	5,000
Effective TAC[2]	-	-	-	8,000	4,500	5,725	5,245	6,090

[1] Provisional data.
[2] Pertains to western side of the midline.

As in 1984, the 1985 fishery took place in the area of Strede and Dohrn Banks and on the slopes of Storfjord Dyb. Due to favourable ice conditions in area, the fishery was more widespread in 1985 than in previous years. The main fishing areas in 1985 extended from 65°30'N to 66°30'N and around 30°W. According to catch-per-unit-effort data for the March-May period, catch rates declined during 1978-80 and have remained relatively stable since then to 1985. It was noted that the stock has sustained catches averaging 6,000 tons annually since 1980, without any apparent decline in the commercial catch rate or any decrease in the size range of shrimp. These observations imply the following scenarios: (i) the fishery began at a time when the stock was expanding and average catches since 1980 have approximated the surplus production, implying a TAC for 1986 of 6,000 tons; and (ii) the stock was at a maximum equilibrium level in the late 1970's and accumulated catches since then have not had a significant impact on stock abundance, implying that a catch level of 6,000 tons in 1986 is conservative. Due to uncertainties in the catch rate data, however, the Council is unable to advice which of the scenarios is more appropriate.

II. OTHER MATTERS

1. Review of Future Meeting Arrangements

The Scientific Council considered that a midterm meeting to assess shrimp is appropriate, at least until quantitative recruitment estimates are available. An assessment in June would utilize data which were a year older than an assessment in the following January, and any adjustments to the TAC to take into account sudden changes in abundance, as has been observed elsewhere for other shrimp stocks, would only be possible 2 years after the changes. Furthermore, since data from the fishery in July-September are important, it is not appropriate to assess the stock until January.

The Council noted that the work of STACFIS would be facilitiated by meeting at a site where the data-base is accessible.

III. ADJOURNMENT

The Acting Chairman on behalf of the Council expressed thanks to the Chairman and members of STACFIS for their hard work and noted, in particular, the excellent assistance and support of the NAFO Secretariat. The meeting adjourned at 1610 hr on 18 January 1986.

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

Chairman: W. R. Bowering Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 14-18 January 1986 to review the status of the shrimp stock in Subareas 0 and 1, as referred to it by the Scientific Council, based on the requests of Canada and Denmark (Greenland). Also, at the request of Denmark (Greenland), the Committee reviewed the status of the shrimp stock in Denmark Strait (see Part D, this volume, for agenda). The Committee addressed specific questions with respect to the necessity of future midterm meetings for shrimp, as requested by the Scientific Council in June 1985 (NAFO Sci. Coun. Rep., 1985, pages 35 and 80). Scientists attended from Canada, Denmark (Greenland), EEC, Iceland and Norway.

I. ASSESSMENT OF SHRIMP STOCKS

1. Assessment of Shrimp in Davis Strait (Subareas 0 and 1)

a) Fishery trends (SCR Doc. 86/4, 7, 10)

The nominal catch of shrimp in the offshore areas of Subareas 0 and 1 increased from less than 1,000 tons before 1972 to almost 43,000 tons in 1976, decreased to 27,000 tons in 1978 and 1979 and increased to about 38,000 tons annually in 1981-84 (Table 1). Preliminary statistics for 1985 indicate a total catch of about 47,000 tons, which is the highest catch since the fishery began. However, the catch by Greenland offshore vessels in Subarea 1 in 1985 includes a shrimp catch of 4,349 tons which was taken in a trial fishery north of 70°52'N and which was considered to be outside the fishing area for which advice on TAC has been given previously. The West Greenland inshore fishery has been relatively stable with estimated catches of 7,000-8,000 tons annually since 1972 (except 10,000 tons in 1974).

The offshore fishery has been regulated by TAC since 1977. Advised TACs by the Scientific Council were 40,000 tons for 1977 and 1978, 29,500 tons annually for the 1979-84 period, and 36,000 tons for 1985. Both effective TACs and nominal catches were below or at the advised

Table 1. Nominal catches and TACs (metric tons) of shrimp (Pandalus borealis) in Subarea 0 and 1, 1976-85.

		1976	1977	1978	1979	1980	1981	1982	1983	1984[1]	1985[1]
SA 0	Canada	-	-	-	-	59	1,590	858	2,030	448	206
	Denmark	-	68	86	67	-	1,923	946	2,627	223	203
	Faroes	-	239	-	115	-	1,686	-	756	729	-
	France	-	-	21	7	-	-	-	-	436	-
	Greenland	-	-	-	149	815	85	8	-	488	2,662
	Norway	65	150	15	791	-	-	-	-	-	-
	Spain	327	-	-	-	-	-	-	-	-	-
	Total	392	457	122	1,129	874	5,284	1,812	5,413	2,324	3,071
SA 1	Canada	-	-	-	245	590	-	-	-	-	-
	Denmark	2,717	5,842	3,382	1,327	872	995	959	451	397	426
	Faroes	11,179	12,612	8,070	6,867	3,554	1,234	530	1,583	360	581
	France	803	924	805	353	247	535	672	408	404	431
	F. R. Germany	-	31	-	-	-	-	-	-	-	-
	Greenland (inshore)	7,300	7,800	7,600	7,500	7,500	7,500	7,500	7,500	7,500	7,500
	Greenland (offshore)	2,478	7,081	5,531	12,527	27,501	28,197	32,016	30,929	32,829	42,000[2]
	Japan	146	-	-	-	-	-	-	-	-	-
	Norway	11,658	7,353	8,959	4,639	3,014	1,055	838	483	451	452
	Spain	6,925	-	-	-	-	-	-	-	-	-
	USSR	6,468	-	-	-	-	-	-	-	-	-
	Total	49,674	41,643	34,347	33,458	43,278	39,516	42,515	41,354	41,941	51,390[2]
	Offshore	42,374	33,843	26,747	25,958	35,778	32,016	35,015	33,854	34,441	43,890[2]
SA 0+1 Offshore Catch		42,766	34,300	26,869	27,087	36,652	37,300	36,827	39,267	36,765	46,961[2]
SA 0+1 Advised Offshore TAC		-	40,000	40,000	29,500	29,500	29,500	29,500	29,500	29,500	36,000
SA 0+1 Effective Offshore TAC		-	36,000	40,000	29,500	29,500	35,000[3]	34,800[3]	34,625[3]	34,925[3]	42,120[4]

[1] Provisional data.
[2] Includes 4,349 tons from Greenland trial fishery north of 70°52'N.
[3] Includes TAC of 5,000 tons in Subarea 0.
[4] Includes TAC of 6,120 tons in Subarea 0.

TAC level in 1977-79, but they have since been substantially higher. Since 1981, Canada and the EEC (from 1986 the Greenland Home Rule Authorities) have set separate TACs for Subareas 0 and 1 respectively. The effective TAC for Subarea 0 was 5,000 tons annually during 1981-84 and 6,120 tons for 1985, whereas affective TACs in Subarea 1 were in the range of 29,625-30,000 tons in 1981-84 and 36,000 tons in 1985.

Ice conditions in the spring months of 1982, 1983 and 1984 severely hampered access to the main fishing grounds in Davis Strait, but the 1985 situation was more similar to conditions in earlier years when fishing grounds in the southern part of Div. 1B were open to the fishery from the beginning of the year. Greenland vessels fished in Div. 1C and 1D and on the southern grounds in Div. 1B throughout the year, with more effort being expended in these areas than in earlier years. The fishing grounds north and west of Store Hellefiske Bank in Div. 1A and 1B were also exploited by Greenland vessels from April and May. The Norwegian fishery in 1985 occurred in Div. 1C and 1D, somewhat further south than in previous years. A French vessel fished west of Store Hellefiske Bank south to 68°N in Div. 1B in August and September. In Subarea 0, Canadian, Danish and Greenland vessels fished from June through November, mainly in the region of 58°-59°W and 67°-68°N as in previous years. There was no information available on the distribution of fishing effort by other countries.

In Subarea 1, a total of 50 vessels (>80 GRT) participated in the fishery in 1985, compared to 56, 48 and 47 in 1982, 1983 and 1984 respectively. The Greenland trial fishery north of 70°52'N took place from June to December, and 21 vessels (>80 GRT) participated. Only preliminary information on the geographical distribution of the fishery was available.

b) Input data

i) Commercial fishery data (SCR Doc. 86/4, 7, 10)

Catch rates. Catch and effort data on the shrimp fishery in 1985 were available from Canadian logbook records and observer reports for Subarea 0, Norwegian and French logbook records for Subarea 1, and Greenland logbook records and corresponding landings for Subarea 1.

Canadian data from both sources showed only a slight decrease in catch rates from 1984 to 1985, which was not considered to be significant. Norwegian logbook data for Div. 1D and 1E showed that the catch rate in Div. 1D (213 kg/hr) was similar to that for the same area in 1984 (209 kg/hr).

Catch and effort data from one French trawler showed that the catch rate primarily for Div. 1B in August 1985 was similar to that for the same month and division in 1981 and 1982 (approximately 330 kg/hr). Catch rates of seven Greenland trawlers (630-722 GRT) increased sharply from January to March and were followed by the typical decline over the remainder of the season. Catch rates from April to June were lower than in 1984 but the March 1985 rate was considerably higher. The Greenland data showed that fishing occurred in Div. 1B during all months of the year, reflecting the favourable ice conditions in 1985.

Indices of mean catch rates during the July-September period from 1976 to 1985 for the national fisheries in Div. 1B (standardized to 1976) and for the Canadian fishery in Div. 0A (standardzied to the average of the other indices in 1980) are given in Table 2. Generally, all indices declined by about the same proportion from 1976 to 1979 and fluctuated similarly from 1980 to 1984, except for the abnormally high 1981 value for the French fishery (no index available from 1983 to 1985) and the stabilization of the Norwegian index from 1982 to 1983 (no index available for 1985). These exceptions, however, were derived from relatively small catches. The 1985 Greenland index is about the same level as observed in 1982 and 12% higher than the 1984 value. The Canadian index is slightly lower (3-5%) than the values of the previous two years.

Table 2. CPUE indices (July-September) for Greenland, Norwegian and French fisheries for shrimp in Div. 1B and the Canadian fishery in Div. 0A, 1976-85.

	Div.	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Greenland	1B	1.00	0.74	0.67	0.51	0.63	0.59	0.74	0.66	0.67	0.75
Norway	1B	1.00	0.84	0.60	0.47	0.60	0.43	0.57[1]	0.56	0.61[1]	-
French[1]	1B	1.00	1.13	0.61	0.48	0.58	0.80	0.60	-	-	-
Canada[2]	0A	-	-	-	-	0.60	0.66	0.78	0.63	0.64	0.61

[1] July only.
[2] Div. 0A (1980 is average of the other 3 indices).

The catch rates of Greenland vessels in Div. 1B during 1976-85 are compared with total offshore catches from Subareas 0 and 1 (Fig. 1). No information exists on the introduction of more efficient fishing gear around 1980 to determine the effects on catch rates, but it was agreed that an upward bias would be expected. Also, the late opening of the fishery in 1982, 1983 and 1984 due to unfavorable ice conditions resulted in a reduction of fishing pressure on spring concentrations of berried females which might have resulted in higher-than-normal adundance later in the season in these years. Therefore, it was agreed that the July-September catch rate index from 1980 to 1984 was likely to be biased upwards, but it was not possible to quantify the effects of either of these factors.

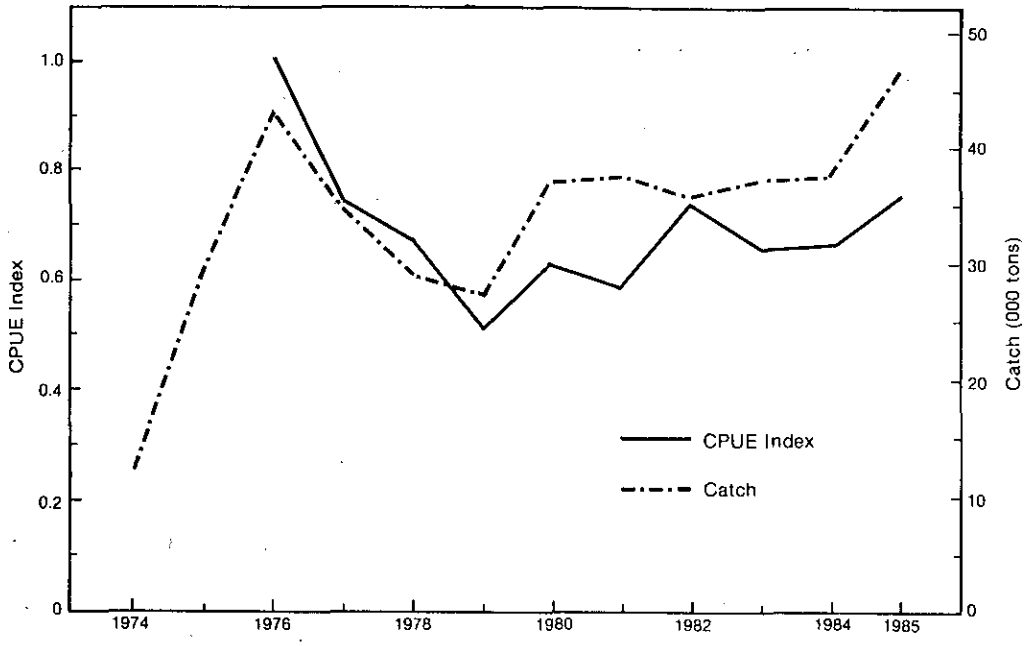

Fig. 1. Shrimp CPUE indices for the July-September period of 1976-85 in Div. 1B compared with total offshore catches in Subareas 0 to 1. (Mean CPUE values are based on logbook records of seven trawlers of the Royal Greenland Trade Department; catch for 1985 is provisional.)

Biological data. No shrimp samples were available from the commercial fishery in 1985 from which sex and maturity data, spawning success and age structure could be obtained. Length frequencies from the Canadian fishery in Div. 0A showed that two size-groups dominated in the catches. The modal group at approximately 21 mm (presumably males) could represent the 1980 year-class and the mode at 25 mm (presumably females) likely represents a number of year-classes, primarily 1978 and 1979. The data also indicated that smaller males (possibly age 4) in commercial length frequencies of previous years were lacking in 1985, implying the possibility of a weak 1981 year-class. However, no data were available from the other components of the fishery or the photographic survey to determine the relative strength of this group.

Shrimp discards. The observed discarding of shrimp in Div. 0A during 1985 ranged from 4.0% in June to 2.2% in November. Except for October, the discard rates were lower than those in 1984 and they appeared to be similar to the lower rates that were observed in 1982 and 1983. The size range of discarded shrimp was similar to that observed in the total catch (SCR Doc. 86/4).

By-catches. Logbook records for eight Greenland trawlers showed a by-catch of 1.8% (by weight) of the shrimp catch in 1985, compared to 2% in 1984 and about 1% in 1981-83. The dominant species in the by-catch was redfish (SCR Doc. 86/10). In the Canadian fishery in Div. 0A, the observed by-catch in 1985 was around 10% of the total catch (by weight) but, as in previous years, the by-catch increased in October-November due to increased incidence of Greenland sharks. The dominant commercial species in the by-catch was redfish, which comprised about 5% of the total catch (SCR Doc. 86/4).

ii) Research vessel surveys (SCR Doc. 86/3, 10)

Abundance estimates from photographic surveys. Data from photographic surveys in 1977-85 have been used for describing the distribution of five size-groups of shrimp in the region from 66°00'N to 69°30'N off West Greenland. Data have also been incorporated into a multiple regression model to derive biomass estimates for each of the size groups in the 1981-85 period . It was noted, that parts of the area exhibit some stability in the density of shrimp from year to year, but that high concentrations occur at different locations in different years. The observed stability may be associated with certain bottom types, but STACFIS was unable to evaluate this possibility at this time.

The regression model applied to the photographic material indicates that environmental parameters, such as bottom temperatures, may affect the five size-groups in different ways. STACFIS noted that only about half of the observed variation in biomass can be accounted for by the model, but that improvement can be expected if the bottom type is included in the analyses. STACFIS noted further that despite the relatively low coefficient of determination, the trend in estimates of total biomass in the area agree fairly well with the trend in the CPUE index for the same years (Fig. 2), and that no larger variation in the biomass was observed during the last 3 years. However, the slight decrease in biomass estimate from 1984 to 1985, which contrasts to the increase in CPUE index for Greenland trawlers, might be due to an underestimate of the biomass in the area around Holsteinsborg Dyb (Div. 1B and 1C) caused by low sampling intensity (SCR Doc. 86/10).

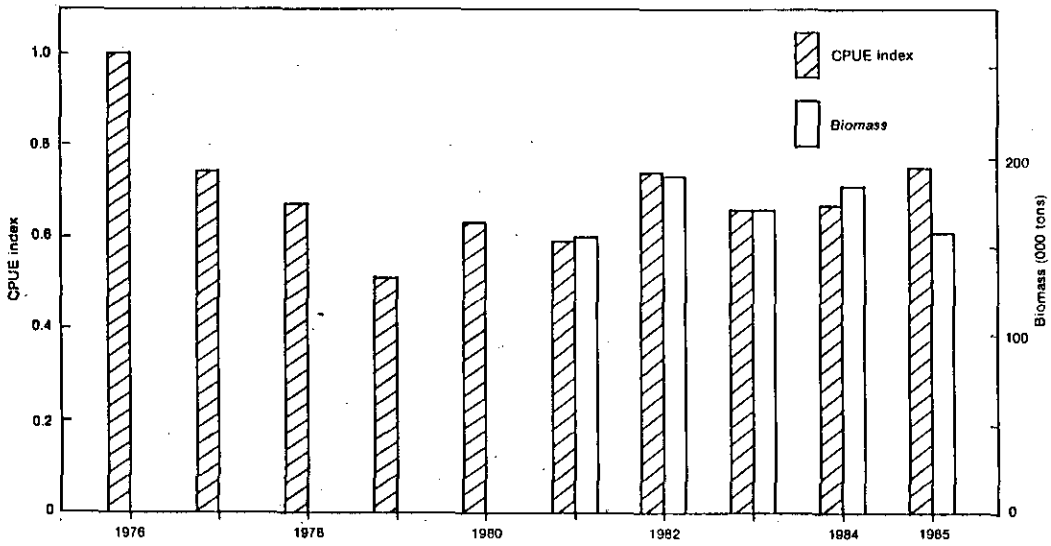

Fig. 2. Shrimp CPUE indices for commercial trawlers in Div. 1B and estimates of total biomass from photographic surveys at depths of 100-600 m in the area from 66°00'N to 69°70'N during 1981-85.

Biological data. Shrimp samples from the Greenland photographic survey from 66°N to 69°30'N in July-August 1985 were analyzed for sex, maturity and age composition. The samples showed wide variation in composition of size groups (year-classes), indicating differences in distribution of the various size groups. Although the samples had been caught with a trawl mesh size of 36 mm stretched mesh, which according to previous studies should yield a 50% retention length of about 16 mm carapace length, only a minor proportion of males and juveniles below 20 mm carapace length were present in most of the samples. However, this was consistent with sampling from research surveys in previous years, and no conclusions could be made about relative year-class strength.

c) Prognoses

Catch rates from the Canadian fishery in Div. 0A for the July-September period in 1985 were only slightly lower than in the previous 2 years. The Norwegian data indicated similar catch rates in Div. 1D in 1984 and 1985 and the catch rate for a French trawler fishing mainly in Div. 1B in August was similar to levels observed in 1981 and 1982. The Greenland data showed a catch rate similar to that obtained in 1982, both of which were higher than in the intervening 2 years. The trend from the Greenland data was overall stability from 1982 to 1985.

Although the CPUE indices indicated that the stock showed an increasing trend from 1979 to 1982 and stability since then, these indices may be biased upwards in recent years because of possible influences of improved trawl design since 1980 and unfavorable ice conditions in the springs of 1982, 1983 and 1984. Although the effects of these factors cannot be estimated, it is quite possible that they could account for the observed increase and subsequent stability of the stock, and that the stock may not have increased since 1979 (Fig. 1).

In 1985, STACFIS recognized that, despite concerns about possible poor recruitment, catch rates in recent years have not declined (NAFO Sci. Coun. Rep., 1985, page 20). Also, because of the apparent stability of the stock, with higher-than-advised yields during the period of stability, STACFIS advised an overall TAC of 36,000 tons, which corresponded to the average catch during 1979-84. The data presented at this meeting, both from the commerical fishery and from the photographic surveys, indicate continued stability in abundance since 1982. Therefore, STACFIS advises that the overall TAC for the offshore grounds in Subarea 1 and the adjacent parts of Subarea 0 in 1986 should not exceed 36,000 tons.

Historically, concentrations of shrimp have not been known to occur in the area north of 70°52'N, where the trial fishery by Greenland vessels occurred in 1985. The possible relationships of these grounds to the traditional fishing grounds are unknown at this time. Therefore, it was agreed that this area should not be included in the 1986 TAC. However, because these concentrations may be part or an extension of the traditional stock, STACFIS recommends a cautious approach to exploitation in this area. If continued in 1986, this trial fishery must be monitored closely and systematically sampled to obtain information on distribution of the fishing effort and the resource as well as biological characteristics of shrimp in the commercial catches.

d) Response to Denmark (Greenland) request for further advice on shrimp in Subarea 1

Denmark, on behalf of Greenland, requested the Scientific Council to provide further advice on the shrimp fishery in Subarea 1, in the light of a regulation by the Greenland Home Rule Goverment which stipulates that shrimp weighing 2g or more must not be discarded.

i) *Whether catches which are given in its reports, upon which TACs for shirmp in Greenland waters are based, are total catches or only landings (i.e. total catches minus rejects)?*

Catches in the most recent year include some reported discards, but these are subsequently updated and represent nominal catches as reported in STATLANT reports.

ii) *Estimated total catches, if reported data are landings?*

STACFIS has repeatedly requested that efforts be made to obtain better estimates of discards in the Subareas 0+1 shrimp fishery. However, due to the variability in discard practices between vessels resulting from different processing methods and seasonal and geographical changes in catch composition, objective estimates are not available and, therefore, the total catches cannot be estimated at this time. Independent estimates currently exist in vessel log records and observer reports. These sources are seldom in agreement, as evident in recent data from the Davis Strait fishery. Estimates reported in vessel logs are generally less than 1% of the total catch, whereas observers frequently report discards of 5% to 20%. Reliable estimates of discards can be obtained only through intensive sampling of the catch before and after discarding has occurred.

iii) *Weight distribuiton of total catches and proportion of small shrimp (2-5 g) therein?*

To obtain a weight distribution for the total catches, samples are required from the various vessel sizes, gear types, areas and seasons. In the absence of such intensive sampling, a reliable estimate of the proportion of small shrimp cannot be obtained.

iv) *The probable conservation effect of the above regulation on the long-term available yield?*

If the above regulation is properly adhered to for the existing TAC, total removals by fishing will be lower than under the present discarding practice. However, if the total annual discards in the years of assumed stability of the stock had been well known, the advised TAC for 1985 would have been increased accordingly.

Under the existing TAC, the regulation might increase the long-term available yield, provided there are no changes in fishing pattern. Under a TAC revised upwards to account for discards, no effect would be anticipated. These conclusions assume that no discarded shrimp survive.

v) *Whether the regulation has any consequence for the size of the recommended TACs for 1986?*

Until reliable estimates of the discards can be obtained, the regulation will have no consequence for the recommended TACs.

vi) *What practical technical measures (such as minimum mesh sizes, closed areas, etc.), could be taken to minimize the catches of small shrimp (2-5 g)?*

The mesh-size regulation of 40 mm was imposed in the late 1970's when very little was known about the sizes of shrimp occurring offshore in Davis Strait. Further selectivity studies are necessary before revisions can be made to this regulation. Small shrimp are known to occur in specific areas at certain times of the year. However, present knowledge of the distribution of various sizes of shrimp is not sufficient to advise on closed seasons or closed areas.

e) Future research requirements

Some of the recommendations from the January 1985 Meeting (NAFO Sci. Coun. Rep., 1985, page 23) have been addressed while others were considered as regional problems. Danish scientists continued the redefinition of size categories of shrimp in the photographic model, and work began on the potential effects of substrate on shrimp distribution. Most logbooks for vessels fishing in Div. 0A were returned to Canadian authorities in time for the January Meeting. It was determined that no information exists to quantify the recent effects of changes in gear on the CPUE index and this recommendation was omitted from the list. Collection of data on the Greenland trial fishery north of 70°52'N was considered a high priority item for 1986. It was agreed that previous recommendations which had not been addressed should be restated. STACFIS accordingly

recommends

i) that stratified-random trawl surveys be conducted on a seasonal basis for a number of years to determine seasonal and annual changes in distribution and abundance;

ii) that observer programs be continued and extended to cover a greater portion of the fleet;

iii) that interpretation of age and growth of shrimp, presented at the January 1985 Meeting, be verified and an attempt made to separate shrimp catch sampling data into year-classes; and

iv) that an intensive sampling program be established to monitor the trial fishery in Subarea 1 north of 70°52'N.

In response to the request from Denmark (Greenland) for further advice on shrimp in Subarea 1, STACFIS further

recommends

v) that efforts be made to develop objective methods for estimating discards;

vi) that sampling of the commercial catches in Davis Strait should be intensified to cover all components of the fishery in order to adequately represent the total catches in terms of length, weight and age;

vii) that selectivity studies be conducted for shrimp in Davis Strait to determine optimal mesh sizes; and

viii) that research surveys should be conducted to determine possible existence of nursery grounds for shrimp in the Davis Strait region.

2. Assessment of Shrimp in Denmark Strait (ICES Div. XIVb and Va)

a) Fishery trends (SCR Doc. 86/1, 5, 6, 9)

The shrimp fishery in Denmark Strait began in 1978 by an Icelandic vessel on the eastern side of the midline between Greenland and Iceland (Table 3). Nominal catches increased to 1,300 tons in 1979, when Norwegian trawlers participated in the fishery on the western side of the midline, and exceeded 8,200 tons in 1980 with the additional involvement of Danish, Faroese, French and Greenland vessels. The total catch on both sizes of the midline declined to 4,800 tons in 1981, well below the level of 8,000 tons that was aimed at by the EEC for regulation of the fishery in the area west of the midline. A TAC of 4,500 tons was set by the EEC for the western side of the midline in 1982, whereas the Scientific Council advised an overall TAC of 4,200 tons; the reported catch was 4,900 tons. For 1983, the EEC set a TAC of 5,725 tons, whereas the Scientific Council advised an overall TAC of 4,200 tons (as in 1982); the reported catch was 4,200 tons. For 1984, the EEC set a TAC of 5,245 tons, whereas the Scientific Council advised an overall TAC of 4,200 tons (as previously); the reported catch was 6,700 tons. In 1985, the Greenland authorities set a TAC of 6,090 tons for the Greenland side of the midline, whereas the Scientific Council advised an overall TAC of 5,000 tons; the reported catch was 7,500 tons.

Table 3. Nominal catches and TACs (tons) of northern shrimp (*Pandalus borealis*) in Denmark Strait, 1978-85.

Country	1978	1979	1980	1981	1982	1983	1984[1]	1985[1]
Denmark	-	-	702	581	740	204	443	353
Faroe Islands	-	-	4,233	713	737	443	668	674
France	-	-	50	353	414	291	500	642
Greenland	-	-	200	1,004	1,115	1,467	2,250	2,596
Iceland	363	485	614	125	-	43	742	1,223
Norway	-	800	2,461	2,016	1,896	1,727	2,128	2,051
Total	363	1,285	8,260	4,792	4,902	4,175	6,731	7,539
Advised TAC	-	-	-	-	4,200	4,200	4,200	5,000
Effective TAC[2]	-	-	-	8,000	4,500	5,725	5,245	6,090

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

The shrimp fishery of Denmark Strait in 1985 took place in the area of Strede and Dohrn Banks as well as on the slopes of Storfjord Dyb. Due to favourable ice conditions in the area, the fishery was more widespread in 1985 than in earlier years. The main fishing area in 1985 extended from 65°30'N to 66°30'N and around 30°W.

In 1983, the overall fishing period extended from March to November, with the main fishing period from March to June. In 1984, the fishing periods west and east of the Greenland-Iceland midline differed considerably; west of the midline, the fishing period extended mainly from January to May, ending in May when most national allocations had been taken, but Faroese vessels continued fishing in November and December; east of the midline, on the other hand, the fishing period extended from June to December, the main fishing period being in September and October. In 1985, fishing took place throughout the year with a larger proportion of the catch (31%) taken in the second half of the year than in 1984 (12%) and previous years. In 1983 and 1984, 41 vessels participated in the fishery, whereas there were 47 vessels in 1985 (excluding Icelandic vessels).

b) Input data

i) Commercial fishery data (SCR Doc. 86/1, 5, 6, 9)

Catch rates. Monthly catch rates and corresponding fishing effort based on logbook data for the French, Greenland, Iceland and Norwegian fisheries during 1980-85, are listed in Table 4. Catch rates were highest during March-April in 1980, 1981 and 1983, whereas 1982 catch rates were highest in May. The catch rates for Greenland vessels in January 1984 were almost as large as the highest rate observed in the period, but they then declined through February and March 1984. This high January catch rate did not occur in 1985, but the level for the other months was similar to the respective rates in previous years. The catch rates for the French vessel were considerably higher in April and May of 1981 and 1984, than in the same months of 1982, 1983 and 1985 with the catch rate for 1985 being higher than the corresponding rates for 1982 and 1983. The

Table 4. Monthly catch rates (kg per hour trawling) and corresponding effort (hours trawling) from available logbooks of vessels involved in the shrimp fishery off East Greenland, 1980-84.

Year	Month	Greenland[1]		France		Norway		Iceland[2]	
		CPUE	Effort	CPUE	Effort	CPUE	Effort	CPUE	Effort
1980	Mar	-	-	-	-	904	398	-	-
	Apr	672	35	-	-	704	793	-	-
	May	392	1,295	-	-	378	1,071	125	1,425
	Jun	139	315	-	-	98	714	90	1,478
	Jul	71	60	62	40	-	-	104	1,176
	Aug	17	32	-	-	95	874	123	851
	Sep	181	482	-	-	145	2,883	96	806
	Oct	107	1,165	-	-	99	3,071	-	-
	Nov	145	465	-	-	160	1,181	-	-
1981	Mar	-	-	-	-	364	137	-	-
	Apr	486	1,343	433	157	296	3,848	-	-
	May	263	914	261	522	161	4,057	-	-
	Jun	123	6	144	257	119	1,101	99	688
	Jul	-	-	-	-	-	-	78	603
	Aug	-	-	-	-	42	167	39	245
	Sep	-	-	-	-	46	65	-	-
1982	Mar	160	763	-	-	197	1,548	-	-
	Apr	195	1,570	216	331	171	4,450	-	-
	May	280	1,394	264	563	248	3,339	-	-
	Jun	-	-	185	238	-	-	-	-
1983	Mar	345	484	-	-	-	-	-	-
	Apr	160	457	165	248	128	2,734	-	-
	May	-	-	254	245	255	1,439	50	2
	Jun	-	-	162	206	143	1,797	99	52
	Jul	-	-	-	-	133	45	-	-
	Aug	-	-	-	-	98	622	-	-
	Sep	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	172	80
	Nov	-	-	-	-	-	-	155	158
1984	Jan	600	105	-	-	-	-	-	-
	Feb	356	312	-	-	232	341	-	-
	Mar	224	281	316	132	224	2,777	-	-
	Apr	-	-	487	723	183	4,000	-	-
	May	-	-	304	349	167	2,994	-	-
	Jun	-	-	-	-	-	-	42	53
	Jul	-	-	-	-	-	-	69	655
	Aug	-	-	-	-	-	-	70	116
	Sep	-	-	-	-	-	-	99	1,546
	Oct	-	-	-	-	-	-	154	1,887
	Nov	-	-	-	-	-	-	74	2,391
	Dec	-	-	-	-	-	-	118	569
1985	Jan	311	647	-	-	-	-	-	-
	Feb	302	610	-	-	-	-	105	53
	Mar	271	697	-	-	181	3,094	13	7
	Apr	222	625	342	257	163	4,510	22	19
	May	-	-	299	402	128	1,386	70	2,256
	Jun	-	-	219	137	-	-	114	1,620
	Jul	-	-	-	-	-	-	100	3,066
	Aug	-	-	-	-	-	-	82	2,992
	Sep	-	-	-	-	-	-	88	3,337
	Oct	-	-	252	294	-	-	49	247
	Nov	-	-	243	37	-	-	55	317

[1] Includes logbook data for Danish vessels in 1980, 1981 and 1982.
[2] Data for Iceland side of midline; all other data for Greenland side of midline.

catch rates for Norwegian vessels have shown little change from year to year since 1982 apart from being somewhat lower in 1985 than in 1984. The Iceland catch rates were stable in June from 1980 to 1983 (no fishing took place in 1982), declined in 1984 and increased in 1985. The October and November catch rates declined from 1983 to 1985.

Ice conditions differed considerably from month to month throughout the years and thereby affected the distribution of the fishery, making the evaluation of CPUE data

difficult. This difficulty was compounded by incomplete data on catch location and fishing effort for a substantial portion of the fleet. Although it was not possible in previous assessments to clearly understand the reason for the trends that have been observed in catch rates in recent years, the inclusion of the 1985 data continued to indicate stability in the stock, based upon second quarter catch rates for Norway and Greenland. Despite this indication of stability from the CPUE series, it was agreed that a more detailed analysis of the existing data was needed.

Biological data. Data on the biology of shrimp in Denmark Strait were available from Iceland, French and Norwegian trawlers in 1985. Size compositions of the catches from the three countries were similar, the size range being about 20-35 mm carapace length with a dominant mode at approximately 30 mm. Samples from Iceland, however, had proportionately more male shrimp with a size range of 20-29 mm.

Iceland samples indicated that males were abundant in July, decreased in August to October and increased again in November and December. The ovigerous period for females is long, beginning in July-August and lasting for at least 8 months. A small proportion of females spawns every second year, as indicated by the absence of head roe in some individuals. Two age-groups of males were present and these were interpreted to be ages 4 and 5. Female modes were difficult to interpret but it was assumed that most were 6 and 7 years old. A weight distribution of the October samples indicated up to five age-classes of females without spines but these were not apparent in the length distribution. Weight-length relationships also were provided for ovigerous and non-ovigerous animals.

French samples indicated that hatching of eggs occurred in April-May, about 2 weeks earlier than in the previous 2 years. Length frequencies showed a dominance of female shrimp in the catches in both spring and autumn of 1985. Sampling from 1982 to 1985 showed similarity in size distribution of the catches over the period.

Norwegian samples in March-April consisted of 10% males, 1.6% transitionals and 88.4% females. The size composition of the catch was similar to that observed in previous years.

Shrimp discards (SCR Doc. 86/6, 9). Information from one French trawler indicated a discard rate of 0.6% by weight, which is about the same as that reported in 1984. For one Norwegian trawler, information from an observer onboard indicated discards between 0.1 and 7.8%, with an average of 2.3%. The discarded shrimp consisted mostly of broken shrimp of somewhat smaller sizes than observed in the catches (modes around 25 and 30 mm carapace length respectively).

By-catches (SCR Doc. 86/5, 9). Data on by-catches of fish in the shrimp fishery were reported for two Greenland vessels (logbook information) and for one Norwegian vessel (observer report). The reported by-catches in the Greenland fishery decreased from 9.1% by weight of the total shrimp catch in 1984 to 0.2% in 1985, while the observed number of fish per kg of shrimp in the Norwegian fishery decreased from 0.24 in 1984 to 0.13 in 1985. In contrast to the year before, no large amount of Greenland halibut was recorded in the Norwegian fishery in 1985. The total by-catch was evidently lower in 1985 than in the earlier years, the major component being small redfish.

ii) Data from research surveys (SCR Doc. 86/8)

The Norwegian research cruise to Denmark Strait in September 1985 provided additional information on the biology of this stock. Males were found in highest numbers in the western and northern parts of the region and in smallest numbers around 66°N 30°W. For the surveyed area as a whole, about 43% of the shrimp (by numbers) were males. Females were also found in greatest numbers to the west and north. Most of the females were ovigerous, very few had head roe and 21% were without roe. The highest frequencies of females without roe were found in the north and the lowest frequencies around 66°N 30°W. Length frequencies showed an increase in length from north to south and from west to east. The smallest males were mainly found in the most northerly and westerly areas of distribution. In spite of using a small-mesh liner (4 mm square) in the cod-end, no specimen smaller than 20 mm carapace length were found in the samples. This is not necessarily an indication of poor recruitment but may reflect the non-availability of these length groups to the trawl.

The highest biomass during the survey was to the west and north of the main area fished in 1985. This was probably a reflection of seasonal migrations, because the distribution is different at other times of the year.

Biomass calculations using the swept-area method, gave an estimate of 31,000 tons for the investigated area. However, the precision of the estimate cannot be determined and a time series is needed so that the estimates can be used as indices of abundance.

c) Estimation of parameters (SCR Doc. 86/2)

A general production model (Fox, 1970) was used to calculate maximum sustainable yield. Data for the fisheries of all countries from 1978 to 1984 were used, except for the first 2 years (1978 and 1979) when only Iceland catch and effort data were available. There was greater difficulty in calculating the total effort for the fishery in 1984 than previously because only one Greenland vessel reported effort and no data were available for Faroese vessels. Moving averages of 3 years for effort were used in the model.

d) Assessment results (SCR Doc. 86/2)

The maximum sustainable yield from the general production model was 5,000 tons. Similar analyses have been considered in previous assessments, and, in the absence of other information, the results have been used as a guide in assessing the yield from the stock. However, such models generally provide only a very approximate estimate of MSY (maximum sustainable yield). In this particular case, the short time series and the lack of a standardized catch rate implies that the estimated MSY level of 5,000 tons cannot be accepted with any degree of confidence.

e) Prognosis

According to CPUE data during the March-May period, catch rates declined during 1978-80 and have remained relatively stable since then. Because catches in 1978 and 1979 were relatively small (363 and 1,285 tons respectively), they could not have had a significant impact on stock abundance. Therefore, the 1978-79 CPUE data must be considered to be unreliable as indices of stock size. This stock has sustained average catches of 6,000 tons since 1980 without any apparent decrease in commercial catch rate. Furthermore, length-frequency data from catches during this period have not shown any decrease in size of shrimp. Taken together, these observations imply two possible scenarios which could explain stock dynamics of shrimp in Denmark Strait since the late 1970's: (i) the fishery began at a time when the stock was expanding and average catches since 1980 have approximated the surplus production, or (ii) the stock was at a maximum equilibrium level in the late 1970's and accumulated catches since then have not had a significant impact on stock abundance.

Because of uncertainties in the catch rate data and the lack of an independent stock size index, STACFIS is unable to advise which of the above two scenarios is the correct interpretation of stock status. Accepting scenario (i) as the most appropriate reflection of stock dynamics, a TAC of 6,000 tons for 1986 is implied. This catch level would, of course, be conservative if scenario (ii) is the correct interpretation of stock status. It was noted that the impact of recruitment to the fishery on the berried female component of the stock still cannot be measured because of the short time series of data and the necessary time lag of 5 years for such recruitment effects to be shown.

f) Future research requirements

Some information on the biology of the shrimp stock in Denmark Strait was contained in reports from Norway, France and Iceland, but its usefulness in assessing this stock was limited by the lack of information on a year-round and year-to-year basis.

STACFIS noted, that some of the recommendations from the January 1985 Meeting were dealt with during the year, but other were not addressed. It was agreed that these be reiterated. Also, there was concern that few data were available on environmental conditions and biological characteristics of shrimp in this area. STACFIS therefore

recommends

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

ii) that research vessel surveys in the area be continued and increased, and that plankton surveys be carried out to observe the distribution of shrimp larvae; and

iii) that a study of environmental conditions in the area be undertaken, particularly temperature, ice conditions and currents.

g) Reference cited

FOX, W. W. 1970. An exponential surplus-yield model for optimizing exploited fish populations. Trans. Amer. Fish. Soc., 99(1): 80-88.

11. OTHER MATTERS

1. Justification for Special Midterm Meeting on Shrimp

At its June 1985 Meeting, STACFIS agreed that reconsideration of the justification for a special meeting in January of each year is required, and that the matter be reviewed at the June 1986 Meeting. It was further agreed that the agenda for the midterm meeting in January 1987 should include the following questions: (i) If quantitative estimates of recruitment are not available for 1986, when can STACFIS expect to have the information on which to base recruitment predictions? (ii) How big a change in assessment parameters, in particular commercial catch rates and photographic survey estimates of stock size, and recruitment estimates if such should be derived, would be required before this would be interpreted as indicating a significant change in stock abundance, and how might advice on the TAC change as a result?

Relative to the first question, it was agreed that it may take 2-3 years before methods to obtain quantitative estimates of recruitment are developed and that information on which to base recruitment predictions will depend on these results. In relation to the second question, it was agreed that, although a specific figure could not be given, if all abundance indices showed a substantial and consistent change from one year to the next, the TAC advice would be changed accordingly.

Other shrimp stocks have been known to collapse over a short period, probably due to a combination of environmental factors and high exploitation (e.g. Alaska offshore and Gulf of Maine stocks). Should this occur in the Davis Strait stock, it was agreed that controls on the fishery would be required immediately. STACFIS noted that data from the fishery in the July-September period play an important role in assessing the status of the Davis Strait shrimp stock. Thus, by meeting in June, it would be necessary to base the advice for the following year on two-year-old data. Because the fishery depends mainly on two or three year-classes, it was agreed that a more immediate evaluation of stock status would be necessary.

Although quantitative estimates of recruitment are not yet available, work is currently being conducted to address this problem. STACFIS agreed that, when such information is available, confidence in projecting TACs over 2 years would be increased greatly and the need for midterm meetings could be reviewed at that time.

2. Acknowledgements

There being no further business, the Chairman thanked the participants for their interest and cooperation during the course of the meeting and expressed the appreciation of the Committee to the Secretariat for their usual efficiency in support of the meeting.

PART B

Report of Scientific Council

June 1986 Meeting

CONTENTS

REPORT OF SCIENTIFIC COUNCIL

June 1986 Meeting

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

The Scientific Council, with its Standing Committees on Fishery Science (STACFIS), Research Co-ordination (STACREC) and Publications (STACPUB) and associated subcommittees and working groups, met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 4-19 June 1986, to consider and report on various matters listed in its agenda (See Part D, this volume). In addition to matters of general scientific interest, the Council considered the requirements of the Fisheries Commission and requests of coastal Contracting Parties (Canada, Denmark on behalf of Greenland, and the European Economic Community (EEC)) for scientific advice on management in 1987 of a number of stocks in Subareas 0 to 4. The Council noted that, although the official request of Denmark on behalf of Greenland was not available when the provisional agenda was distributed in early April 1986, the relevant stocks had been included, and it was agreed unamimously that STACFIS should deal with the request in the usual way. The Executive Committee met briefly prior to the opening session and recommended a plan of work for the three Standing Committees which was adopted by the Council.

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

The reports of the Standing Committees, as adopted by the Council on 19 June 1986, are given in Appendix I (STACFIS), Appendix II (STACREC) and Appendix III (STACPUB). Lists of research and summary documents are given in Part D of this volume. Brief summaries of the committee reports and other matters considered by the Council follow in sections I to VII.

I. FISHERY SCIENCE (APP. I)

1. General Fishery Trends

From near-final statistics for 1984 and provisional data for all member countries except Faroe Islands in 1985, the nominal catch of all fish and invertebrate species in the Northwest Atlantic (Subareas 0 to 6) increased (2.5%) from 2.63 million (metric) tons in 1984 to 2.70 million tons in 1985 (see Appendix I, Table 1). The total catch of "groundfish" species was approximately the same in 1984 and 1985 at 1.22 million tons. The total catch of "pelagic fish" increased (30%) from 469,000 tons in 1984 to 610,000 tons in 1985. For the "other finfish" group of species, the catch decreased (13%) from 112,000 tons in 1984 to 97,000 tons in 1985. The total catch of "invertebrate" species decreased (8%) from 836,000 tons in 1984 to 773,000 tons in 1985.

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

2. Assessment of Finfish and Invertebrate Stocks

The Council noted that STACFIS had reviewed the status of certain stocks in Subareas 0 to 4, as requested by Canada, Denmark (Greenland), EEC and the Fisheries Commission, and had advised on catch levels corresponding to the reference fishing mortality ($F_{0.1}$) or to two-thirds of the fishing effort associated with the maximum sustainable yield. Advice on other levels of fishing mortality was provided for certain stocks, as requested specifically by the Fisheries Commission. Management advice, based on the reference levels, could not be provided for some stocks due to insufficient data. For the capelin and squid stocks, different management criteria were used. In cases where specific total allowable catches (TACs) were advised, these are listed in the last column of Table 1. Details of the stock assessments are given in the Report of STACFIS at Appendix 1. Some general observations are as follows:

a) The cod stock in Subarea 1 has declined drastically in recent years, but there are indications that the 1984 and 1985 year-classes are stronger than average. Management options for various levels of fishing mortality are presented (see relevant section of Appendix I for details).

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

Species	Stock area	Nominal catches (000 tons)						TACs (000 tons)							
		1980	1981	1982	1983	1984	1985[1]	1980	1981	1982	1983	1984	1985	1986	1987
Cod	1	54	53	56	63	33	15	...	50	62	62	68	28.3	12.5	( )[2]
	2J+3KL	176	171	230	232	231	227	180	200	237	260	266	266	266	(266)
	3M	10	14	13	10	13	14	13	12.7	12.4[6]	12.4[6]	13	13	13	(0)[3]
	3NO	20	24	32	32	27	41	26	26	17[6]	17[6]	26	33	33	( )[4]
	3Ps	38	39	34	38	37	51	28	30	33	33	35.8	44.6	...	( )[2]
Redfish	1	8	6	8	8	6	2	...	...	...	...	...	...	...	(9)
	3M	16	14	15	20	20	20	20	20	20	20	20	20	20	(20)
	3LN	16	24	22	20	15	21	25	25	25	25	25	25	25	(25)
Silver hake	4VWX	45	45	60	36	74	76	90	80	80	80	100	100	100	(100)
A. plaice	3M	1	1	1	2	1	2	2	2	2	2	2	2	2	(2)
	3LNO	49	50	50	38	38	51	47	55	55	55	55	49	55	(48)
Witch flo.	3NO	2	2	4	4	3	9	7	5	5	5	5	5	5	(5)
Yellowtail	3LNO	12	15	12	9	15	27	18	21	23	19	17	15	15	(15)
G. halibut	0+1	8	10	9	9	7	9	25	25	25	25	25	25	25	(25)
	2+3KL	33	31	26	28	25	17	35[7]	55[7]	55[7]	55[7]	55[7]	75	100	100
R. grenadier	0+1	2	+	+	+	+	+	8	8	8	8	8	8	8	(8)
	2+3	2	7	4	4	4	5	30	27	27	11	11	11	11	(11)
Wolffishes	1	5	4	4	3	2	2	...	...	...	...	5-6	5-6	5-6	(5-6)
Capelin	3LNO	14	24	27	25	33	26	16	30	30	60	38[8]	60[8]	130[8]	(293)[9]
Squid-*Illex*	3+4	70	33	13	+	1	1	150	150	150	150	150	150	150	(150)
Shrimp	0+1	44	46	44	47	43	...	30	35	35	35	35	42	36	( )[5]

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

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

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

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

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

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

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

h) For capelin in Div. 3L, a catch of 283,000 tons was advised for 1987, which represents more than twice the advised level for 1986. In Div. 3NO, it appears that the stock has recovered

sufficiently to permit a fishery, and a TAC of 10,000 tons is therefore advised for 1987.

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

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

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

3. Environmental Research

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

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

4. Ageing Techniques

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

5. Other Matters

a) Response to questions by Fisheries Commission

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

b) Irregularities in catch statistics

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

c) Topics deferred for consideration in September 1986

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

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

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

iv) Review of arrangements for conducting stock assessments.

II. RESEARCH COORDINATION (APP. II)

1. Statistics and Sampling

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

The Council noted that STACREC had reviewed the Report of the *ad hoc* Interagency Consulta-

tion on Atlantic Fishery Statistics, which was held in London, England, on 5-6 October 1985 (SCS Doc. 86/4). The report of that meeting was presented by Mr. D. G. Cross (EUROSTAT), who is Deputy Secretary of the CWP (Coordinating Working Party on Atlantic Fishery Statistics).

The Council was informed that the 13th Session of the CWP will be held in Rome, Italy, on 11-18 February 1987 and decided that NAFO be represented at that session by the Assistant Executive Secretary and the Chairman of STACREC. It was further agreed that Canada be invited to be the participating NAFO Contracting Party and that the EEC be invited to provide a substitute participant should Canadian participation not be forthcoming. In making these proposals for NAFO representation, the Council points out that participation by the Chairman of STACREC and the country representative would be, as traditionally, at national expense.

b) Fishery statistics

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

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

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

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

c) Sampling data

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

2. Biological Surveys

a) Stratification schemes

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

b) Time series of survey data

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

3. Other Matters

a) List of fishing vessels

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

b) Maritime boundary between Canada and USA

The Council endorsed the proposal (GC Doc. 86/2) that the statistical boundary between Sub-

areas 4 and 5 be modified, and that catches in Subdiv. 5Ze be reported in the future as being from Subdiv. 5Zc (east of the Canada-USA boundary) and Subdiv. 5Zu (west of the Canada-USA boundary).

III. PUBLICATIONS (APP. III)

1. Review of Publications

The Council, in considering STACPUB's review of the status of publications in the preceding 12 months, was pleased to note that the reissue of Vol. 27-31 of the Statistical Bulletin for 1977-81 (required to correct errors in the original submissions) had been completed, that Vol. 33 had been published in December 1985, that the Inventory of Sampling Data (for 1967-78) was published in April 1986, that NAFO Scientific Council Studies (No. 9) was published in September 1985, and that Vol. 6 of the Journal was published in two parts in June and December 1985.

2. Editorial Policy Concerning Publications

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

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

3. Promotion and Distribution of Scientific Publications

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

4. Production of Microfiche Copies of Meeting Documents

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

5. Papers for Possible Publication

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

6. Title and Scope of the Journal

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

IV. AMENDMENT TO RULES OF PROCEDURE

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

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

The question arose as to whether there was a quorum, because it was uncertain whether a non-

representative assuming that a non-response would be counted as a positive vote. Therefore, the Executive Secretary was requested to determine from the non-respondents to the May 8 telex whether the telex had indeed been received. It was agreed that responses be requested by the end of July 1986, in order that the Chairman could judge which countries should be approached for proxy delegations to the Executive Secretary in time for the September meeting.

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

V. COLLABORATION WITH OTHER ORGANIZATIONS

1. NAFO/ICES Study Group on Redfish off Greenland

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

2. Assessment of West and East Greenland Cod Stocks

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

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

The Council reviewed the relevant information on the ICES proposal for establishment of a joint working group (SCS Doc. 86/10), noting particularly its decision in September 1985 to defer any formal relationship with ICES on this matter until there is some clear indication of what advice will be required by the coastal states. The Canadian representative indicated that the report of the Royal Commission on Sealing was not yet available, and that some time would be needed to study the report after it became available before advice, if any, would be sought. The Denmark (Greenland) representative indicated that Greenland was keenly interested in establishment of a joint ICES/NAFO working group and hoped that the matter will be considered again next year. The Council, in declining the ICES invitation at this time, expressed an interest in the work of the ICES Working Group on Seals and agreed to keep the matter under review.

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

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

VI. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting in September 1986

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

2. Mid-term Meeting for Shrimp

The Council concurred with the view of STACFIS regarding the provision of advice on management of

meeting, to be held in Copenhagen at the Greenland Fisheries and Environment Research Institute, was tentatively accepted, with the time to be decided at the September 1986 Meeting.

3. Scientific Council Meeting, June 1987

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

4. Special Session in September 1987

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

VII. OTHER MATTERS

1. Provisional Report of January 1986 Meeting

The Council formally approved, with minor amendments, the report of its meeting on 14-18 January 1986 (Part A, this volume).

2. Theme for Special Session in September 1988

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

VIII. ADJOURNMENT

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

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

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

Chairman: W. R. Bowering Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 4-18 June 1986 to consider and report on various matters that were referred to it by the Scientific Council, particularly with regard to the provision of advice on management measures for certain finfish and invertebrate stocks in Subareas 0 to 4 (see Part D, this volume, for agenda). Representatives attended from Canada, Cuba, Denmark (Greenland), EEC, German Democratic Republic, Japan and USSR, and observers were present from the USA.

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

I. FISHERY TRENDS

1. Introduction

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

2. General Trends for the Northwest Atlantic

The overall reported catch (round fresh weight) of all finfish and invertebrates was 2.70 million (metric) tons in 1985, a 2.5% increase over the 1984 catch of 2.63 million tons. The total "groundfish" catch, which represented 45% of the overall catch in 1985, was essentially the same in 1984 and 1985 (1,217 and 1,219 respectively), with increases for pollock (22%) being offset by decreased catches of yellowtail flounder (21%) and unspecified groundfish (25%). The total "pelagic fish" catch, which represented 23% of the overall catch in 1985, increased significantly (30%) from 469,000 tons in 1984 to 610,000 tons in 1985, due to increased catches of herring (36%), menhaden (24%) and mackerel (89%). The total "other finfish" catch, which represented less than 4% of the overall catch in 1985, decreased (13%) from 112,000 tons in 1984 to 97,000 tons in 1985, due mainly to a decrease in the catch of capelin. The total catch of "invertebrates", which represented 29% of the overall catch in 1984, decreased (8%) from 836,000 tons in 1984 to 773,000 tons in 1985, due mainly to decreased catches of squids (30%), crabs (32%) and oysters (73%), although increases were noted for clams (9%), shrimp (43%) and lobsters (8%).

3. Fishery Trends by Subarea

a) Subarea 0

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

b) Subarea 1

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

c) Subarea 2

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

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

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

d) Subarea 3

The total nominal catch of all species increased (14%) from 533,000 tons in 1984 to 605,000 tons in 1985, due mainly to increased catches of cod (18%), haddock (100%), redfish (10%) and flounders (6%), although declines were noted for capelin (26%) and crabs (30%). In 1985, the cod catch represented 56% of the overall catch in this subarea, followed by redfish (13%), American plaice (8%) and capelin (5%).

e) Subarea 4

The total nominal catch of all species increased (9%) from 703,000 tons in 1984 to 766,000 tons in 1985, due mainly to increased catches of pollock (35%) and herring (51%), although declines were noted for cod (6%), redfish (11%) and American plaice (11%). Cod (29%) and herring (24%) were the most significant components of the overall catch in this subarea, followed by silver hake (10%), pollock (5%), redfish (5%) and crabs (5%).

f) Subarea 5

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

g) Subarea 6

The total nominal catch of all species decreased slightly (3%) from 824,000 tons in 1984 to 803,000 tons in 1985. Significant changes in catches from 1984 to 1985 were increases for

II. STOCK ASSESSMENTS

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

a) Introduction

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

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

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Trawlers	19	46	53	57	16	14	29	42	20	7[1]	
Other vessels	14	27	20	42	38	39	27	21	13	8[1]	
Total (000 tons)	33	73	73[2]	99[2]	54[2]	53	56	63	33	15[1]	
TAC (000 tons)	45[3]	31[3]	-[4]	-[4]	20[3]	50	62	62	68		
CPUE (tons/hr)	0.63	1.29	3.33	2.38	1.24	3.26	2.21	1.36	0.99	28.3	12.5

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

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

During the 1955-68 period, catches fluctuated between 234,000 and 451,000 tons, with the highest catch in 1962. Catches declined gradually after 1968 to a low of 33,000 tons in 1976, after a number of years with recruitment failure. Recruitment of the relatively good 1973 year-class in 1976-77 resulted in increased catches up to 1979. During 1980-83, catches fluctuated between 53,000 and 63,000 tons (close to the TAC level) but decreased sharply in 1984 to 33,000 tons and fell again in 1985 to only 15,000 tons (half the TAC level). The TAC for 1986 has been set at 12,500 tons, with no direct trawl fishery allowed.

b) Commerical fishery data

i) Age composition

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

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

ii) Weight-at-age data

Mean length-at-age, and thereby also mean weight-at-age, of fish caught by Greenland trawlers has decreased substantially over the 1979-84 period. The decrease which was

about 45% over that period seems to have continued in 1985. A decrease in weight-at-age from 1984 to 1985 also was evident for the inshore catches.

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

c) Data from research surveys

i) Stock size and distribution

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

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

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

ii) Age composition

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

iii) Maturity-at-age

Data on maturity-at-age were obtained from the trawl-survey catches. The results dif-

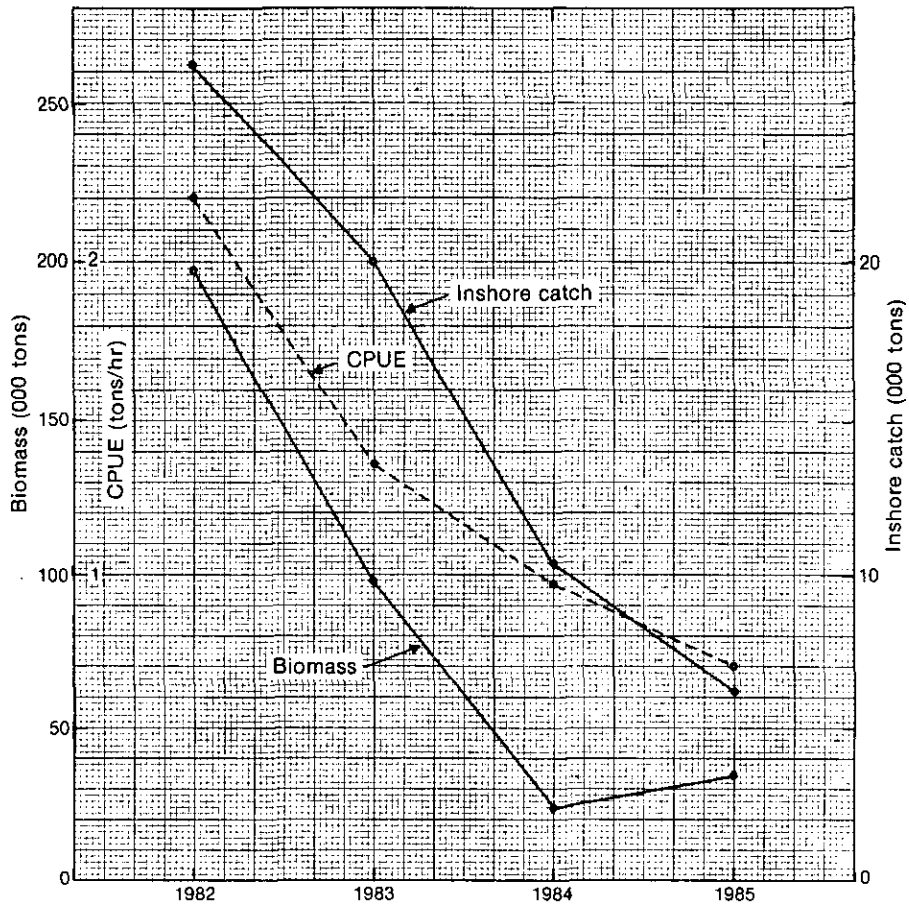

Fig. 1. Cod in Subarea 1: trends in total survey biomass, catch-per-unit-effort of Greenland trawlers and inshore catches, 1982-85.

fered only very slightly from those found in 1983 and used for the 1983 and 1984 assessments. The percentages for 1985 are listed in Table 3.

iv) Environmental data

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

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

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

In the present assessment, the stock estimates for the two consecutive years are each taken at their mid-value, and, although there is a rather high variability connected with each of

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

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

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

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

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

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

e) Recruitment prospects

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

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

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

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

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

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

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

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

The rate of stock rebuilding will depend much upon the actual size of the 1984 and 1985 year-classes but also upon the extent to which these will be fished. The maximum potential in the illustrative examples (Table 5) would be realized by an immediate closure of the fishery in 1986 and a continued closure in 1987 and 1988, but the differences, from 1986

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

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

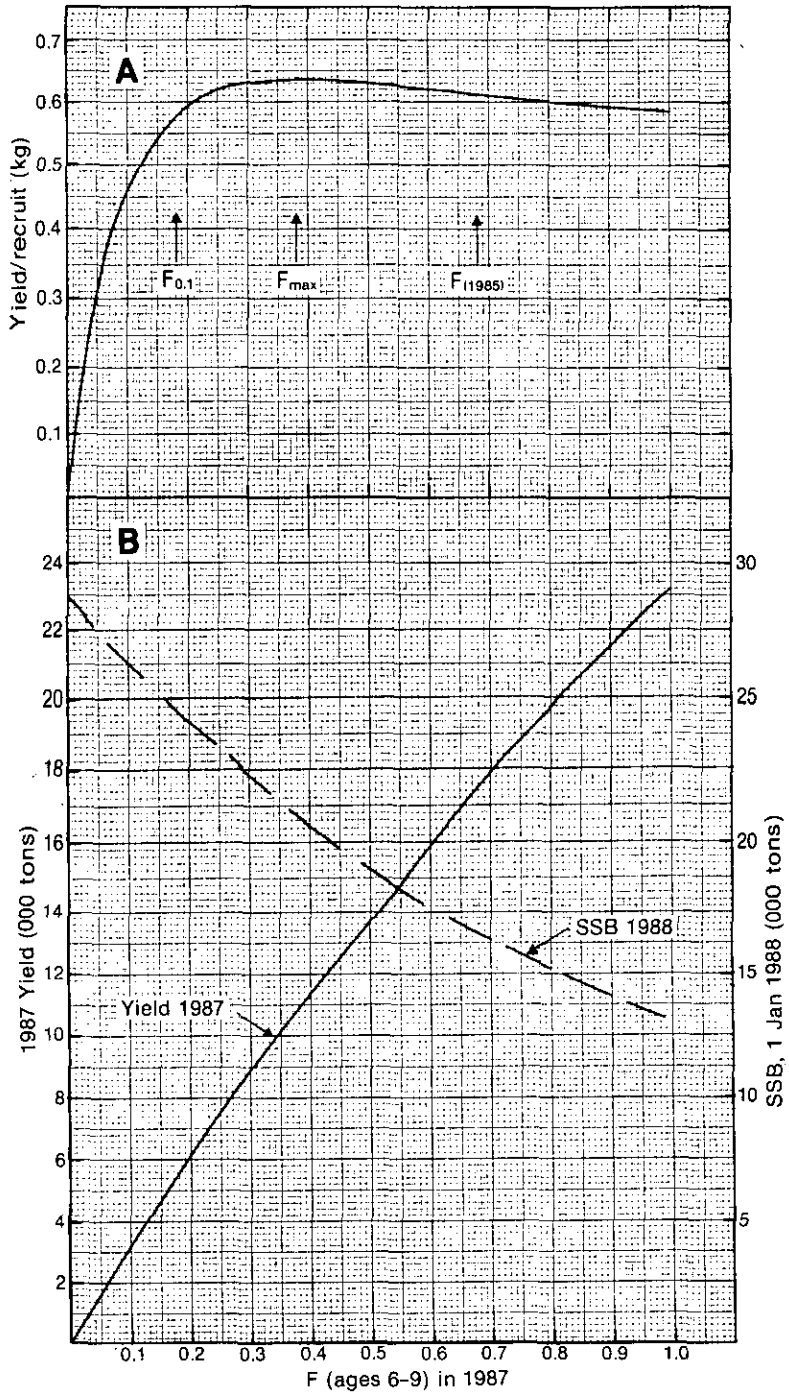

Fig. 2. Cod in Subarea 1: (A) yield-per-recruit curve, and (B) calculated yield in 1989 and spawning stock biomass (SSB) in January 1988 for various levels of fishing mortality in 1987.

onwards, between the projected stock biomasses from such closures and those from the options with small annual catches (fishing at $F_{0.1}$) are marginal.

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

Table 6 shows that 3-year-old fish will dominate the stock by 1987. If that year-class achieves the size used for illustration, 3-year-olds will account for 72% of the stock bio-

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

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

mass but only 11% of the catch ($F_{0.1}$ level). However, by 1988, the year-class could account for more than 62% of the catch (by weight). This clearly illustrates that the actual catch level in the projections depends heavily on a more precise estimate of recruitment of the 1984 and 1985 year-classes.

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

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

i) Offshore distribution

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

ii) Inshore distribution

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

borg southward. It would also be expected to occur as small fish (generally <40 cm) in pound-net catches in 1987.

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

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

The age and length compositions of the samples from the Federal Republic of Germany trawl survey in 1985 showed that, if the 1984 year-class follows the growth of the preceding four year-classes, taking into account that the survey took place at the end of the year, more than half the individuals by age 3 (1987) could be expected to be below 40 cm. Also at age 4 (in 1988), a portion of the individuals may still be below that size.

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

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

i) Management considerations

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

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

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

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

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

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

a) Introduction

Nominal catches for this stock declined from a peak of about 800,000 tons in 1968 to a low of about 139,000 tons in 1978. The catches in recent years (1982-85) have been about 230,000 tons. While Canada continued to take a major portion of the catch in 1985 (80%), the catch by other countries was the highest of the past 6 years, about 40,000 tons. The

catch by inshore gears (trap, longline, handline, gillnet) increased from a low of 35,000 tons in 1974 to a high of 116,000 tons in 1982 and has declined since then to about 78,000 tons in 1985. STACFIS considered that the discrepancies between catches reported by member countries and Canadian surveillance estimates were not large enough to have a significant effect on this assessment. Recent catches and TACs (000 tons) are as follows:

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

[1] Provisional data.

b) Input data

i) Commercial fishery

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

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

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

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

Because this procedure violates the assumptions of the model, it was suggested that

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

In general, the catch-rate series for Div. 2J+3KL showed a decline through the late 1960's to the mid-1970's, followed by a subsequent increase. The 1985 level was about the same as those in the early 1960's. The trends in the catch-rate indices by division are similar to those of the combined series, with the exception of the Div. 2J index. This series showed a decline in 1984 and 1985, which may be attributed to a disruption of fishing activity due to unfavourable ice conditions.

ii) Research data

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

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

[1] Discontinued after 1985.

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

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

c) Estimation of assessment parameters

i) Catch composition, weight-at-age and partial recruitment

Catch-at-age and average weight-at-age data from the commercial fishery were used in cohort analysis for the 1962-85 period. In previous assessments, one set of average weight-at-age values was used for the 1962-76 period and annual values were calculated from 1977 onward. Because of the concern that was expressed during the assessment in June 1985 about the abrupt change in average weight from 1976 to 1977, sampling data were reevaluated and average weight-at-age values were determined separately for each

year from 1972 to 1985. As part of the reevaluation, the catch-at-age matrix was also considered. This reanalysis removed the abrupt change in weight-at-age that had been observed in previous years. Changes in the catch-at-age matrix occurred in some years as a result of updating the reported catches and more appropriate adjustment of sampling information. Mean values of weight-at-age were still used for all years prior to 1972. Natural mortality was assumed to be 0.20.

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

ii) Fishing mortality in 1985

Two research-vessel survey indices were used in calibration of cohort analysis. A survey abundance index for ages 6+ was obtained by combining results from Canadian autumn surveys in Div. 2J, 3K and 3L. Values for 1978-80 during autumn in Div. 3L were estimated from the ratio (1.25) of age 6+ autumn values to age 7+ spring Div. 3L values in the following year for two overlapping years (1981 and 1984). The age 7+ Div. 3L values for 1979-81 were adjusted by this ratio to give age 6+ autumn Div. 3L estimates for 1978-80. Calibration using this survey abundance index and age 7+ population numbers from the cohort in the following year implied a high level of F in 1985 (0.45-0.50). However, the age 7+ spring index for Div. 3L in 1981 seemed anomalously high, and, if this value was more in line with adjacent values, the relationship would imply a fully recruited fishing mortality in 1985 of about 0.35. The relationship of total abundance from November surveys by Federal Republic of Germany in Div. 2J versus age 4+ population numbers at the beginning of the following year implied a fully-recruited fishing mortality in the range of 0.20-0.30 and probably about 0.25. Some concern was expressed about the representativeness of this index, because the survey is conducted only in Div. 2J and may not reflect the abundance of the stock as a whole.

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

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

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

iii) Recruitment

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

In trial cohort analyses, using the predicted strengths of the 1979-81 year-classes and the estimated fully-recruited fishing mortality of 0.25 in 1985, the partial recruitment vector was slightly different from that initially calculated as described in 2c(i). The partial recruitment vector in 1985 was adjusted to reconcile predicted year-class strengths and estimated fully-recruited fishing mortality in 1985. This adjusted partial recruitment was used in the final cohort analyses as well as in the catch projections.

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

d) Catch projections

The parameters that were used to project stock sizes and catches are given in Table 7. The partial recruitment vector, used for the projections, was described in the preceding section. In previous assessments, average weight-at-age values for the most recent 2 years were used. There was a decline in weight-at-age from 1984 to 1985, but it was unclear if this could be attributed to a change in growth or change in fishing pattern. To account for the lower average weight values in 1985, but to dampen the effect of the decrease, the utilized weight-at-age values are averages of the values for 1983-85. The TAC of 266,000 tons was used as the expected catch in 1986, and the 1983 year-class was set at the 1977-82 geometric mean of 250 million fish.

The projections (Table 8) indicate that spawning stock biomass values are slightly below those that were calculated last year. Approximately 40% of the catch biomass in 1987 is accounted for by the 1981 and 1982 year-classes, which may be imprecisely estimated but have been set, based on research-vessel survey results, at a level of 1.6 times the 1977-82 geometric mean and as large as the largest year-class in that time period.

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

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

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

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

Table 8. Cod in Div. 2J, 3K and 3L: projections of spawning stock biomass (age 7+) at beginning of the year and catch during the year at fishing mortality on fully recruited age-groups.

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

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

e) Stock definition (Fig. 3)

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

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

On the basis of inshore tagging during the 1950's and 1960's in inshore waters at many localities from Labrador to the Avalon Peninsula and in offshore waters from Hamilton Bank to the northern Grand Bank, cod of the Labrador-East Newfoundland stock were shown to intermingle and overlap in their winter-spring spawning areas in deep water on the slopes of the Labrador and Northeast Newfoundland shelves. During June-September (the main feeding and growing period) in the years after tagging, the most obvious migratory characteristic was the homing of most of the coastally-tagged cod to or near their tagging areas. Based upon

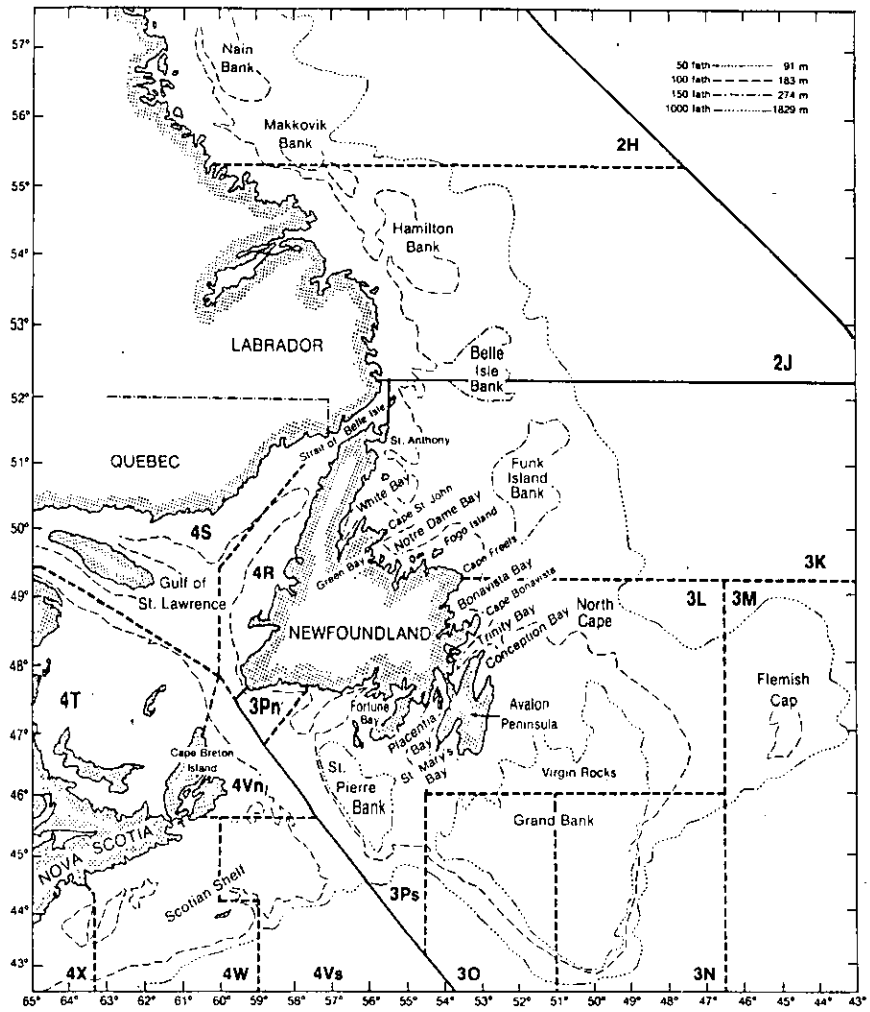

Fig. 3. Area map showing NAFO divisions, offshore banks and some of the place names mentioned under stock discrimination.

the tagging of about 25,000 Atlantic cod during February-March 1978-81 from the prespawning concentrations on Hamilton Bank, Belle Isle Bank, Funk Island Bank and northern Grand Bank, there was evidence of a consistent annual pattern of migration to inshore waters during summer and to offshore areas during winter for each group of cod tagged along the outer continental shelf. The Hamilton Bank component (Div. 2J) evidently contributes to the southern Labrador (Div. 2J) and northeast Newfoundland (Div. 3K) coastal fisheries mainly from Notre Dame Bay northward. The Belle Isle Bank component (located mainly in Div. 2J and a small portion in Div. 3K) migrates during summer mainly to southern Labrador (Div. 2J), the Strait of Belle Isle entrance (Div. 4R) and northeastern Newfoundland as far south as Notre Dame Bay (Div. 3K). The pattern of movement is similar to that of the Hamilton Bank component (Div. 2J) except for the greater proportion in the Strait of Belle Isle from the Belle Isle Bank component.

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

STACFIS considered that the information on infestation by parasites, growth, timing of

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

recommends

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

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

a) Introduction

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

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

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

b) Input data

i) Commercial fishery data

Catch rates presented in SCR Doc. 81/12 for the 1960-80 period, have not been extended due to the scarcity of fishing effort data after 1980. That series showed a decline from about 2.0 in 1963-64 to about 0.5 in 1978-79 and to 0.1 in 1980. Catch-rates from Spanish pair-trawl data, derived from a multiplicative model, did not show any trend during 1983-85.

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

ii) Research data

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

c) Estimation of parameters

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

d) Assessment results

The average biomass (age 3+) was in the range of 30,000-35,000 tons in 1978-80 (NAFO Sci.

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

e) Prognosis

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

f) Fisheries Commission request for information (see Agenda Annex 1, part D, this volume)

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

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

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

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

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

a) Introduction

Nominal catches declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Catches in 1985, as reported to NAFO by member countries and by Canadian surveillance personnel for non-member countries, were estimated to total 41,300 tons, of which more than 75% was taken in Div. 3N. In 1985, catches by Canadian otter trawlers increased substantially over the 1984 level and were the highest since the early 1950's. Spanish catches were mainly by the traditional pair-trawl fleet, with an additional 1,200 tons being taken by a new freezer-trawler component. Recent TACs and catches (000 tons) are as follows:

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

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

b) Input data

i) Commercial fishery data

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

ii) Research surveys

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

iii) Catch-at-age data

Biological sampling data from the Canadian otter-trawl, Portuguese gillnet and Spanish pair-trawl fisheries were used to estimate the age composition and mean weight-at-age of the commercial catch in 1985. Assessments conducted since 1981 have used average weight-at-age values for the earlier years together with those obtained from commercial sampling for years beginning in 1977. Constant average weight-at-age values were used for both the 1959-65 and 1966-76 periods. For the current assessment, data for the 1972-76 period were reanalyzed and average weights for each of these years were determined. The average for this time period was then used as an estimate for each year from 1966 to 1971. This adjustment produced some improvement in the results by reducing some large discrepancies in the calculation of sum of products. The calculated "sum of products" for 1984 was found to be unacceptably low (-21%), and reanalysis of the data indicated that the difference was mainly associated with estimates for the Spanish catch-at-age. Average weights from the Canadian fishery had been applied to these data in the absence of reported figures. Because the average weight-at-age values reported by Canada and Spain for 1985 were similar, it was considered that the average weights used in 1984 might have been inadequate and, consequently, number-at-age values from the Spanish fishery in 1984 were underestimated. For this reason, the Spanish catch-at-age vector for 1984 was adjusted so that the sum of products was consistent.

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

c) Estimation of parameters

i) Partial recruitment

A partial recruitment vector for 1985 was estimated from the ratio of commercial catch-at-age to survey number-per-tow in 1985, after each had been normalized to its highest value. These data suggested full recruitment at age 6, with a diminishing exploitation pattern at older ages, as opposed to full recruitment age 7, which was used in the 1985 assessment of this stock, with assumed full recruitment for the remaining ages. Prev-

ious cohort analyses, using a dome-shaped partial recruitment pattern, did not indicate similar patterns in the adjacent years. Therefore, an average partial recruitment vector for the recent period (1981-83) from cohort analysis was used in subsequent analyses. The values are as follows:

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

ii) Cohort analysis

Catch and average weight-at-age data from the commercial fishery over the 1959-85 period were used in the cohort analysis. A natural mortality rate of 0.20 was used, and the fishing mortality for the oldest age (12) was set at the level for fully recruited ages (7-10).

iii) Fishing mortality in 1985

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

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

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

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

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

a) Introduction

Catches from this stock have ranged from a high of 84,000 tons in 1961 to a low of 27,000 tons in 1978. Since 1977, only Canada and France have prosecuted the fishery, and, because of restrictions on Canadian offshore allocations in recent years, inshore gears (gillnet, cod-trap, line-trawl, and handline) have taken the larger portion of the total catch. In

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

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

[1] Provisional data.
[2] Effective TAC is obtained by combining the Canadian portion (as established by Canada) of the advised TAC with the EEC recommended catch as given in EEC regulations.
[3] See NAFO Sci. Coun. Rep., 1985, page 59.

b) Input data

i) Commercial fishery catch-effort data

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

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

ii) Research surveys

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

The timing of surveys in this area was considered to be an important source of variation between the two sets of data. In particular, it was thought that the higher abundance and biomass estimates in the French surveys, particularly in 1986, may have resulted from a migration of some cod from the eastern Gulf of St. Lawrence stock (Div. 3Pn+4RS) to the general area of Burgeo Bank in winter. Some intermixing of the two stocks, variable between years in this area during the early months of the year, has been documented previously and is based on tagging and growth data (Templeman, 1978) Therefore, survey data from both countries were analyzed, after excluding observations from the Burgeo Bank portion of the stock area (Strata 306-309). This procedure did not reconcile the two series, but they did show a similar population age structure in 1986. The 1980 and 1981 year-classes were most abundant in both surveys.

iii) Catch-at-age data

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

c) Estimation of parameters (Table 9)

i) Partial recruitment

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

ii) Cohort analysis

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

iii) Fishing mortality in 1985

The relationships of abundance estimates from cohort analysis and survey results of the French and Canadian surveys, excluding Burgeo Bank, at ages 3+ and 6+, by using unweighted least squares regression analysis, indicated a significant relationship only for age 3+ from the French survey data. Use of the criterion of best 'fit' on the basis of the balance of residuals from 1983 to 1985 implied an F-value of approximately 0.45 in 1985. Examination of the relationship between exploitable offshore biomass and catch rates indicated different trends in the 1977-85 period than in the earlier period. It was felt that, due to possible changes in fleet behavior after 1976, the use of the recent series was more appropriate. STACFIS noted that fishing mortality in 1985 could not be precisely determined by this method but considered that the results implied an F between 0.25 and 0.45.

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

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

d) Projections

Catch projections were considered by assuming F-values of both 0.25 and 0.45 for 1985 and a catch of 41,000 tons in 1986, with mean weight and partial recruitment vectors as given in Table 9. Recruitment values for 1986 and 1987 were assumed to be equal to the geometric mean of 55 million fish, as used in previous assessments. These projections imply a catch at $F_{0.1}$ (0.2) in 1987 in the range of 26,000-58,000 tons which encompasses the 1985 effec-

tive TAC. STACFIS noted that the requested advice could not be provided because of the difficulty in estimating fishing mortality for 1985.

e) Recommendation for database improvement

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

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

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

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

f) Reference cited

TEMPLEMAN, W. 1978. Migration and intermingling of stocks of Atlantic cod of the Newfoundland and adjacent areas from tagging in 1962-66. ICNAF Res. Bull., 14: 550.

6. Redfish in Subarea 1

a) Introduction

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

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Catch	14	31	8	9	8	6	8	8	6	2[1]

[1] Provisional data.

b) Catch projections

The *Sebastes marinus* stock was assessed at the ICNAF Meeting in June 1979 (ICNAF Redbook, 1979, page 74), at which time a general production analysis indicated a maximum sustainable yield (MSY) level of about 10,000 tons, with an equilibrium catch at 2/3 MSY effort of about 9,000 tons. Further assessment has not been possible and no new information is available. STACFIS presently has no basis on which to advise whether a catch of 9,000 tons in 1987 will correspond to 2/3 MSY effort.

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

a) Introduction

The total nominal catch has been at the level of the TAC since 1983. The USSR continued to dominate the fishery, catching 13,800 tons in 1985. Large discrepancies (35%) between

catches as reported to NAFO and those estimated from Canadian surveillance were noted. Recent TACs and catches (000 tons) are as follows:

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

[1] Provisional data.

b) Input data

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

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

c) Estimation of parameters

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

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

d) Catch projections

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

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

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

a) Introduction

The reported catch of 21,000 tons in 1985 was 6,000 tons higher than the 1984 catch. About 3,000 tons of this increase was attributable to a new Spanish freezer-trawler fishery, primarily in Div. 3N. Only small discrepancies were noted between Canadian surveillance estimates of catch and those reported to NAFO. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	20	16	16	18	25	25	25	25	25	25	25
Catch	21	17	12	14	16	24	22	20	15	21[1]	

[1] Provisional data.

b) Input data

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

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

c) Estimation of parameters

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

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

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

d) Catch projections

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

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

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

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

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

a) Introduction

The fishery for silver hake in Div. 4VWX is mainly undertaken by large trawlers using small-meshed bottom otter trawls. Prior to 1977, the fishery for silver hake was not restricted to a particular season or area. Since 1977, the fishing season has been from April to November and the fishery has been restricted to the seaward side of the Small-Mesh-Gear-Line (SMGL). Nominal catches of silver hake increased from about 169,000 tons in 1970 to 300,000 tons in 1973 and declined to 37,000 tons in 1977. Catches after 1977 fluctuated between 43,000 tons and 60,000 tons until 1983 when a catch of 36,000 tons was reported. The catch increased to 74,000 tons in 1984, and the provisional catch in 1985 was 76,000 tons. Recent TACs and catches (000 tons) are as follows:

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

[1] Provisional data.

b) Input data

i) Commercial fishery data

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

The results indicated that the only significant effect in the model was "year". There was interannual variation in the catch rates but no variation that could be explained by month, division, fishing regime or data source (NAFO or Canadian IOP). A separate analysis was carried out by comparing monthly catch rates from NAFO and the Canadian IOP, and the regression was highly significant with correlation coefficient of 0.96, slope of 1.0 and intercept of 0.0 (SCR Doc. 86/82). STACFIS was encouraged by the progress in examining how the factors mentioned above might affect the catch-rate series and recommends that it should be updated annually and retained as an index of abundance. The new catch-rate series is as follows:

Year	CPUE	Year	CPUE	Year	CPUE	Year	CPUE
1970	2.295	1974	1.676	1978	1.599	1982	4.198
1971	1.733	1975	1.476	1979	1.764	1983	2.251
1972	1.888	1976	2.146	1980	1.673	1984	3.042
1973	2.476	1977	1.946	1981	1.420	1985	3.263

Commercial catch rates during 1982-85 were higher than any other year since 1973. The catch rate for 1982 (the largest in the series) was approximately 3 times larger than the 1981 value. It is considered unlikely that such a drastic change in CPUE was representative solely of a change in biomass. The 1983 CPUE was approximately half the 1982 value and the 1984 and 1985 values were higher than in 1983.

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

that year. Commercial samples were available from Canadian and USSR observers, but the 1985 age composition, adopted by STACFIS, was calculated from the Canadian data, this being consistent with the procedure in the June 1985 assessment. Age-validation studies of silver hake are continuing and a more detailed account of the results of these is given elsewhere in this report (see Section V.4).

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

ii) Research vessel indices

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

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

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

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

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

It was agreed that, because both methods produced similar results, either index could be used in assessments, and it was recommended that the same method be adopted by both

countries for future work and that future surveys should cover as wide an area as possible, including strata outside the core area where juveniles have occurred during previous years. The decision on which method to use in future assessments was deferred until the September 1986 Meeting.

iii) Environmental data

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

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

c) Estimation of parameters

i) Total mortality

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

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

ii) Partial recruitment

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

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

iii) Natural mortality

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

iv) VPA calibration

Based on the conclusion that the standardized catch-rate series may be a useful index of abundance, it was used in an attempt to calibrate the VPA. Exploitable biomass was calculated from VPA mean biomass and the two partial recruitment vectors given above.

A preliminary calibration plot indicated that the 1982 CPUE was anomalously high, and this point was removed from the calibration. The criterion for selecting terminal fishing mortality (F_t) was a combination of the maximum correlation coefficient, the minimum sum of the last three squared residuals standardized by the standard error of the regression, the minimum absolute standardized residual for 1985 and the closeness of the intercept to zero. Calibration plots were also examined for serial correlation. The various criteria indicated different values of F_t. The correlation coefficient was highest (0.88) at F_t = 0.10 and declined to 0.70 at F_t = 0.25. The residual sum of squares was minimized at F_t = 0.05 and the 1985 residual was smallest at F_t = 0.30. The intercept was closest to zero at F_t = 0.25. Serial correlations in the residuals indicated severe trends in catchability. Based on these results, STACFIS was not able to estimate fishing mortality in 1985. The VPA's with F_t = 0.25 and 0.40 showed that average F on ages 3 and 4 for the 1977-85 period was approximately 0.40. Under all levels of F_t used (0.05-0.50), the calculated biomass increased steadily from 1978 to 1985.

v) Yield-per-recruit

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

d) Prognosis and catch projections

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

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

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

e) Future studies

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

10. American plaice in Division 3M

a) Introduction

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

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

[1] Provisional data.

b) Input data

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

c) Catch projections

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

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

a) Introduction

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

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	47	47	47	47	47	55	55	55	55	49	55
Catch	52	44	50	49	49	50	51[1]	39[1]	38[1]	51[2]	

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

b) Input data

i) Commercial fishery

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

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

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

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

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

ii) Research-vessel surveys

Data from Canadian research-vessel surveys, conducted in the spring of 1985 and 1986 in Div. 3L, 3N and 3O, indicate a decline in biomass from the relatively-stable level of the 1977-82 period. However, survey coverage was incomplete in 1983-84, which are important years in evaluating the apparent decline between the estimates for 1982 and 1985. Preliminary analysis of the 1986 survey data indicates virtually the same biomass estimate as was calculated for Div. 3L and 3N in 1985 and a decline of about 37% for the smaller portion of the stock in Div. 3O. Results from Canadian autumn surveys in Div. 3L during 1981-85 showed a decline in biomass from 314,000 tons in 1984 to 220,000 tons in 1985. However, the 1984 survey was about 2 months earlier in the year than the others in this series, and the value for 1985 was close to the average of the 1981-83 values (249,000 tons).

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

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

c) Estimation of parameters

i) Partial recruitment

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

ii) Natural mortality

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

iii) Fishing mortality

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

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

Age	Population in 1985 (000)	Catch in 1985 (000)	Mean wt. kg	PR
6	214,000[1]	254	0.369	0.025
7	180,000[1]	1,748	0.435	0.100
8	75,448	5,081	0.500	0.220
9	113,483	10,270	0.593	0.300
10	109,435	15,086	0.648	0.470
11	81,339	13,590	0.731	0.580
12	42,013	8,622	0.914	0.730
13	13,963	3,759	1.205	1.000
14	5,810	1,564	1.541	1.000
15	3,447	928	2.006	1.000
16	999	269	2.605	1.000
17	338	91	2.969	1.000
18	26	7	3.554	1.000
19	4	1	3.377	1.000

[1] Geometric mean (1974-83).

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

d) Assessments results

The VPA (cohort analysis) with $F_t = 0.35$ showed a relatively stable population size at ages 8+ from 1981 to 1985. The 1985 biomass for these ages and the 1985 CPUE value compared well with the 1967-69 averages for ages 8+ biomass and CPUE. The population sizes at ages 6 and 7 in 1985 were unreasonably low, and, given the sensitivity of these values to slight changes in partial recruitment, geometric means (GM) were used in the catch projections. The VPA value for the population at age 8 in 1985 was low compared to other years, and this agreed with the results of recent surveys which showed the 1977 year-class to be relatively weak.

Various trends in some population parameters and a yield-per-recruit curve are illustrated in Fig. 4-6.

e) Catch projections

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

The yield-per-recruit curve for this stock indicates $F_{0.1}$ to be 0.26, but F_{max} is unrealistically high (>3.0) because of the extensive flat-topped portion of the curve.

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

Trends in yield and spawning stock size with fishing mortality are shown in Fig. 7.

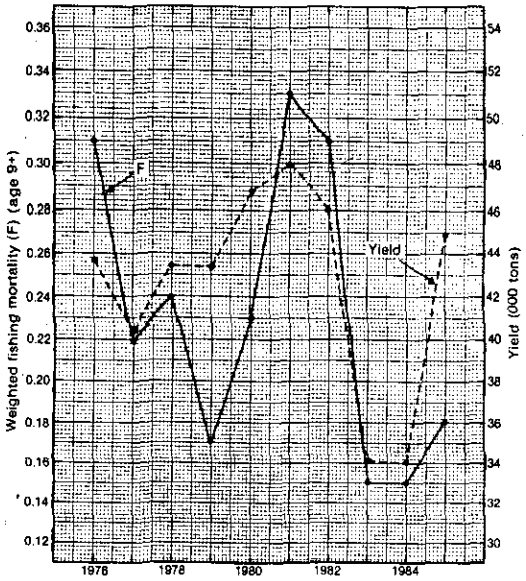

Fig. 4. American plaice in Div. 3LN: trends in yield and fishing mortality in 1976-85.

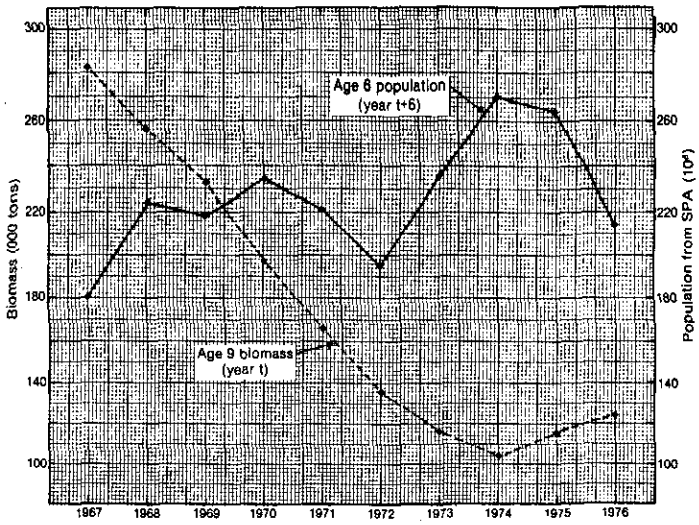

Fig. 5. American plaice in Div. 3LN: trends in age 9+ biomass in year t and age 6 recruits in year t+6, for the 1967-76 period.

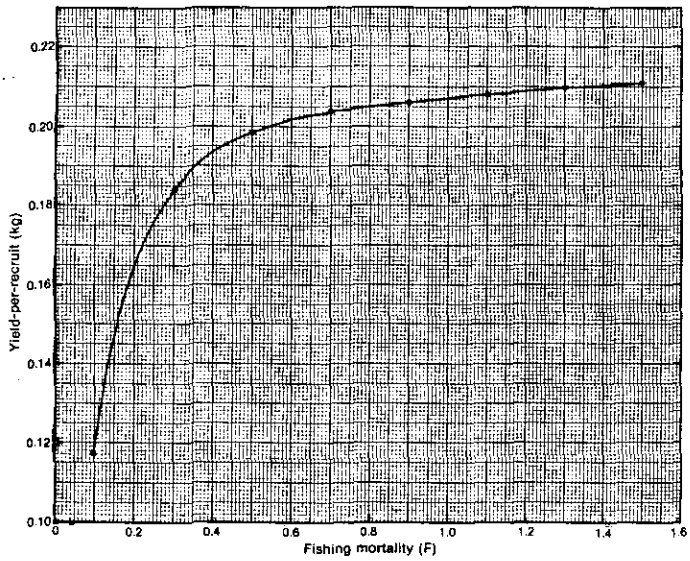

Fig. 6. American plaice in Div. 3LN: yield-per-recruit curve.

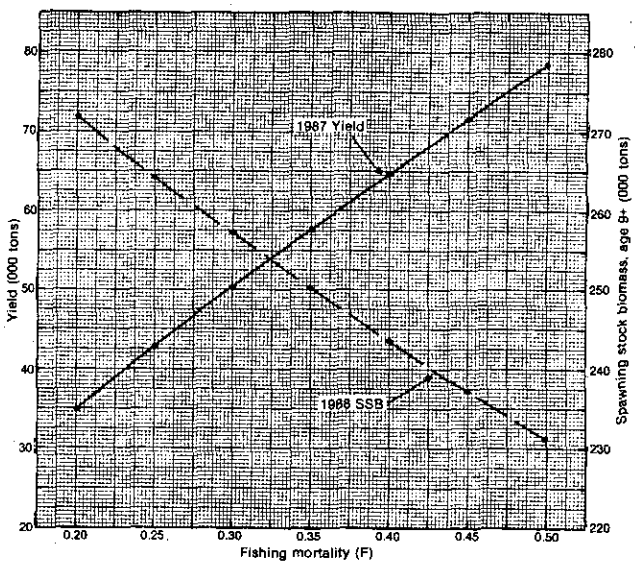

Fig. 7. American plaice in Div. 3LN: projected yield (1987) and age 9+ biomass (1 Jan 1988) for a range of fishing mortality (F).

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

a) Introduction

Catches of witch flounder have ranged from 8,000 tons in 1974 to approximately 2,400 tons in 1980 and 1981. Provisional data for 1985 indicate a catch of about 8,500 tons, the highest recorded catch since 1972. This catch is nearly twice the 1985 TAC. Recent catches and TACs (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	10	10	10	7	7	5	5	5	5	5	5
Catch	6	6	3	3	2	2	4	4	3	9[1]	

[1] Provisional data.

b) Input data

Catch and effort statistics were available for Canadian trawlers which fished the south-western slope of the Grand Bank during winter and spring in 1972-85. As in previous analyses, a directed fishery was assumed when the main species in the catch was witch flounder. The highest catch rate of 0.72 tons/hr was recorded in 1972. The catch rate declined to 0.25 tons/hr in 1975, then increased to 0.67 tons/hr in 1981 and 1982 and declined to 0.38 tons/hr in 1983. The catch rate in 1985 was 0.57 tons/hr, this being the third highest catch rate in the past 14 years. Considering the level of the 1982, 1983 and 1985 catch rates and the fact that they are based upon relatively high proportions of directed catch, STACFIS concluded that the stock may have been relatively stable during 1982-85 at some level higher than in the previous 10 years. An attempt was made to update the general production analysis of 1980, upon which the present TAC is based, but the CPUE-effort relationship was not statistically significant.

c) Catch projections

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

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

a) Introduction

Nominal catches since 1967 have ranged from 8,000 to 39,000 tons and have averaged about 15,500 tons annually in 1980-85. Catches by USSR vessels exceeded 3,400 tons in the 1967-75 period, while Canada was virtually the only nation involved in the fishery during 1976-81. Since 1981, other nations have joined the fishery, notably South Korea in 1982-85, and Panama, Spain, USA and Cayman Islands in 1985. This increased participation in the fishery in 1985 resulted in an estimated overall catch of 26,900 tons, an increase of 79% from the catch in 1984. The estimated catch of 13,600 tons by non-Canadian vessels in 1985, 82% of which was taken by non-member countries, was taken exclusively in Div. 3N and 3O, outside the Canadian 200-mile fishery zone. Recent TACs and catches (000 tons) are as follows:

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

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

b) Input data

i) Commercial fishery

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

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

ii) Research vessel surveys

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

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

c) Assessment results

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

d) Catch projections

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

e) Response to Fisheries Commission questions

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

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

a) Introduction

Nominal catches peaked at 25,000 tons in 1975 and have been less than 10,000 tons annually since 1980. In recent years, the fishery has been prosecuted mainly by inshore Greenland fishermen using gillnets and longlines with a small by-catch in the offshore fishery. The Greenland inshore catch increased by 30% from 1984 to 1985 to about 9,000 tons. The increase was due to an increase in fishing effort in a directed fishery as compensation for the decrease in the trap fishery for cod. Recent TACs and catches (000 tons) are as follows:

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
TAC	20	20	20	25	25	25	25	25	25	25	25
Catch	16	13	12	19	8	10	9	9	7	9[1]	

[1] Provisional data.

b) Input data

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

c) Catch projections

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

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

a) Introduction

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

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

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

b) Input data

i) Commercial fishery data

Some information on directed fishing effort by Canada (N) trawlers in Div. 2H, 2J and 3K was available for 1980-85, although the calculated catch rates (tons/hr) were often based upon relatively low levels of directed catch. Similar information was also available from Polish vessels for 1979 and 1981-85, but catch rates were also based upon some low levels of directed catch, particularly in the more recent years. In all cases, the catch rates declined from 1984 to 1985 in all three divisions. The decrease may be related to the fact that the strong year-classes of the early 1970's, which contributed to the relatively high catch rates during the early 1980's, have now passed through the accessible fishery. On the other hand, it was expected that the entry of the strong 1979 and 1980 year-classes to the fishery would help maintain the catch rates in 1985. Although they did account for much of the 1985 catch by numbers, it may have been too early to have expected them to contribute much in terms of weight to the 1985 catch rates. It was also believed that the decline in catch rates from 1984 to 1985 could be related in part to environmental factors. During the summer of 1985, catch rates for Greenland halibut by the Canadian trawler fleet were reasonable when

the fishery began, but they declined so abruptly that the fishery was no longer economical. Consequently, fishing effort was diverted to other species.

ii) Research vessel surveys

Estimates of biomass from research-vessel surveys by Canada and the USSR declined from 1984 to 1985. However, in view of the estimates of minimum trawlable biomass that have been associated with this stock in the recent past (435,000 tons in 1984, assuming 200,000 tons in Div. 2GH), it is obvious that exploitation was not the reason for this decline. It was noted from the USSR surveys that the highest abundance occurred in depths greater than 1,000 m, possibly a result of very cold water at shallower depths. Because very little area is surveyed beyond 1,000 m in USSR surveys and none at all in Canadian surveys, it is possible that much of the biomass was outside the range of the surveys. This could also partially explain the decline in Canadian commercial catch rates, because most Canadian vessels are not capable of fishing at such depths.

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

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

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

c) Estimation of parameters and assessment results

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

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

Due to the lack of suitable calibration procedures for the VPA, estimation of fully-recruited fishing mortality for this stock remains difficult to calculate with any degree of precision. Although STACFIS still considered the overall fishing mortality of this stock to be quite low, it was pointed out that fishing mortality on the major age-groups may be con-

siderably higher. Furthermore, most exploitation may occur on age-groups which have not contributed to the spawning stock. Despite these concerns, STACFIS continues to believe that commercial exploitation of this stock is minimal.

d) Catch projection

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

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

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

a) Introduction

The nominal catch in 1985 was only 51 tons. Since 1978, all catches have been by-catches in the Greenland halibut fishery. Recent TACs and catches (000 tons) are as follows:

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

b) Input data

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

c) Catch projections

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

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

a) Introduction

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

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

[1] Provisional data.

b) Input data

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

c) Estimation of parameters

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

d) Catch projections

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

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

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

a) Introduction

The nominal catch off West Greenland includes two species: Atlantic wolffish (*Anarhichas lupus*) and spotted wolffish (*A. minor*). Since 1957, the total combined catch has been in the range of 2,000-6,000 tons. There is some indication that the officially-reported catches for 1977-79 were overestimated. Recent catches (000 tons) are as follows:

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

[1] Provisional data.

b) Input data

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

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

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

Tagging experiments of spotted wolffish show that they are rather stationary, although, in the Nuuk area, there seems to be some indication of a local seasonal migration, possibly related to spawning and feeding.

c) Catch projections

Until more biological data and detailed fishery statistics for the two species become available, it is not possible to carry out a detailed assessment. However, the available statistics and earlier biological information (NAFO Sci. Coun. Studies, No. 1, pages 35-40; NAFO Sci. Coun. Rep., 1979-80, pages 85-86) indicate that a catch in the range of 5,000-6,000 tons, corresponding to a long-term average catch, seems to be reasonable.

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

a) Introduction

Nominal catches of capelin in these divisions increased from about 1,600 tons in 1971 to 166,000 tons in 1975 and declined to 12,000 tons in 1979. No offshore fishing was allowed in the region during 1979-85. Provisional statistics for 1985 indicate a total catch of 26,000 tons in the inshore fishery of Div. 3L by purse seines, beach seines and traps during June and July. Recent TACs and catches (000 tons) are as follows:

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

[1] For Div. 3L only in 1979-85.
[2] Management measures adopted by Fisheries Commission without STACFIS advice NAFO Sci. Coun. Rep., 1981, page 83).
[3] Countries without allocations could each take up to 5,000 tons.
[4] Provisional data.

b) Input data

i) Commercial fishery (SCR Doc. 86/15)

A logbook survey of the inshore capelin fishery in Div. 3L, which was designed to provide estimates of catch-per-unit-effort, was initiated in 1981. The catch rates of trapnets and seines in the following table (where catches are derived from the addition of the quantities actually landed and the quantities of discards from logbooks) show similar patterns over the 5-year period, increasing from 1981 to 1983, declining in 1984 and increasing in 1985. The relative increase from 1984 to 1985 was greater for trapnets and the trap-net catch rate was the highest in the series.

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

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

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

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

ii) Research data (SCR Doc. 86/14, 53, 64, 65, 79)

Aerial surveys of capelin in Trinity Bay and Conception Bay have been conducted in June and July since 1982 (SCR Doc. 86/14). Total surface-area of schools, estimated from aerial photographs, provided an index of abundance. The patterns in this index agree with the patterns of trapnet catch rate and predictions of mature biomass derived from acoustic estimates of immature capelin from offshore surveys.

An acoustic survey, conducted by Canada in Div. 3L during 10-29 May 1985, provided a biomass estimate of 3,426,000 tons, in contrast to an estimate of 353,000 tons from an April-May survey in 1984 (SCR Doc. 86/79). The difference is attributable to both the presence of large numbers of the 1983 year-class in the 1985 survey and the fact that a portion of the planned survey in 1984 could not be completed due to ice cover.

An acoustic survey was also conducted by Canada in Div. 3L and 3NO during 21 June-08 July 1985. The capelin biomass in Div. 3L was estimated to be 1,001,000 tons and the 1983 year-class dominated by number and weight. A comparable survey in 1984 resulted in a biomass estimate of 458,000 tons. The 1983 year-class dominated by numbers and the 1982 year-class dominated by weight. The estimates from the June 1985 survey were much lower than estimates derived from the survey conducted approximately one month earlier. It was considered unlikely that natural mortality could account totally for the decline, but it was possible that some portion of the capelin stock had moved out of the survey area.

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

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

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

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

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

The estimates of year-class size in Div. 3L from the Canadian survey in May 1986 indicated that the relative strengths of the 1983 and 1984 year-classes were consistent with results of previous surveys. The 1983 year-class was strong in USSR and Canadian surveys in 1985

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

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

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

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

A method of estimating natural mortality rates (SCR Doc. 86/64) was reviewed, and a summary of this review is given in Section VI(1) of this report.

d) Catch projections

The results of the projections, using the above estimates of year-class strength and the parameters in Table 11, together with M = 0.30 (between spawning periods) and a spawning date of 1 June, are given in Table 12.

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

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

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

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

Even though STACFIS has used the most recent estimates of year-class abundance, the projected values of mature biomass may be biased upwards. The estimates of proportions mature from the 1986 survey may be underestimated, because a portion of the mature stock may have

already moved inshore to spawn and would not have been available to the survey. This would result in overestimates of mature biomass in 1987. The estimates of year-class strength were obtained from an acoustic survey that was conducted in Div. 3L where it is believed that capelin from the Div. 3L and Div. 3NO stocks mix. However, the relative proportions of these two stocks could not be quantified, and projections have been calculated for Div. 3L using the total estimate of year-class abundance from Div. 3L. This would result in an overestimate of projected abundance in Div. 3L for 1987.

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

e) Future research

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

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

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

a) Introduction

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

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

Year	SA 2	SA 3	SA 4	Total SA 2-4	Total SA 5-6	Overall total
1976	-	11,257	30,510	41,767	24,936	66,703
1977	6	32,748	50,726	83,480	24,883	108,363
1978	7	41,369	52,688	94,064	17,568	111,632
1979	1	88,832	73,259	162,092	17,341	179,433
1980	1	34,779	34,826	69,606	17,864	87,470
1981	-	18,061	14,142	32,203	15,574	47,777
1982	-	11,164	1,744	12,908	18,188	31,096
1983	-	-	421	421	11,623	12,044
1984	-	393	318	711	9,999	10,710
1985[1]	-	404	269	673	6,069	6,742

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

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

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

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

b) Input data

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

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

Research survey abundance indices were available only from Canadian surveys in Div. 4VWX. The July abundance indices for 1972-85, which have been standardized with the currently-used vessel and gear (*Alfred Needler*/Western IIA) as the standard (SCR Doc. 86/52) are as follows:

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Number per tow	16.2	16.6	23.2	70.9	376.6	102.8	39.1	147.5	32.7	47.9	11.1	57.0	13.5	69.2

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

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

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

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

Commercial and research data for Subarea 3 in 1985 again indicated extremely low abundance both inshore and on the Grand Bank. Temperatures at Holyrood, Newfoundland, in 1985 were slightly lower than in 1984.

iii) Biological characteristics (SCR Doc. 86/17, 26, 52)

relative to the arrival times in 1978-84. First-arriving squid in 1985 were smaller than first arrivals during the same period (except 1983), and, as the season progressed, mean sizes remained smaller than those of previous years. As in the most recent years, two cohorts of squid were observed in Div. 4VWX. The smaller squid of the second cohort were restricted largely to the intermediate (51-100 fm) depth range. Two cohorts were also observed inshore in Subarea 3, and, based on sizes relative to times of observations, these appear to have been the same two size-groups that occurred on the Scotian Shelf. The second cohort appears to have arrived inshore at Newfoundland roughly 2 months after being observed on the Scotian Shelf. Although two cohorts are commonly seen on the Scotian Shelf, the second cohort is rarely seen inshore at Newfoundland.

c) Catch projections

No new information was available for prediction of squid biomass in 1987. Therefore, STACFIS has no reason to change its advice from that which was formulated in 1980 (NAFO Sci. Coun. Rep., 1979-80, pages 39-40 and 57-59) and advises that the TAC for 1987 should remain at 150,000 tons.

d) Future research requirements

Because an understanding of the basic life history and stock characteristics of *Illex illecebrosus* is important to the future management of this resource, STACFIS

recommends

i) continuation of larval-juvenile surveys to identify spawning areas and factors influencing recruitment of squid to the fisheries; and

ii) continuation and expansion of larval-juvenile surveys in the northern areas off Georges Bank, Scotian Shelf and Grand Bank to more adequately cover the distributional range of squid between approximately 70°W and 50°W.

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

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

III. RESPONSE TO FISHERIES COMMISSION REQUEST

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

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

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

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

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

within the Regulatory Area (25%), the maximum proportion of the entire Div. 2J+3KL cod stock estimated to occur in the Regulatory Area is less than 10% in winter and less than 5%, on average, throughout the year.

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

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

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

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

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

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

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

2. Cod in Division 3M

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

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

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

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

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

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

Recent estimates from fall surveys are available for Div. 2J, 3K and 3L. The estimated biomass in the Regulatory Area during the fall of 1985 was 5,782 tons or 3.5% of the total. Estimates were unavailable for Div. 2G and 2H in 1985, but surveys in 1978, 1979 and 1981 indicated that the biomass in this area was about 200,000 tons, thus implying that 3.5% is a maximum for the stock as a whole.

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

Length (cm)	1982 (Age 1)	1983 (Age 2)	1984 (Age 3)	1985 (Age 4)
7	2			
10	71			
13	42	2		
16		82		
19		908	3	
22		5235	53	2
25		4846	189	7
28		1197	360	26
31		125	565	92
34		18	818	173
37		2	822	313
40		-	561	537
43		2	332	684
46		-	140	681
49		2	41	640
52			11	485
55			1	308
58			-	200
61			-	87
64			1	26
67				4
70				1
73				1
Total	115	12,420	3,899	4,269
Average length	11.0	23.6	35.2	45.9

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

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

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

Data are insufficient to provide an answer to this question.

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

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

4. Roundnose grenadier in Subareas 2 and 3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6. Squid in Subareas 3 and 4

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

There is evidence that squid (*Illex*) migrate as juveniles from the Gulf Stream Frontal Zone into the Regulatory Area of both Subareas 3 and 4 in the spring. They are subsequently harvested as adults during their on-shelf residency period which extends to late autumn. In Subarea 4, there is no fishery outside the 200-mile fishery zone, which might intercept some of the juveniles as they migrate to the Scotian Shelf. In Subarea 3, fisheries do occur in the Regulatory Area both

on the Grand Bank and Flemish Cap. These fisheries could intercept migrating juveniles as well as harvest that portion of the biomass remaining as adults outside the 200-mile fishery zone. The proportions of squid biomass either migrating into and/or later remaining in the Regulatory Area of Subareas 3 and 4 and in the area within 200 miles in Subarea 3 are unknown. However, historical fishing patterns and catch data indicate that squid biomass on the Grand Bank and Flemish Cap is considerably less than that found inshore in Newfoundland and on the Scotian Shelf. Data on nominal catches of *Illex* in Div. 3N (Tail of Grand Bank) and Div. 3M (Flemish Cap) relative to total catches in Subarea 3 during 1976-82 are presented in Table 15. Since the 200-mile fishery zone roughly bisects that area of the Grand Bank falling within Div. 3N, it has been assumed that 50% of the catch for this division is fished outside the zone. It has also been assumed that the proportion of total catch from those parts of Div. 3O (Tail of Bank) and Div. 3L (Nose of Bank) in the Regulatory Area are negligible. Of the total of 238,210 tons caught in Subarea 3 during 1976-82, it is estimated that only 1,367 tons (0.6%) came from the Regulatory Area (0.5% from Div. 3N and 0.1% from Div. 3M). If catches are assumed to reflect availability of biomass, it would appear that only a very small proprotion of the stock is found in the Regulatory Area. It is recognized that allocations and restrictions of fishing activity subsequent to establishment of the 200-mile fishery zone may have influenced the distribution of catches.

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

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

IV. ENVIRONMENTAL RESEARCH

1. Introduction

The fifth meeting of the Subcommittee on Environmental Research was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, during 9-10 June 1986, with M. Stein (EEC) as Chairman. Annex 7 contains the detailed report of the meeting but a brief summary follows.

2. Review of Environmental Studies in 1985

A total of 22 documents referred to environmental conditions in Subareas 0-6 during 1985. Slightly warmer-than-normal conditions were observed in summer and autumn over Fyllas Bank, ending several years of extremely cold conditions. Investigations of the Baffin Island Current showed that, between the autumn of 1984 and the end of 1985, the volume of cold water had decreased, indicating that warming has taken place. The negative temperature anomalies of the Labrador Current to a depth of 200 m in the region of Hamilton Bank were smaller than in the previous year, and it was suggested that the very cold conditions that have existed since 1982 may be changing. Colder and fresher than normal subsurface waters were observed during the spring over the tail and the eastern slope of the Grand Bank and over Flemish Cap. In contrast, water along the southwest slope was observed to be warmer than the long-term. In 1985, water temperatures of the 'cold pool' in the Mid-Atlantic Bight southeast of Sandy Hook, New Jersey, were higher-than-normal.

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

As a continuation of a project which began in 1983, the 1986 presentation provided an overview of (i) sea-surface temperature data from the Gulf of Maine to Labrador and southwestern Greenland, (ii) subsurface temperatures and salinities off Newfoundland and in the Bay of Fundy, (iii) wave

heights and ice conditions in the Labrador Sea region, and (iv) meteorological observations of air temperature and sea-surface pressure. Except for warmer-than-normal conditions off south-western Greenland, sea-surface temperature anomalies were negative in the north and positive in the south. Air temperatures were above normal in the north and below normal in the south. Anomalous low pressure systems dominated the atmospheric circulation patterns over the North Atlantic, which could account for the milder conditions off West Greenland.

4. Environmentally-induced Variations in Stock Assessment Parameters

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

V. AGEING TECHNIQUES AND VALIDATION STUDIES

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

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

From the progression of modes in the age compositions, growth appeared to be linear over the range of modal lengths examined. Regression of modal length and year allowed the identification of year-classes in the years at which the modal lengths were predicted to be about zero. Modal lengths were consistent with average lengths that were derived for the same year-classes from age determinations. The modal length at age 1, either observed or extrapolated from the linear regressions, was in the range of 10-15 cm. In an earlier study on growth rates of larvae (SCR Doc. 82/37), the extrapolated standard length of age 1 cod in February was 11 cm, which is consistent with the range from modal analysis. Off West Greenland, 11-cm cod have been designated as age 0 (age 1 in the following month).

Repeated age readings (4,320) from a batch of 360 otoliths, with the age reader being unware of the length of the specimens or the year of capture, indicated a probability in excess of 90% of determining the same age. Discrepancies were almost always within one year of the modal age. A comparison of the modal ages from this test with the original age readings showed agreement of about 85% for the years 1977, 1980, 1982 and 1984. Agreements in 1978 and 1979, however, were 70% and 72% respectively. Further, there was a bias in that, where there were differences, the original ages were almost invariably higher. The samples of 60 otoliths each from these two years indicated inconsistencies both in the age compositions and average lengths. The variation in these parameters to be expected from samples as small as 60 otoliths was not quantified. STACFIS concluded that the age determinations from this series were reasonable and indicated that the provision of other validation studies of cod on Flemish Cap would be welcome.

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

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

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

At its meeting in September 1984, STACFIS recommended that participants in the 1981 Shrimp Ageing Workshop be contacted in early 1986 to see if there has been sufficient progress to warrant another shrimp ageing workshop. STACFIS reaffirmed this recommendation at its June 1985 Meeting. Consequently, in early April 1986, the NAFO Secretariat circulated a letter to participants in the 1981 Workshop and to other interested scientists asking for their comments on progress in work on ageing shrimp and on their thoughts about an appropriate time for a second workshop.

Available information at the present meeting indicated that work in the national laboratories has been insufficient to warrant a second workshop in 1986 or 1987. STACFIS was informed that some of the scientists have planned to take an informal collective look at sampling data from West Greenland. It was agreed that planning for a second Shrimp Ageing Workshop be discussed at the mid-term meeting of STACFIS to assess shrimp in early 1987.

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

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

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

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

VI. REVIEW OF SCIENTIFIC PAPERS

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

The method of assessing stocks with natural mortality varying by age, in this paper, has a direct bearing on the fisheries management. The work on variable rates of natural mortality for fish of different ages seems to be very interesting. For some stocks, use of age-specific natural mortality rates may lead to biologically more realistic assessments. It is clear, however, that age-specific natural mortality calculations cannot be adopted without considering how the M(t) vector interacts with other parts of the virtual population analysis (VPA). In particular, M(t) is expected to interact with the partial-recruitment vector; but less obvious interactions with other terms in the VPA are also possible. Concerns were also expressed that, for some stocks, older fish which are not frequent in catches may still have an important role in the spawning stock. Assessments, using methods which assume that older fish necessarily die due to greater rates of natural mortality, should be done with careful attention to consequences on estimated and functional spawning stock biomass. It was also noted that calculations of M(t) values are apparently more sensitive to estimates of t_e than t_s. The ability to extract good estimates of t_e from catch statistics, and ways that estimates of t_e change with other features of VPA which may interact with M(t) require careful documentation. It was also pointed out that the accuracy of natural mortality by age is dependent upon the reliability of the minimum mortality estimates used in the equation.

Finally, if assessments were to use variable rates of natural mortality, traditional reference standards for fisheries management, specifically $F_{0.1}$ and F_{max}, are expected to be different. Recalibration of these standards of reference would also be necessary. To understand how age-specific natural mortality rates interact with other components of VPA will require simulation

studies. The simulations should include at least exploring how age-specific natural mortalities interact with partial recruitment vectors, how M(t) changes with changing fishing mortality, and how reference fishing standards change. Noting the timeliness of the problem, STACFIS agreed that research in this field should be continued.

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

Capelin are common at West Greenland but they are caught only locally and in very small quantities in shallow water, especially in the fjords. However, very little is known about their biology, distribution and abundance. During the last 2 years, there has been an interest in Greenland for catching roe-bearing capelin for the Japanese market, which led to a commercial experimental fishery in the 1985 spawning season. In connection with that fishery, a research cruise was carried out to investigate the biology of West Greenland capelin. Some of the data and results from both fisheries are presented.

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

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

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

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

The return of 30 questionaires, representing approximately 20% of the longline vessels exceeding 40 ft (12.2 m) in length, indicated that activity was lowest in the winter months when fishing was conducted on the banks closer to the home port in Div. 4X. Cod and haddock were the main species sought. Fishing activity increased in spring and summer when over 85% of the trips were to Georges Bank and the Fundian Channel. Cod and haddock were sought on the northern edge of the Bank, and cod, cusk and halibut were sought in the Channel. In the fall, fishing activity declined and became more widespread. The northern edge and northeast peak of Georges Bank remained the most important area, but fishing effort on the banks in Div. 4X increased.

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

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

This paper explains the results of the ichthyoplankton survey on Flemish Cap in 1985. Eggs and larvae were characterized quantitatively and qualitatively, and the pattern of distribution of redfish larvae was considered. *Sebastes* redfish larvae (5.0-10.7 mm) predominated in the ichthyoplankton. Eggs and larvae of cod (*Gadus morhua*) were found throughout the entire area of the bank.

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

This paper considers the results of a survey for 0-group redfish (*Sebastes mentella*) during August and September 1984 in the Irminger Sea. The densest concentrations of juveniles were found north of 61°N, with noticeably less dense concentrations south of this latitude. Juveniles were actually absent over Reykyanes Ridge. Regarding resolution of the question of *S. mentella* stock identification, the paper emphasized the need for a similar survey to extend from the

larvae-hatching area in the Irminger Sea toward western Iceland, East and West Greenland, and possibly Labrador.

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

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

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

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

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

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

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

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

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

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

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

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

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

Examination of the stomachs of 16,787 Atlantic cod (*Gadus morhua*) from waters off southern Labrador and northeastern Newfoundland (Div. 2J+3K) during the autumn in 1977-85 revealed that the major prey were capelin (*Mallotus villosus*), hyperiid amphipods, Arctic cod (*Boreogadus saida*), shrimp (primarily *Pandalus borealis*) and crabs (primarily *Chionoecetes opilio*). Total stomach fullness of Atlantic cod tended to be much higher and more variable on Hamilton Bank (Div. 2J) than on Funk Island Bank (Div. 3K). The rate of predation by Atlantic cod on capelin varied with capelin abundance. The only prey other than capelin to be preyed upon with considerable annual variability were hyperiid amphipods, but predation on hyperiids did not vary inversely with predation on capelin. During periods of low capelin abundance, Atlantic cod apparently did not compensate by preying more intensively on any other prey. With the size structure of the Atlantic

cod population in recent years, Atlantic cod of intermediate size (54-71 cm) are the major predators on capelin in the offshore area of Div. 2J+3K.

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

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

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

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

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

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

VII. OTHER MATTERS

1. Reporting Problems with Catch Statistics

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

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

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

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

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

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

recommends

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

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

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

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

3. Acknowledgements

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

ANNEX 1. REPORT OF SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH

Chairman: M. Stein Rapporteur: K. Drinkwater

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

The Subcommittee reviewed the following documents: SCR Doc. 86/13, 17, 19, 20, 25, 31, 43, 46, 48, 56, 57, 63, 65, 67, 71, 72, 73, 74, 75, 76, 77, 78, 87; SCS Doc. 86/8, 9, 15, 17.

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

a) Data collected in 1985

Approximately 12,671 oceanographic stations were occupied within the NAFO area during 1985, of which data for 6,732 were sent directly to MEDS and data for 2,575 were received through IGOSS (Integrated Global Oceans Services System). This more than doubled the amount of data received in 1984 through IGOSS. Only Canada and the USSR sent data directly to MEDS in 1985. Cruise tracks of the processed data, which have been provided in past reports, were not available this year due to recent cutbacks at MEDS. Most of the processed data were collected with bottles. It was noted that the operational processing of CTD data by MEDS has not proceeded as rapidly as anticipated.

b) Historical data holdings

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

c) Drifting-buoy data

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

d) Review of environmental conditions

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

2. Review of Environmental Studies in 1985

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

Slightly warmer-than-normal conditions were observed in summer and autumn over Fyllas Bank, ending several years of extremely cold conditions. The warming was attributed to local meteorological events. In the deepwater layer (400-600 m) within the core of the Irminger component of the West Greenland Current, temperatures were found to be higher than in the past 2 years. Cause of the increase is unknown. An extreme negative temperature anomaly in this water layer (also observed in July 1984) was attributed to local conditions in the West Greenland region which prevented the normal flow of warm Irminger water.

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

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

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

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

The waters of the Labrador Current in the region of Hamilton Bank (Div. 2J) during the autumn-winter period of 1985 were colder and fresher than normal, relative to 1962, 1964-77 and 1979-80. However, the negative anomalies down to 200 m were smaller than in the previous year, and it was suggested that the very cold conditions which have existed since 1982 may be changing. In the deep layers (200-500 and 500-1000 m), however, temperature conditions in 1985 were near those of 1984.

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

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

Two hydrographic transects were occupied in the St. Pierre Bank-Green Bank area during February-March 1985. Very cold (-1.2°C to -0.6°C) water extended to a depth of 200 m. These temperatures were lower than any that have been observed in late winter since 1977.

c) Subareas 4, 5 and 6 (SCR Doc. 86/56, 57, 71, 74, 75, 76, 77; SCS Doc. 86/8)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4. Remote Sensing Activities at the Bedford Institute of Oceanography

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

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

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

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

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

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

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

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

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

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

9. National Representatives

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

10. Other Matters

a) Symposium on marine sciences of the Arctic and Subarctic regions

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

b) World Ocean climate experiment (WOCE)

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

c) ICES Hydrography Committee

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

d) Sea-surface temperature maps

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

11. Acknowledgements

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

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

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

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

I. STATISTICS AND SAMPLING

1. Fishery statistics

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

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

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

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

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

recommends

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

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

c) Conversion factors

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

recommends

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

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

The Committee expressed general satisfaction with the format of the STATLANT forms and the deadlines for their submission (15 April for STATLANT 21A and 30 July for STATLANT 21B). However, in recognition of the need for national authorities to have complete and precise knowledge of their obligations under the NAFO Convention, STACREC

recommends

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

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

e) Effort data and prorating

The Assistant Executive Secretary reported on the information which he received from the statistical offices of Contracting Parties, following the expression of concern at the June 1985 Meeting on the question of "prorating". Although prorating could be appreciable in some fisheries, the general impression was that it was not currently a serious problem. The Committee considered that the situation should be kept under review and

recommends

that an additional line should be added to the STATLANT 21B form requesting information on the percentage of prorated fishing effort, if any.

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

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

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

a) Progress report on activities in 1985/86

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

b) Updating of sampling database

The Assistant Executive Secretary informed the Committee that the inventory of sampling for 1967-78 had been printed in early 1986 and distributed to scientists and laboratories involved in the work of NAFO.

c) Adequacy of sampling requirements

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

II. BIOLOGICAL SURVEYS

1. Review of Survey Activities in 1985

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

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

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

2. Survey plans for 1986 and Early 1987

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

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

Country	Area	Type of survey	Dates
		STRATIFIED-RANDOM SURVEYS - 1986	
CAN-N	0AB+SA1	Groundfish	Aug 15-Sep 18
	2GH	Groundfish	Sep 10-29
	2HJ	Shrimp	Jul 29-Aug 13
	2J+3K	Groundfish	Oct 01-Dec 11
	3L	Groundfish	Oct 01-20
	3LNO	Groundfish	Apr 15-May 27
CAN-SF	4VWX	Groundfish	Jul 07-Aug 01
		Redfish	Sep 29-Oct 10
		Groundfish	Oct 13-Nov 07
	4WX	Scallop	May 19-30
	4VW+5Ze	Groundfish	Mar 02-28
	4X+5Ze	Scallop	Aug 11-29
CAN-G	4RST	Redfish	Aug 04-29
	4T	Groundfish	Sep 02-26
CAN-Q	3Pn+4RST	Groundfish	Jan 07-28
DEU	E. Greenl.	Groundfish (OTB)	Aug 26-Oct 06
	1BCDEF	Groundfish (OTB)	Oct 09-Nov 11
FRA	3Ps	Groundfish	Feb 05-Mar 11
	4R	Cod	Jan 18-30
GRL	0A+1ABC	Shrimp (research)	Jul 21-Aug 28
	1ABCD	Large cetaceans	Jun-Jul
USSR	0B+2GHJ	Greenland halibut	Sep, Nov-Jan
	3KLMNO	Groundfish stocks	Feb,28-Aug 05
	4VWX	Silver hake spawning	Oct 15-Nov 30
USA	4X	Groundfish	Apr 07-25
		Groundfish	Oct 13-31
	5YZ	Groundfish	Mar 24-Apr 25
		Groundfish	Sep 29-Nov 07
	5+6	Scallops	Jul 29-Aug 29
		Clams	Jun 16-Jul 17
	6	Groundfish	Mar 03-Apr 04
		Groundfish	Sep 11-Oct 10
		OTHER SURVEYS - 1986	
CAN-N	2J	Cod sampling	Jul 29-Aug 27
	2J+3K	Capelin (acoustic)	Oct 09-28
	2J+3KLM	Salmon tagging	Oct 22-Nov 10
	2J+SA3	Oceanography	Jul 28-Aug 18
		Gear trials	Nov 12-Dec 01
	3K	Herring	Oct 08-15
	3KL	Cod (acoustics)	Jun 04-23
		Cod tagging	Jun 10-Jul 04
		Capelin tagging	Jun 10-Jul 04
	3L	Capelin (acoustic)	May 10-Jun 02
		Oceanography	Apr 01-25
		Crab	May 29-Jun 12
		Pelagic larvae	Jun 16-27
		Pelagic larvae	Jul 15-25
		Cod tagging	Sep 08-Oct 06
		Crab	Oct 20-31
		Oceanography	Jun 02-06
		Crab	Aug 04-14
		Pelagic larvae	Aug 18-29
		Squid	Sep 02-06
	3LNO	Capelin (acoustic)	Jun 25-Jul 06
		Juvenile flatfish	Aug 20-Sep 08
	3LPs	Herring	Nov 10-Dec 12
	3NO	Groundfish	Apr 01-10
	3NOPs	Squid	May 29-Jun 12
	3Ps	Scallop	Mar 26-Apr 08
		Scallop tagging	Jun 16-24
	3P	Redfish (acoustic)	Jul 08-27
	4R	Crab	Apr 28-May 12
CAN-SF	4RS	Capelin (acoustic)	Jun 02-20
	4VW	Shrimp	May 05-16
		Shrimp	Oct 13-24
	4VWX	Pollock ichthyoplankton	Jan 06-10
		Pollock ichthyoplankton	Jan 03-07
		Gear trials	May 05-13
	4W	Herring acoustic	Jan 13-Feb 28
	4WX	Deepsea trawling	Feb 10-21
		Deepsea trawling	Aug 25-Sep 05
		Lobster larvae	Jun 30-Jul 18
	4X	Observer training	Feb 24-28
		Groundfish acoustic exp.	Mar 10-28
		Plankton gear trials	Jan 27-31
		Gear trials (VW camera)	May 19-30
		Lobster bycatch study	Sep 15-26
		Plankton gear trials	Apr 14-18
		Lobster habitat study	Apr 21-May 02
		Live fish gear test	Jul 21-Aug 01
		Juvenile gadoid study	Jun 02-13
	4X+5Ze	Juvenile gadoid study	Jun 16-27
		Scallop larvae	Sep 29-Oct 14
		Herring larval abundance	Oct 27-Nov 14
		Herring larval process	Oct 27-Nov 14
	South of 6	Larval & juvenile squid	Jan 02-Feb 06
CAN-G	4T	Herring spawning beds	Oct
		Herring acoustic & trawl	Nov 10-Dec 05
CAN-Q	4RS	Larval fish & invertebrates	Apr 28-Jun 13
	4RST	Shrimp biomass	Sep 02-Oct 10
	4S	Herring tagging	Apr 28-May 16
		Scallop exp. fishing	Jun 09-20
		Snow crab prerecruit	Jul 21-Aug 01
		Lobster tagging (2 boats)	Aug 02-15
	4T	Snow crab tagging	Apr 14-May 02
		Herring	May 26-Jun 13
		Snow crab prerecruit	Jul 01-10
		Scallop photographic	Jul 21-Aug
		Scallop	Aug 04-15
	4TVn	Mackerel egg & larvae	Jun 16-Jul 08
FRA	3Ps	Scallop	Mar 17-24
GRL	E. Greenl.	Shrimp (commercial)	Jan, Apr
		Hooded seals (sampling)	Jul-Aug
	1A	Narwhals	Aug-Sep
	1ABC	Plankton	Jun 16-Jul 04
	1ABCDEF	G. halibut & cod (res.)	Jun, Aug
	1BC	Shrimp (commercial)	Mar, Jun-Oct
	1BCD	Scallop	May, Jun, Aug
	1BCDEF	Cod (commercial)	Jan-Dec
	1CD	Capelin	Oct, Nov
	1DEF	Juvenile cod & redfish (res.)	Oct
	1EF	Groundfish	Nov, Dec
	1F	Hooded seals (sampling)	Apr-Jun
USSR	2J+3K	Capelin prerecruits (acoustic)	Oct 21-Nov 15
	3LNO	Capelin prerecruits (acoustic)	Oct 01-20
		Prespawning capelin (acoustic)	May 15-Jun 20
	3M	Ichthyoplankton	Mar 20-Apr 20
USA	5YZ	Environmental monitoring	Aug 25-Sep 24
	5Z	Juvenile fish (IK, IYGPT trawls)	May 02-22
		MOCNESS	Jun 09-Jul 03
		Bottom trawl & IYGPT	Jul 23-Aug 08
		Submersible	Aug 03-15
	6ABC	Environmental monitoring	Aug 25-Sep 24
	4X+5+6	Fish eggs, larvae, phyto-plankton, hydrography	Jan-Feb
		" " " "	May-Jun
		" " " "	Aug-Sep
		" " " "	Nov-Dec
		Fish eggs, larvae, temp.	Feb-Apr
		Fish eggs, larvae, temp.	Sep-Nov
	5Z+6	Fish eggs, larvae, temp.	Jun
		Fish eggs, larvae, temp.	Jul-Aug
		SURVEYS PLANNED FOR EARLY 1987	
CAN-N	3M	Groundfish	Jan 30-Feb 18
	3Ps	Groundfish	Jan 30-Feb 18
	3LN	Cod tagging	Feb 20-Mar 09
	4Vs	Squid	Feb 20-Mar 09
CAN-SF	4W	Herring acoustics	Jan 05-30
	4X	Groundfish acoustics	Mar 23-Apr 03
	4VW+5Ze	Groundfish	Mar 09-Apr 03
	4X+5Ze	Larval cod condition	Mar 23-Apr 03
	6 and South	Larval & juvenile squid	Jan 05-30
USA	4X	Groundfish	Apr 06-24
		Groundfish	Oct 12-30
	5YZ	Groundfish	Mar 23-Apr 24
		Groundfish	Sep 28-Nov 06
	5+6	Scallops	Jul 28-Aug 28
	6	Groundfish	Mar 02-Apr 03
		Groundfish	Sep 07-25

3. Review of Stratification Schemes

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

4. Coordination of Surveys in 1986 and 1987

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

5. Documentation of Survey Design and Procedures

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

III. OTHER MATTERS

1. Review of Scientific Observer Program

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

2. List of Fishing Vessels

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

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

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

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

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

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

5. Modification of the Subarea 4/5 Boundary

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

recommends

that catches in Subdiv. 5Ze be reported as from two subdivisions, 5Zc (east of Canada-USA

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

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

6. Acknowledgements

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

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

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

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

1. Review of Scientific Publications Since June 1985

a) Journal of Northwest Atlantic Fishery Science

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

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

b) NAFO Scientific Council Studies

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

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

c) *NAFO Scientific Council Reports*

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

d) NAFO Statistical Bulletin

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

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

e) Inventory of Sampling Data, 1967-78

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

f) Index and Lists of Titles

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

2. Editorial Matters Regarding Scientific Publications

a) Editorial Board activities

Receipt of papers for the Journal of Northwest Atlantic Fishery Science and their subsequent disposition were reviewed. There was a continued declined in the number of papers that were received for possible publication in the Journal to 13 in 1985 from 22 in 1984 and an average of 31 for 1982-83. This was a significant element in the delay in publication of the two issues of Volume 6.

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

b) Editorial Board appointments

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

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

In April 1986, Mr. B. E. Skud indicated that he would not be able to continue as Editor. At the June 1986 Meeting, the Chairman of the Committee (J. S. Beckett) discussed the matter by telephone with the Editor who indicated that he could not continue beyond a month or so. Having discussed the matter and being unable to come up with an immediate long-term solution to the difficulties regarding a new editor of the Journal, the Committee agreed that the economical and practical possibilities of a professional editor on contract should be explored. As a short-term solution, Associate Editors should be informed that the manuscripts already passed to them would be published in the form in which they returned them. It was, thereby, hoped that the Associate Editors would, in fact, undertake the complete editing of manuscripts assigned to them. This would also indicate whether this short-term solution could be the long-term solution of editing the Journal, in which case the role and title, of the associate editors might need to be revised.

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

3. Promotion and Distribution of Scientific Publications

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

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

a) Brochure for Journal

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

b) Advertising of Journal

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

c) Abstract practices

The Committee was informed by the Assistant Executive Secretary that Journal papers are abstracted in Biological Abstracts, and the contents are listed in FAO's Marine Science Contents Tables.

d) Invitational papers

At its meeting in September 1985, the Committee agreed that the Chairman of STACPUB should

correspond with the Editor concerning his proposal to solicit review papers from recognized authorities in particular fields, explore suggestions as to what types of papers should be solicited and who should be approached to provide such review papers.

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

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

e) Cooperation with ICES

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

f) Production costs and revenues for council publications

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

4. Progress Report on Microfiche Project

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

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

5. Papers for Possible Publication

a) Review of proposals from 1985 meetings

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

b) Proposals for publication from 1986 and deferred 1985 documents

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

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

6. Acknowledgements

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

PART C

Report of Scientific Council

Annual Meeting, September 1986

CONTENTS

REPORT OF SCIENTIFIC COUNCIL

Annual Meeting, September 1986

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

The Scientific Council and its Standing Committees on Fishery Science (STACFIS) and Publications (STACPUB) met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, during 8-12 September 1986, to consider and report on various matters listed in the agenda (see Part D, this volume). Representatives attended from Canada, Cuba, EEC, Japan, Portugal, Spain and USSR.

That meeting was preceded by the Special Session on "Recent Advances in Understanding Recruitment in Marine Fishes of the Northwest Atlantic, with Particular Emphasis on Georges Bank Herring and Flemish Cap Cod and Redfish Stocks", which was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, during 3-5 September 1986, with approximately 50 scientists in attendance.

The reports of the Standing Committees, as adopted by the Council at this meeting, are given in Appendices I and II. Lists of research and summary documents and the list of participants are given in Part D (this volume). Brief summaries of these reports and other matters considered by the Council are given below.

I. FISHERY SCIENCE (APP. I)

1. Special Session on Recruitment Studies

At the Special Session which was convened by M. D. Grosslein (USA), 26 scientific papers and 2 oral reports were presented by authors from various countries. The first day was devoted primarily to papers dealing with herring recruitment on Georges Bank and in adjacent waters, following a review paper which traced the development of the ICNAF larval herring program and subsequent studies relevant to herring recruitment. The second day focused on the Flemish Cap program which began with the presentation of a review paper that summarized the development of this program and the results of recruitment-related research on cod and redfish. On the third day, the presentations dealt with more general recruitment studies not directly related to the two major international projects.

The Council was encouraged by the level of interest and discussion that was promoted by the Special Session. While the mechanisms behind recruitment of marine fish are still far from being resolved, many areas of research were identified which could enhance future knowledge on this very important subject. In general, the Special Session was considered to be highly successful with good attendance and high quality papers that promoted fruitful discussion.

2. Stock Assessments

A reassessment of the cod stock in Div. 3NO was carried out by STACFIS. While no precise TAC could be advised, the Council agreed with results of the evaluation regarding the biomass levels.

The Council supported the recommendations of STACFIS regarding questions from the Fisheries Commission on definition of the cod stock in Div. 2J+3KL and the Greenland halibut stock in Subarea 2 and Div. 3KL, which were deferred from the June 1986 Meeting.

The Council noted that a standard method of calculating abundance estimates from juvenile silver hake surveys has now been adopted by the countries involved and supported this decision. It was further noted that no new research recommendations for silver hake were considered necessary at this time.

A review of arrangements for conducting stock assessments was carried out by STACFIS, and the Council endorsed the recommendations for further improving the efficient use of time at future June meetings.

3. Environmental Research

The Council supported the decision by STACFIS to re-elect M. Stein (EEC) as Chairman of the Environmental Subcommittee for a second term.

The Council also endorsed changes in positions of two standard stations off West Greenland as

4. Topics for Future Special Sessions

The Council adopted the program which was outlined by STACFIS for the Special Session in September 1987 on "Biology of Demersal Resources of the North Atlantic Continental Slope, with Emphasis on Greenland Halibut and Grenadiers", noting that W. R. Bowering (Canada) had agreed to be Convener. The Secretariat was requested to prepare and circulate a suitable announcement as soon as possible after the present meeting.

The Council also adopted the proposal by STACFIS that the theme for the Special Session in 1988 be "The Impact of Changes in Environmental Conditions in the North Atlantic on Distribution, Availability and Abundance of Marine Species, with Particular Emphasis on the Labrador and Grand Bank Regions during the early 1980's".

5. Other Matters

Data were not available for STACFIS to provide advice on a request by the Fisheries Commission relevant to trawl escapement and selectivity problems. Therefore, the Council

recommends

that the national Scientific Council representatives bring this matter to the attention of scientists in their institutes to determine if data are available concerning the effects of strengthening ropes, splitting straps and codend floats on selectivity of trawls, and present any forthcoming information at the June 1987 Meeting.

The Council was encouraged by the results of discussion in the working group on the development of abundance indices and recruitment indices for cod in Div. 2J+3KL, which was held during the first 2 days of the STACFIS Meeting in June 1986. The Council endorsed the use of these standard indices until such time as superior indices are developed and proven.

II. RESEARCH COORDINATION

1. Documentation of National Conversion Factors

With reference to the recommendation of STACREC in June 1986, the Assistant Executive Secretary reported that, although FAO had recently solicited up-to-date information on conversion factors from national statistical offices, the most recent data available was published in FAO Fisheries Circular No. 725 (1980). When the Secretariat was informed that the circular was out-of-print, a condensed version was prepared and issued as SCS Doc. 86/25. It is anticipated that FAO may report some up-to-date information to the CWP (Coordinating Working Party on Atlantic Fishery Statistics) in February 1987.

2. Survey Design Procedures

The Council noted that the Secretariat had received, before the June 1986 Meeting, detailed information on survey procedures from Canada, Federal Republic of Germany, France and USSR. No additional information has been received.

Regarding establishment of a working group to evaluate the submitted material and to examine past survey results in order to derive more precise abundance indices for assessment purposes, the Council was informed that the nominated candidate for convener, S. Gavaris (Canada), was unable to accept the task due to other commitments. This then led to the nomination of W. Brodie (Canada) who agreed to undertake the work. Final composition of the *ad hoc* working group was deferred to the June 1987 Meeting, but J. Messtorff (EEC), V. A. Rikhter (USSR) and J. C. Poulard (EEC) were named as national contacts by correspondence, so that work can be initiated before the June 1987 Meeting.

III. PUBLICATIONS (APP. II)

1. Editorial Matters

The Council noted the efforts of STACPUB to find a new Editor for the Journal and approved the interim measures for maintaining publication schedules.

2. Promotion of Journal

The Council stressed the importance of measures to promote a wider distribution of the Journal and agreed that the actions proposed by STACPUB should be quickly implemented.

3. Papers for Publication

The Council was pleased to note that a substantial number of papers which had come before it were potentially suitable for publication, and, in particular, that the list included the review papers presented to the Special Session (SCR Doc. 86/101 and 104), as proposed by the participants in the Session.

4. Microfiche

The Council looked forward to completion of the microfiching of all research-related ICNAF documents and was pleased to note that sets of microfiche would be made available for purchase before the end of 1986.

The Council agreed that having historical documents available at meetings away from Headquarters would be most valuable and

recommends

that the Executive Secretary provide the Council, at the June 1987 Meeting, with a proposal regarding the purchase of a portable microfiche reader for use of the Scientific Council and its Committees, and that one set of microfiche be available for the use of the Council.

The Council is of the view that the microfiche sets will be popular with libraries and wishes their availability to be widely known. The Council

recommends

i) that the Executive Secretary ensure that the relevant laboratories of all Contracting Parties and all libraries and organizations, which had expressed some interest in purchase when previously solicited, be informed immediately that sets are now available,

ii) that advertisements for these sets be placed in forthcoming issues of Scientific Council publications, a flyer be prepared for inclusion with the proposed brochure advertising the Journal, and all other opportunities be taken to make the availability of microfiche sets known.

With the ICNAF document project approaching completion, the Council agreed that it was timely to consider microfiching NAFO documents and requests STACPUB to consider this matter at its June 1987 Meeting.

IV. RULES OF PROCEDURE

1. Final Results of Vote by Mail

The Executive Secretary informed the Council that he had contacted the Contracting Parties, who had not responded to the May 1986 request for a vote on the amendment to the Council's Rules of Procedure (NAFO Sci. Coun. Rep., 1985, page 107). Tabulation of the responses indicated that a quorum had indeed existed at the time of the mail vote. The final result is that the amendment to the Council's Rules of Procedure was adopted for future use.

2. Implementation of the Amended Rules

The Council considered it necessary that action be taken under these rules to ensure that proxy votes are available at the June 1987 Meeting from Contracting Parties not in attendance. Accordingly, the Council

recommends

that the Executive Secretary contact all Contracting Parties well in advance of the June 1987 Meeting and request them, if they do not intend to send a Scientific Council representative to the meeting, to provide him with authority to cast a proxy vote on their behalf under Rule 8.3.

The Council agreed that its Rules of Procedure, including the amendments that are given on pages 107-108 of NAFO Scientific Council Reports for 1985, be distributed as a summary document as soon as possible after this meeting.

V. FUTURE SCIENTIFIC MEETINGS

1. Special Meeting on Shrimp, January 1987

The Council, upon being informed that an official invitation had been received from the Greenland Fisheries and Environmental Research Institute, Copenhagen, Denmark, agreed to meet there during 28 January-03 February 1987, to review the status of the shrimp stocks in Davis Strait and Denmark Strait, as requested by Canada and by Denmark (Greenland) (SCS Doc. 86/6 and 12).

2. Scientific Meeting in June 1987

The Council reaffirmed its decision in June 1986 to meet, together with its Standing Committees on Fishery Science, Research Coordination and Publications and the Environmental Subcommittee, at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 3-18 June 1987. This meeting will deal with the usual requests for scientific advice on fisheries management and other fishery-related research and statistical matters.

3. Special Session and Annual Meeting in September 1987

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

4. Scientific Meeting in June 1988

Considering the need for the Secretariat to arrange for meeting facilities at the Bedford Institute of Oceanography well in advance of scientific meetings, the Council tentatively agreed to meet during 1-16 June 1988.

5. Special Session and Annual Meeting in September 1988

Considering that the Annual Meeting is scheduled for 6-10 September 1988, the Council tentatively agreed that the Special Session be held on 12-14 September 1988.

VI. OTHER MATTERS

1. Provisional Report of June 1986 Meeting

The Council formally approved, with minor amendments, the summary report of its meeting on 4-19 June 1986 (see Part B, this volume).

2. Consideration of Reports of Special Mid-term Meetings

In the context of the discussion on time and place of the Mid-term Meeting on Shrimp, concern was expressed about the poor representation of Contracting Parties. It was suggested, therefore, that the Council should, under those circumstances, restrict its activity to the provision of scientific advice on shrimp without considering matters of a more general nature which should be discussed in the presence of Council representatives from more Contracting Parties. It was also suggested that the Council, at its forthcoming meeting in June 1987, will review the report of the Special Meeting on Shrimp in January 1987 in order to see if there is any potential for improving the advice on shrimp at subsequent mid-term meetings.

3. Proposal Regarding the Feasibility of Establishing a Herring Stock

The Council Chairman introduced a letter from J. J. Graham (USA), which sought the Scientific Council's endorsement of a proposal to hold a conference on the establishment of the Georges Bank herring stock by artifical means (injection of early life stages). The Council representatives showed little interest in supporting the proposal and requested the Chairman to communicate this view to Dr. Graham.

VII. ADJOURNMENT

There being no further business, the Chairman expressed his sincere thanks to the Chairmen of STACFIS and STACPUB, to the rapporteurs, and to all participants for their cooperation and support in fulfilling the tasks of the Council. Appreciation was also expressed, on behalf of all representatives, to the Secretariat members for their excellent assistance.

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

Chairman: W. R. Bowering

Rapporteurs: Various

The Committee met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, during 8-11 September 1986, to consider and report on various fishery science matters that were referred to it by the Scientific Council. Representatives attended from Canada, Cuba, EEC, Japan, Portugal, Spain and USSR.

That meeting was preceded by the Special Session on recruitment studies, which was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, during 3-5 September 1986. The session attracted scientists from Canada, EEC, Japan, Norway, Portugal, Spain, USSR and USA.

The various matters that were considered at both sessions are outlined below. Various participants contributed to the preparation of initial drafts of different sections of this report.

I. SPECIAL SESSION ON RECRUITMENT STUDIES

1. Introduction

The Special Session on "Recent Advances in Understanding Recruitment in Marine Fisheries of the Northwest Atlantic, with Particular Emphasis on Georges Bank Herring and Flemish Cap Cod and Redfish Stocks", convened by M. D. Grosslein (USA), was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 3-5 September 1986. Twenty-six scientific papers and two oral reports were presented. The first day was devoted chiefly to papers dealing with herring recruitment on Georges Bank and in adjacent waters. A review paper (SCR Doc. 86/104) traced the development of the ICNAF larval herring program and subsequent studies relevant to herring recruitment and provided a synopsis of knowledge to date on the recruitment process in herring. The second day focused on the Flemish Cap Program and similarly began with a review paper (SCR Doc. 86/101) which summarized development of the project and the results of recruitment-related research on the cod and redfish stocks. On the third day, papers were presented on general recruitment studies, which were not directly related to those of the two major international projects. Discussion periods followed the presentation of papers on each of the three days.

The papers represented a wide range of topics covering the entire reproductive life cycles of herring, cod and redfish, with particular emphasis on empirical correlations of recruitment with various physical and biological factors, including spawning stock size and processes affecting abundance, distribution, dispersal, survival and growth of egg and larval stages. Knowledge of these processes was reviewed in relation to the principal historical and current hypotheses about timing and mechanisms which control year-class strength. Also, the effectiveness of research approaches, represented by the Georges Bank and Flemish Cap programs, was considered in relation to their objectives and to the understanding and predictability of recruitment achieved, and ways of improving research strategy were discussed at length.

2. Georges Bank

The ICNAF larval herring project was initiated in 1971 to help clarify the relative sizes and interrelationships of the adult and juvenile herring populations in the Georges Bank-Gulf of Maine region. The objectives were expanded in 1974 to investigate the factors which control variability in year-class success, and this led to a much broader research program which ultimately contributed to a comprehensive description of the ecology of herring larvae and associated ichthyoplankton and zooplankton on Georges Bank and the primary production and hydrography of the region.

During the 8-year ICNAF program (1971-78), timing and location of spawning on Georges Bank and Nantucket Shoals were documented, larval growth, feeding and mortality were described, and larval production curves were calculated for each year. Initial larval production was correlated with spawning stock size, but larval abundance (up to 6 months of age) was not correlated with recruitment, indicating that year-class success was not set before the late larval stage. From the ICNAF larval herring survey program, knowledge of the late larval and post-metamorphosis stages was extremely limited. However, other evidence pointed to determination of year-class size at least by the end of the first year of life (age 1) but probably earlier near the time of metamorphosis.

Mortality in postlarval and juvenile stages (late larvae to age 2) appears to be roughly comparable in magnitude to that of the first 6 months (eggs to late larvae), which indicates that both

periods may be roughly of equal importance in controlling year-class size. In any case, neither the classical "critical period" hypothesis nor the "match-mismatch" hypothesis appears to control recruitment variability in Georges Bank herring. It was noted that overwinter mortality of larvae may exert significant control over recruitment variability, and there was some evidence during several winter seasons that this mortality was inversely correlated with temperature and larval abundance. However, the collapse of the herring stock on Georges Bank in 1978 interrupted the data series, and the significance of overwinter mortality could not be confirmed.

Although the overall objectives of the ICNAF program on Georges Bank herring were successfully met (except for the limitations imposed by the untimely collapse of the stock), there were several constraints on the program which should be avoided in the future. In particular, the rate of processing the zooplankton samples was slow, and timely evaluation and reporting of results was not possible, resulting in prolonged delay in completion of the patch study. In future, for large-scale programs, adequate resources should be committed to ensure timely processing of samples. In addition, resources should be allocated to sampling postlarval as well as larval stages of each cohort to provide a basis for comparing mortality profiles of each stage.

Eight papers were presented on a wide range of topics relevant to recruitment of Georges Bank herring. The introductory paper summarized the status of knowledge on recruitment processes in herring, based on available analysis and reports prior to the Special Session. The overview demonstrated that the ICNAF larval herring program had succeeded in estimating spawning biomass, larval dispersal and mortality for a series of years prior to the disappearance of the population. A westerly shift in spawning from Georges Bank to Nantucket Shoals was observed, coincidental with the shift in fishing activity after the disappearance of herring from eastern Georges Bank. A review of the herring stock structure in the entire Gulf of Maine region confirmed that the stocks are discrete at the time of spawning (and for the first several months of larval life) but that juveniles and adults intermix at other times of the year.

A review was presented of the historical literature and the results of MARMAP (Marine Monitoring Assessment and Prediction) surveys which have monitored larval production since 1977. The former indicated that herring, although present, was probably not a dominant species on Georges Bank during the first half of the 20th century. The MARMAP data indicated virtual extinction of spawners on Georges Bank (as shown by the absence of larvae) over the last eight spawning seasons (1978-85), although limited spawning still occurs on Nantucket Shoals.

Three zooplankton faunal zones were described on Georges Bank and these were related to different water masses on the Bank. A seasonal cycle and interannual variability of these zones were documented and the zones were linked to ichthyoplankton faunal zones (described in an earlier paper) which in turn appeared to be linked to retention of shelf larvae on the Bank.

In the last year of the ICNAF program (1978), a multinational larval herring patch study was conducted on Georges Bank. Although no herring larvae were found, a dense patch of chaetognaths was observed in the area normally occupied by early-stage herring larvae and the drift of chaetognaths served as a model for larval herring. The analysis indicated that the mean drift and dispersion of the patch was inconsistent with mean flow, but the observed dispersal was plausible if vertical structure of the water column (both physical and biological) was taken into account.

A model of recruitment to the coastal Maine herring fishery was described. It took account of spawning stock size, overwintering temperature, and exchange rates from east to west and between coastal waters and estuaries. Model development and validation were noted as being in progress.

A study of recruitment to the Gulf of St. Lawrence herring stocks documented predation by mackerel on herring eggs and unusual mortality of herring eggs which were deposited in extremely thick layers. This unusual spawning behavior may have been triggered by oscillations in temperature due to storms.

An exploratory analysis of satellite imagery was undertaken to develop indices of the exchange of shelf water and slope water in the Northwest Atlantic, insofar as they may affect recruitment. Hypotheses developed from the exploratory analysis will be tested on independent data.

Dispersion of larval sea scallops from the Bay of Fundy, Georges Bank and Scotian Shelf was described. There was no evidence of larval exchange between spawning areas, but only two spawning seasons have been sampled.

3. Flemish Cap

Flemish Cap was chosen for the groundfish study because fluctuations in year-class strength of both cod and redfish had been observed, the cod stock was discrete, the area was not too large, the circulation patterns were likely to be amenable to study, and a historical database existed

for both physical oceanography and fish production. Objectives of the project were very broad: to study the effect of water circulation patterns on the retention of larvae and the influence of the abundance and size composition of the food supply on the survival of larvae; to determine the effect of intraspecific and interspecific predation on the survival of juvenile fish; and to improve the assessment of the size of the spawning stock in order to study the relationship between stock size and recruitment. When it became clear that only two countries (USSR and Canada) would participate, the frequency of ichthyoplankton surveys was much reduced (original proposal was one every 2 weeks) and special juvenile surveys were eliminated. Most sampling was conducted during 1978-83, with some surveys continuing to the present.

The program documented several significant events: a strong year-class of cod arose from a small spawning stock; two relatively strong year-classes of redfish were born; annual differences in growth rates of redfish juveniles and larvae were described; one year-class of redfish virtually disappeared at the larval stage and another was greatly reduced in abundance at the juvenile stage. Causes of these events have not yet been described. With respect to the hypotheses listed above, it is thought that breakdown of the clockwise gyre on the bank might cause a loss of eggs and larvae, but there has been no documentation of such a breakdown that was followed by a loss of larvae and subsequent poor recruitment. However, mortality from dispersal away from Flemish Cap clearly does occur, and the results of a numerical model of water dispersion on the bank (oral presentation by S. A. Akenhead) indicated that the observed progressive shift of larval redfish from the edge (where spawning occurs) toward the center of Flemish Cap can be attributed to diffusion. Furthermore, from the model, it appears possible to distinguish between the rate of loss from Flemish Cap and the mortality rate occurrring on the bank. Spatial and temporal patterns in the life cycle of copepods have been described, but relationships between prey availability and the feeding of fish larvae, and between feeding and survival, have not been described. Cod are known to consume smaller cod and large numbers of small redfish, but the contribution of predation on juveniles to variability in year-class strength has not been assessed. Recruitment in cod appears to be unrelated to size of the spawning stock.

Although the project has not yet greatly advanced an understanding of factors which affect recruitment, it has greatly improved knowledge of the physical oceanography of Flemish Cap and the biology of the species found there. The ichthyoplankton community has been described. For redfish, the time and location of spawning, the change in distribution of larvae over time, and the vertical distribution of larvae are known. Rates of growth and mortality during 2 years have been measured. Very few eggs and larvae of cod were caught, but some information on distribution, growth and mortality was obtained. Techniques were developed for ageing redfish larvae by interpreting rings in otoliths. One important study was conducted on variability in the abundance of redfish larvae at a single station during a 24-hour period. Repeated bottom-trawl hauls within a small area provided a good measure of the distribution of catches within strata.

Several aspects of the Flemish Cap Project reduced the probability of success. Flemish Cap is so far from land that it was not convenient to make brief diversions from research trips to other areas, and, hence, observations tended to be greatly restricted in time. The poor biological sampling of the commercial catch made it difficult to measure recruitment and spawning stock size. The lack of success in keeping moored current meters in place caused the early curtailment of the special oceanographic program. The intensive fishery kept the cod stock at a very low level so that the influence of varying stock size on recruitment could not be studied. The hypotheses remained too numerous and too broad, so that the research effort, already very limited, was not sufficiently focused on specific questions. The time required for analyses was seriously underestimated. Results came out so slowly that progress could not be adequately monitored, and the program could not be modified in response to accumulating information. Ichthyoplankton gear in use by the two countries should have been identical, or a calibration study of different gears should have been conducted and reported at a very early stage. The bongo sampler used by Canada was quite useful as a tool for measuring abundance but it was much less useful for examining various aspects of the biology of larvae, such as distribution in the water column. The absence of surveys for juveniles meant that the success of each cohort could not be assessed until juveniles were caught in bottom-trawl surveys in the following winter, and even these catches were unsatisfactory because the juveniles were not highly recruited to the trawling gear. The ageing of juvenile redfish received too little attention, and there was very little work on adult redfish. The redfish spawning stock could not be measured, partly because fecundity was not measured, and cannibalism in redfish could not be measured because there were no quantitative feeding studies. A major problem was that the project went into a monitoring phase without the benefit of a pilot study to describe such things as the annual zooplankton production cycle, spawning times, horizontal and vertical distribution of adults, eggs, larvae and juveniles, and the growth patterns of larvae and juveniles. A very important factor was that the total effort was much too small to address the hypotheses that were proposed. In fact, the total effort was probably equivalent to that which one might want to put into a pilot project, with the lack of a strong seasonal component.

Much data analysis remains to be completed. It may be possible to account for annual variability in mortality of larvae by examining the dynamics of water circulation or by analyzing spatial variation in food availability, feeding and condition. A more accurate estimate of spawning stock of cod may be forthcoming from new information on fecundity and the percentages of females (by size-group) which spawn in a given year. There will also be further analyses of the influence of prey availability on the production of the cod stock, and of the influence of predation by cod on mortality of juvenile redfish and cod. It will also be possible to use the groundfish surveys to describe the groundfish "community" and to look for changes over a period of at least 8 years.

4. Other Recruitment-related Studies

On the third day, the final series of recruitment-related papers included a method for identifying daily growth increments on the shells of larval scallops; temperature-induced effects on survival of Arcto-Norwegian cod larvae; recent surveys of 0-group saithe off the Norwegian coast; effects of temperature and severe advective events on survival of haddock eggs and larvae on Georges Bank; and a conceptual evaluation of the evidence for internal behavioral capabilities of early life stages of fishes, which allow them to "direct" their movements contrary to passive drift. Following the presentation of these papers, there was general discussion on the issues which were raised during the course of the Special Session.

5. General Discussion

The papers stimulated discussion on a number of key topics, including stock structure, density-dependent and density-independent processes, age at which year-class strength is established (i.e. predictable), and adequacy of estimates (i.e. accuracy, precision and independance of variables). It was apparent that no single dominant physical or biological process determines recruitment and that critical events can occur at almost any stage in the early life history. This implies that year-class strength is not established in a predictive sense until relatively late in the first year of life. Because of the multiplicity of possible factors that can operate over a broad time-scale, it will be difficult to develop useful predictive models to explain interannual variability.

It was concluded that density-dependent processes are most relevant to long-term fishery management strategies, because they involve biological mechanisms that can be influenced by fishing. Although greater research emphasis on density-dependent processes seems desirable, it is clear that these processes cannot be isolated from physical factors which have a density-independent effect, and thus both types of processes must be incorporated into a definitive research strategy on the recruitment problem.

Evidence of density-dependent effects (on growth, maturation and fecundity) was discussed relative to herring, and several hypotheses were considered regarding depensatory processes that might explain the nearly complete extinction of Georges Bank herring and the failure of the stock to recover after almost a decade. If the demise of the stock was due to depensatory processes which began operating after the population was reduced to a very low level by fishing, a slow recovery (if at all) may be expected. Recovery of the herring stock may also be inhibited by increased abundance of several species, most notably sand lance. The replacement may have resulted from the response of opportunistic species which filled the void that was left when the herring stock was overexploited, or from a change in the climatic regime that favored the replacement species, or both.

There was general agreement among participants that the recruitment process is so complex that even large logistic efforts, such as the ICNAF Georges Bank and Flemish Cap projects, may not provide a level of understanding of mortality causes and predictive capability sufficient to justify their overall costs. In order to improve the chances of success in future recruitment studies, it would be extremely important to ensure that sampling design and scope of the research plan provide all essential data which are relevant to the hypotheses being tested. In particular, it is important to conduct appropriate pilot studies in advance of a standard monitoring series in order to document critical biological characteristics (vertical distribution of pelagic life stages) and to develop and/or test the sampling gear for all important life stages. Also it is important to select species and stocks which are amenable to an extended and definitive research effort, i.e. clearly discrete stocks which are expected to maintain reasonable spawning populations (not overfished) and for which good data on annual recruitment and stock size are available. Also, it was emphasized that, during the initial planning stages, more importance should be given to assuring adequate resources for timely processing and dissemination of data.

Another explanation for the failure of the Georges Bank herring stock to recover relates to the historical occurrence of herring on the bank. One hypothesis is that Georges Bank is a suboptimal habitat which is occupied when the population expands its distribution due to crowding of the

optimal habitat (e.g. coastal waters). If this hypothesis is correct, the recovery of the Georges Bank herring stock will not occur until the coastal populations increase substantially. Further evaluation of alternative hypotheses concerning recovery of the Georges Bank stock is desirable because they have important implications for management.

Despite recognition that significant progress had been made in understanding aspects of the recruitment process, there was general concensus that some new approaches are needed. Suggested new approaches include:

a) Models (genetic) relating diversity of populations to stock size and vulnerability to fishing and environmental perturbations.

b) Experimental laboratory work on selected behavioral response of fish (including early life stages) to clarify scope for response to environmental cues, stresses and other adaptive capabilities.

c) Studies of actual maturation and spawning processes to determine the range of "condition" of adults and possible effects on egg viability.

d) Comparative studies among different stocks and general patterns of population distributions and production (particularly stock-recruitment relationships) relative to exploitation levels and environmental characteristics of population habitats.

e) Incorporation of selected fine-scale studies into the framework of larger-scale studies to improve knowledge of basic biology of fishes and to improve measures of the nature and magnitude of sampling errors.

f) Improved analytical and statistical procedures to reduce incidence of bias and spurious correlations arising from lack of independence among variables in complex and interrelated data sets.

6. Publication of Papers

Twenty-six research documents were presented and discussed at the Special Session, as follows: SCR Doc. 86/91, 92, 93, 94, 96, 97, 98, 99, 100, 101, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117 and 119 (see Part D, this volume, for titles and authors). With respect to the possible publication of these papers by NAFO, the participants agreed that, in view of the wide range of scope and subject matter, publication of all papers in a single volume was not appropriate. However, it was noted that publication of the overview papers (SCR Doc. 86/101 and 104) was desirable as a record of the major international recruitment studies that were sponsored by ICNAF and NAFO.

II. STOCK ASSESSMENTS

1. Cod in Divisions 3N and 3O (SCR Doc. 86/124)

a) Introduction

The status of the cod stock in Div. 3NO was recently considered at the Scientific Council Meeting in June 1986. It was not possible at that time, with the data available, to determine the level of fully-recruited F for 1985, and, consequently, advice concerning stock abundance and biomass was deferred to the present meeting. Additional data which became available since the June Meeting included survey data from Canada for 1986 and USSR for 1985 and 1986, and catch-at-age and catch-effort information from the Canadian commercial fishery during January-June 1986.

b) Input data

i) Commerical fishery catch-effort data

Catch and effort data from Canadian otter trawlers during January-June 1986 were added to previously-used 1977-85 data and analysed by using a multiplicative model. Standardized catch rates (tons/hr) generally increased from 1.22 in 1977 to 1.83 in 1982 and declined to 1.24 in 1986.

ii) Research surveys

New information included age compositions from a USSR survey in 1985 and a Canadian

survey in 1986, as well as total biomass and abundance estimates for Div. 3NO from USSR and Canadian surveys in 1986. Total biomass estimates from Canadian surveys have been stable in recent years (mean of 195,000 tons in 1984-86) but were considerably higher than in previous years (60,000 tons in 1977-82). Abundance estimates have declined in Div. 3N since 1984, but the presence of higher numbers of older fish has maintained high biomass levels. Abundance in Div. 3O has fluctuated from 11 million to 49 million fish over the survey period, with estimates being relatively high in 1984 and 1986 (49 million and 45 million respectively). Biomass levels in Div. 3O have been high since 1984.

USSR surveys of Div. 3NO indicated that both total biomass and abundance increased from 1984 to 1985 but decreased in 1986. The dominant year-classes in both the 1986 Canadian survey and the 1985 USSR survey were those of 1981 and 1982. Considerable numbers of older fish, most notably the 1975 year-class, were present in the Canadian 1986 survey. Biomass estimates from Canadian and USSR surveys in 1984-86 were considerably different despite the use of similar survey techniques. These estimates (000 tons) are as follows:

	USSR			Canada		
Year	3N	3O	3NO	3N	3O	3NO
1984	-	-	262.5	92.7	125.3	218.0
1985	284.4	174.5	458.9	85.5	97.2	179.7
1986	159.1	226.1	385.2	95.3	92.7	188.0

A recruitment index, based on abundance of age-groups 2 and 3 from the Canadian and USSR surveys, indicated that the 1980 year-class was strong, the 1981 and 1982 year-classes were slightly above average, and the 1983 and 1984 year-classes were weak.

iii) Catch-at-age

Canadian sampling data were used to adjust Canadian catches for the first half of 1986. The dominant year-classes were those of 1980 and 1981. Significant numbers of older fish were present (particularly the 1975 year-class), as had been the case in recent years.

c) Estimation of parameters

The following relationships were considered with regard to surveys, CPUE, cohort abundance and biomass to determine F in 1985: (i) age 5+ survey abundance and age 5+ abundance from cohort analysis; (ii) age 5+ survey abundance and age 5+ abundance from cohort analysis (without 1984); (iii) age 6+ survey abundance and age 6+ abundance from cohort analysis; (iv) age 6+ survey abundance and age 6+ abundance from cohort analysis (without 1984); (v) total survey biomass and age 3+ mid-year biomass from cohort analysis; (vi) total survey biomass and age 3+ mid-year biomass from cohort analysis (without 1984); and (vii) CPUE against exploitable biomass from cohort analysis. Of these relationships, only two (iv and v) produced significant results. In both, for the range of fully-recruited F-values under consideration, the correlation coefficient increased as F decreased but the sum of the residuals in the most recent years became larger. With the uncertainties associated with these calibrations, STACFIS concluded that neither could appropriately estimate fishing mortality in 1985.

d) Catch projections

The Canada and USSR survey results indicated that the age 3+ annual mean biomass in 1986 is at least 200,000 tons. This is probably a minimum estimate, because both sets of data assumed a catchability equal to 1, which is considered high for research trawls, and the USSR estimates indicated biomass levels well in excess of 200,000 tons.

STACFIS concluded, therefore, that the mean age 3+ biomass would likely exceed 200,000 tons in 1987. However, since the 1985 terminal F could not be precisely determined, no analytical assessment could be conducted and the detailed advice as requested by the Fisheries Commission cannot be provided. STACFIS, however, advised in 1985 that the 1986 mean age 3+ biomass could be 271,000 tons, and it has no basis at present to consider that the 1987 biomass will be significantly different from that level.

Because of discrepancies in survey results, STACFIS

recommends

that possible reasons for discrepancies between biomass estimates for cod in Div. 3NO from Canadian and USSR surveys be investigated, including differences in timing of surveys, gears and analysis techniques.

2. Silver Hake in Divisions 4V, 4W and 4X

a) Standard method of calculating survey abundance indices

It was agreed that the Canadian method of calculating abundance indices of prerecruit year-classes from the USSR-Canada cooperative juvenile surveys (SCR Doc. 86/54) should be used in the future.

b) Future research requirements

Research requirements for silver hake were identified in detail at the June 1985 Meeting (NAFO Sci. Coun. Rep., 1985, pages 64-65), and no new requirements were identified at this time.

3. Further Consideration of Fisheries Commission Questions

a) Stock discrimination of cod in Div. 2J, 3K and 3L (SCR Doc. 86/118, 122, 123)

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

A review of past and recent studies on discrimination of the various stock components of cod in Div. 2J+3KL (Fig. 1) included discussion of genetic variation, migrations, meristics, infestation by parasites, growth rates, ages and lengths at maturity, and spawning time. The conclusions drawn in each subject area reflect the authors' interpretations. Cod in Div. 2GH are probably a part of the Labrador-East Newfoundland stock complex, but they have been considered separately for management purposes since 1974. Analysis of genetic variation of cod implied that there was a northern component from the deep northern slopes of the Grand Bank (Div. 3L) up to and including Hamilton Bank (Div. 2J) and a southern component from the shallower areas of the northern Grand Bank (Div. 3L), St. Pierre Bank and Burgeo Bank (Subdiv. 3Ps) and the Gulf of St. Lawrence (Div. 4RS) north of the Laurentian Channel. The cod of Flemish Cap (Div. 3M) were significantly different from the population on the northeastern Grand Bank.

Studies based upon the parasitic copepod *Lernaeocera branchialis* as a biological tag were considered to be useful in determining relationships between inshore and offshore stock components. In Div. 2J and 3K, the inshore cod and the larger offshore cod were from the same intermingling population, but the smaller offshore cod did not visit the coast in sufficient numbers to obtain high infestation rates. For cod over 30 cm in length, infestation rates near the coast were much higher off Newfoundland and off southern Labrador immediately north of the Strait of Belle Isle than further north along the remainder of the Labrador coast. The cod in Div. 3L had lower infestation rates offshore (east of 50°W) and higher rates inshore. For the nearshore area west of 50°W, infestation rates were as high as in the inshore area for smaller cod but intermediate for larger sizes. It seems clear that the cod in the offshore area (east of 50°W) have much less contact with the inshore area than cod of the nearshore area (west of 50°W).

From studies on the prevalence of the protozoan parasitic trypanosome (*Trypanosoma murmanensis*) in cod, it was suggested that cod in Div. 2J+3K represented a stock that is distinct from the stock in the neighboring Gulf of St. Lawrence (Div. 4RS). Differences in the prevalence recorded for cod in Div. 2J+3K (southerly limit of 50°N) and Div. 3L, were sufficient, in the authors' opinion, to warrant separation of a northern Grand Band stock from the Labrador-East Newfoundland stock complex.

On the basis of vertebral averages from samples collected in Newfoundland and adjacent areas during 1947-71, an average of 54.8 vertebrae appeared to be the appropriate level at which to separate high vertebral averages from low ones. Cod with high vertebral averages extended from Labrador along east Newfoundland to the northern slopes of the Grand Bank. Around the Avalon Peninsula, they usually intermingle with cod of the Avalon stock complex and with migrants from the southern Grand Bank.

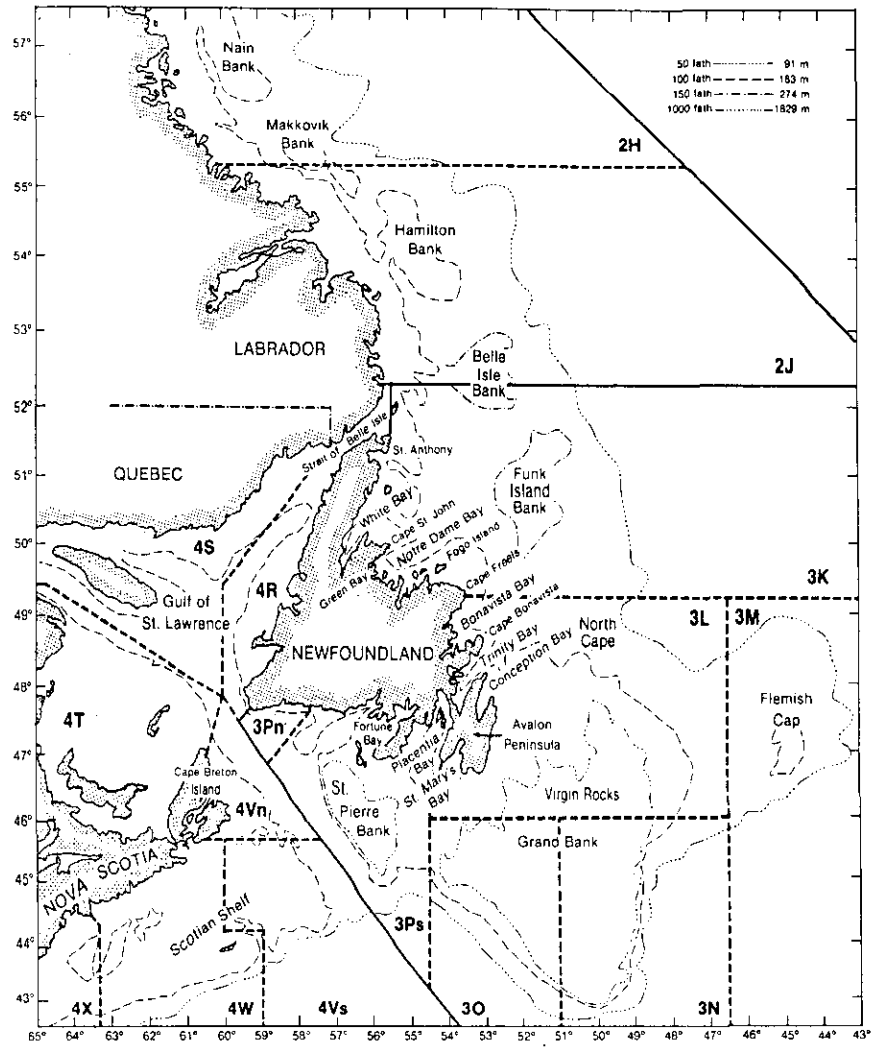

Fig. 1. Area map showing NAFO divisions, offshore banks and some of the place names mentioned under stock discrimination.

On the basis of meristic characters of mature cod from spawning and postspawning concentrations sampled in 1982, it was found that the fin-ray and vertebral counts of cod from southeastern Hamilton Bank were significantly different from those from Funk Island Bank, indicating that the two groups may be distinct spawning components. Homogeneity of meristic characters was evident in cod from Funk Island Bank and northern Grand Bank. The significantly lower vertebral averages of cod on the eastern slope of the Grand Bank indicate that mature cod in this area during the spring are somewhat different from the other groups.

On the basis of taggings during the summer-autumn period in the 1950's and 1960's at many inshore localities from Labrador to the Avalon Peninsula and in offshore areas from Hamilton Bank to the northern Grand Bank, cod were shown to intermingle and overlap from north to south in their winter-spring spawning areas in deep water on the slopes of the Labrador Shelf (Subarea 2) and Northeast Newfoundland Shelf (Div. 3K). In June-September (the main feeding and growing period) in the years after tagging, the most obvious migratory characteristic was the homing of most of the coastally-tagged cod to or near the tagging area.

On the basis of the tagging of about 25,000 cod during February-March, 1978-81, from the prespawning concentrations on Hamilton Bank, Belle Isle Bank, Funk Island Bank and northern Grand Bank, there was evidence, for each group of cod tagged on these offshore banks, of a consistent annual pattern of migration during summer to inshore waters and during winter to or near the offshore areas where they were tagged. The Hamilton Bank component (Div. 2J) evidently contributes to the southern Labrador (Div. 2J) and northeast Newfoundland (Div. 3K) coastal fisheries mainly from Notre Dame Bay northward. The Belle Isle Bank component (located mainly in Div. 2J with a small portion in Div. 3K) migrates during summer mainly to southern Labrador (Div. 2J), the Strait of Belle Isle entrance (Div. 4R) and northeastern Newfoundland as far south as Notre Dame Bay (Div. 3K). The pattern of movement is similar to that of the Hamilton Bank component (Div. 2J) except for the greater proportion in the Strait of Belle Isle from the Belle Isle Bank component. Cod on the northern and northeastern slopes of Funk Island Bank (Div. 3K) migrate during summer to eastern (Div. 3K) and

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

On the basis of tag recaptures by Newfoundland fishermen in January-April from tagging, during 1978-83, of about 33,000 adult cod from offshore concentrations, there was evidence of a significant degree of homing. In years following the tagging, cod returned mainly to the same or adjacent areas where they had originally been tagged. In each of Div. 2J, 3K and 3L, the proportion of recaptures during January-April in the same division was about two-thirds, and most of the remainder were taken in the adjacent division or divisions.

Recaptures in the inshore areas from the same experiments showed that, from cod tagged in Div. 2J in winter, about two-thirds of the inshore recaptures were taken in Div. 2J and 3K and most of the remainder in Div. 3L. From the Div. 3K tagging, in excess of 75% of the recoveries were made in Div. 3K and 3L. Inshore recoveries of cod tagged in Div. 3L were almost entirely (90%) in Div. 3L.

On the basis of an analysis of tag returns from the offshore and inshore areas combined, there was evidence that about half the recaptures of cod which were tagged in Div. 2J were caught in Div. 2J and most of the remainder in Div. 3K. About half of the recaptures of cod which were tagged in Div. 3K were caught in Div. 3K, and those remaining were about equally distributed in Div. 2J and 3L. About two-thirds of the recaptured cod which were tagged in Div. 3L were eventually caught in Div. 3L, and those remaining were about equally distributed in Div. 3K and 3NO. Thus, the results of this analysis indicate a significant intermingling of cod among Div. 2J, 3K and 3L.

The locations of spawning grounds in Subarea 2 and Div. 3KL are poorly documented. However, there is evidence that spawning occurs between April and June in various areas from southern Labrador and Hamilton Bank in the north to the Avalon Channel and the northern and northwestern slopes of the Grand Bank in the south. Tagging of prespawning concentrations of cod on the offshore banks gave results which indicated a clear tendency for fish to return to the vicinity of tagging in following winters, implying an important degree of homing to localized spawning components. In summer, returns were distributed broadly in coastal waters of the division of tagging and those adjacent to it, but, nonetheless, there was also a tendency to home to particular summer feeding grounds. Thus, there is evidence from tagging of a complex of spawning components, the adjacent groups of which overlap broadly in their distributions, particularly in coastal areas in summer. Biochemical, parasitological and meristic studies all indicate close similarities among cod in Subarea 2 and Div. 3K, but these and also the tagging studies indicate that cod in Div. 3L are a more heterogeneous group. Clearly, some of the cod occurring in Div. 3L, particularly those occurring in deep areas of eastern Div. 3L, are similar to those in more northern areas. However, cod on the northern slopes of the Grand Bank, especially in shallower water, show affinities with those of Div. 3NO. From the point of view of assessing the stock in Div. 2J+3KL, in spite of some evidence for genetic subdivisions, the cod of Div. 2J, 3K and 3L are intermingled to a significant degree, especially inshore during the feeding season. The pattern and degree of intermingling may vary, depending on environmental conditions such as ice coverage and water temperature. Therefore, STACFIS concluded that, at present, it is advisable to assess Div. 2J+3KL cod as one stock complex as has been the practice in the past.

From the point of view of management of the resource, STACFIS was not able to precisely assess the effects of exploitation on any one of the spawning components, because biomass estimates of these components were not available. However, from the results to date and the evidence for incomplete mixing of these components, STACFIS advises that the concentration of fishing effort in any one division will generate differential fishing mortality between stock components and that this could result in local over-exploitation. If managers wished to guard against this, measures should be considered which provide for a distribution of fishing effort among the three divisions, aimed at more even distribution of fishing mortality over stock components. Unfortunately, the Committee is not presently able to provide advice on the relative distribution of the resource among divisions but it could provide some general guidance on this matter at a future meeting if requested to do so.

With respect to the stock complex as a whole, the importance of knowing the degree of intermingling of spawning stock components was emphasized, and STACFIS

recommends

that the relative contribution of each spawning component of the Div. 2J+3KL cod stock to the offshore and inshore fisheries on that component and on other components be quantified.

With regard to the effects of environmental factors on cod distribution, STACFIS

recommends

that the effects of seasonal ice cover and extreme environmental conditions on the distribution of cod in Div. 2J+3KL be examined.

b) Stock discrimination of Greenland halibut in Subareas 2 and 3

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

To answer this request from the Fisheries Commission, STACFIS reviewed SCR Doc. 82/IX/78 on stock identification studies of Greenland halibut in the Northwest Atlantic. The paper dealt mainly with tagging experiments in the Newfoundland and Labrador areas and also reviewed published stock identification studies based on meristics, biochemical genetics, parasites, and biochemical composition. STACFIS agreed that the weight of the available evidence supports the conclusion that there is a single continuous stock extending from the Davis Strait to the northern Grand Bank, i.e. there is no stock division in Subarea 2 and Div. 3K and 3L.

4. Review of Arrangements for Conducting Stock Assessments

Stock assessments at the June 1986 Meeting were again conducted by using the system of two working groups. Draft reports were considered within each working group as before, but this was done in a more provisional way for some stocks than previously, before consideration by the Committee as a whole.

Two major changes in approach were adopted, the first being to devote 2 days at the beginning of the meeting to development of abundance indices of fishable stock size and recruiting year-classes for cod in Div. 2J+3KL, and the second being the imposition of a strict timetable of work in order to minimize the amount of *ad hoc* reanalysis during the time frame of the meeting. More emphasis was placed on forming research recommendations which, if followed, would result in thorough analyses being conducted and properly documented in time for the assessments at the June 1987 Meeting.

The second innovation resulted in a more timely conduct of business with better distribution of time over consideration of assessments, reanalyses, formulation of advice and drafting of reports, but several problems continue to be identified. In particular, the last 2 days of the meeting devoted to report approval were too cramped for time, resulting in late hours and less effective scrutiny of reports than some members considered desirable. Thus, further improvements in time management are desirable.

One view was that discontinuities in discussions, due to scheduling of non-assessment activities during assessments, resulted in inefficiencies and that this scheduling practice should cease. However, it was also pointed out that time for reanalyses was required, necessitating breaks in the assessment schedule, and that perhaps the creative use of the whole Scientific Council timetable to provide appropriately-timed breaks in the assessment schedule would contribute more to the efficient conduct of business. More weight was given to this latter view, and STACFIS

recommends

that the Scientific Council's timetable for the June 1987 Meeting be revised to accommodate suitable breaks in the assessment schedule.

It was recognized that it will be necessary, nonetheless, to continue to schedule the meetings of other committees in advance to facilitate attendance by appropriate experts. It was also pointed out that the proposal of the September 1985 Meeting concerning ways of dealing with reports was only partially implemented. At that time, it was agreed that working groups would carry their work only as far as agreement on report content and that the first draft of the report be discussed and approved by STACFIS (NAFO Sci. Coun. Rep., 1985, pages 114-115). The intention was

that the reports should be subjected to only one review and not two, as in the previous year. It was agreed that this approach should be fully implemented at the June 1987 Meeting.

The report-approval process has proved to be a difficult one from the institution of the working group approach, particularly in determining what is open for discussion at each approval stage and in controlling discussion to appropriate aspects. It is this process which largely determines the degree of autonomy of working groups from STACFIS or, put conversely, the extent to which STACFIS, as a whole, participates in matters which are first considered in working groups. The above proposal should result in most, usually all, technical aspects of particular stock assessments being resolved within working groups. It will then be the responsibility of the working group convener, in conjunction with his rapporteurs, to ensure that a satisfactory first draft of the report is made available to STACFIS. This may involve the main participants in a particular stock assessment in consultations and redrafting but would not involve convening a working group meeting. When the report comes before STACFIS, the primary purposes would be to ensure (i) that it is a clear and unambiguous statement of preceived stock status, and (ii) that the advice provided is consistent with that statement and answers fully all questions asked of the Scientific Council. Clearly, the report must also be open to comment on its technical accuracy both by members of the working group and other STACFIS members. However, to ensure efficient working of the Committee, members should be expected to raise only matters of particular substance, i.e. those for which there is established theory or recorded observation supportive of the member's point and not matters which are supported only by personal opinion. The Chairman of STACFIS must rule at an early stage on whether a technical point is one which is sufficiently new to allow debate or whether it has been adequately dealt with in a working group.

It was generally recognized that the ideal situation would be to conduct all business in the Committee rather than have some aspects dealt with in working groups. This would not only solve difficulties in report approval but give all members an opportunity to bring their expertise to bear fully on all topics. It was agreed that a return to this situation, or even to one where several of the major stocks were assessed in STACFIS while the remainder were done in working groups, was not practical immediately. However, it was agreed that this is a situation which should be worked towards by progressively implementing new procedures which increasingly devote Committee time to advice formulation and to recommendations for technical analyses which are to be conducted between the June meetings.

III. ENVIRONMENTAL RESEARCH

1. Appointment of Environmental Subcommittee Chairman

It was the unanimous decision of STACFIS to reelect the present Chairman, M. Stein (EEC), for a second term of 2 years until September 1988.

2. Other Matters

a) On behalf of the Greenland Fisheries and Environmental Research Institute, Copenhagen, Denmark, the Chairman of the Environmental Subcommittee presented a proposal for change in location of two stations in Subarea 1, because the present positions are in areas of unfavorable topography. Accordingly, STACFIS

recommends

that the position of the first station on the Lille Hellefiskebanke Section be changed from 65°06'N 53°00'W (150 m) to 65°06'N 52°55'W (490 m), and the first station on the Fyllas Banke section be changed from 64°01'N 52°19'W (108 m) to 63°57'N 52°22'W (287 m).

b) The Chairman of the Environmental Subcommittee informed STACFIS that occupation of the Seal Island Section off Labrador will not be continued by the Federal Republic of Germany beyond 1985. STACFIS proposed that the hydrographic survey of this section be undertaken during the Canadian autumn survey in Div. 2J, and this was endorsed by Canadian scientists. The Environmental Subcommittee Chairman pointed out that it would not be necessary to run the section in a quasi-synoptic way. Standard methods of sampling were recommended.

IV. TOPICS FOR FUTURE SPECIAL SESSIONS

1. Outline for Special Session in September 1987

Slope, with Emphasis on Greenland Halibut and Grenadiers" was chosen as the theme for the Special Session in advance of the Annual Meeting in September 1987. At the June 1986 Meeting, W. R. Bowering (Canada) was unanimously nominated to be Convener for the Special Session. The following outline was adopted:

a) General theme

The primary intent is to elicit research papers on Greenland halibut and grenadiers which have established commercial potential but about which relatively little is known. While the principal area of interest is the North Atlantic Ocean, papers related to Greenland halibut in the North Pacific Ocean are welcomed since the species is the same as in the North Atlantic. The scope of the Special Session will be broadened to include other unexploited deepwater species which share the same or greater depths on the continental slope. These may include benthic invertebrates of the slope but exclude well-studied species, such as cod and redfish, even though these species are distributed along the upper parts of the slope. Papers which deal with oceanographic and topographic features of the slope area, especially in relation to the biology of deepwater species, are also invited.

b) Specific topics

i) Oceanographic features of North Atlantic continental slopes.
ii) Spatial and temporal distribution and abundance of deepwater species.
iii) Biological characteristics (age and growth, sexual maturity, food and feeding, other biological features).
iv) Species interactions (e.g. predator-prey relationships among deepwater species).
v) Biological implications to management.

2. Proposed Theme for Special Session in September 1988

STACFIS, at its June 1986 Meeting, considered that the "early eighties anomaly" in the environment and its possible impact on distribution and availability of marine species would be a topic of interest for a Special Session of the Council, possibly in September 1988. It has since been suggested that the environmental conditions of the early 1980's may prove to be of long-term duration and, hence, may prove not to be suitably characterized as "anomalous"; that a definitive description of the impacts of conditions in the early 1980's are unlikely to be possible until the early 1990's, and, hence, 1988 is too early to deal with this question; and that effects on recruitment should also be considered, but this likewise could not be described until the early 1990's.

While STACFIS considered that these views were valid in the context of providing a definitive statement on impacts of observed environmental changes, the motivation for the original proposal lay in the stock assessment difficulties being faced at June meetings, which appeared to stem from these changes. In the stock assessment context, greater understanding of the influences of environmental changes on distribution and abundance, and their impact on survey and commercial abundance indices, is required immediately. STACFIS considered that these practical aspects should be the focus of the September 1988 Special Session. The effects on recruitment, as distinct from survey recruitment indices, would of necessity have to be considered at a later date.

STACFIS confirmed its view that a Special Session on the general topic proposed at the June 1986 Meeting would be worthwhile and proposed the following title:

> *The impact of changes in environmental conditions in the North Atlantic on the distribution, availability and abundance of marine species, with particular emphasis on the Labrador and Grand Bank regions in the early 1980's.*

It was suggested that the session synopsis, while emphasising the practical stock assessment implications for stocks in these latter areas, encourage case histories of effects of environmental changes on resources in other areas (particularly the Northeast Atlantic).

V. REVIEW OF SCIENTIFIC PAPERS

1. A Genetic Stock Structure Study of Dogfish in the Northwest Atlantic (SCR Doc. 86/102)

Previous studies of the stock structure of spiny dogfish (*Squalus acanthias*), using tagging methods, indicated that they are composed of one stock in the Northwest Atlantic with an extensive seasonal migration. In this study, the amount of genetic differentiation between dogfish from the Gulf of Maine and on the Scotian Shelf was estimated from electrophoretically detectable

protein loci expressed in skeletal muscle and liver. Both samples were in Hardy-Weinberg equilibrium and showed no genetic differentiation in allelic frequencies. These results support the previous conclusions that there is one stock of spiny dogfish which undergoes large seasonal migrations.

2. Nature of Spermatogenesis and Maturity Scale in Testes of Pearlsides (SCR Doc. 86/120)

Histophysiological analysis of changes in the gonads of male pearlsides (*Maurolicus muelleri*) was carried out on specimens that were collected in the central North Atlantic (48°N to 58°N). Some special features in the development of the reproductive system were investigated, including stages of maturation and the duration and nature of spawning.

3. Mesopelagic Fishes in the NAFO Subareas 1, 2 and 3 (SCR Doc. 86/121)

A total of 586 samples of mesopelagic fish of the Suborder Stomiatoidei, belonging to 27 species, were collected in Subareas 1, 2 and 3 during 1979-85. The distributions of all species are shown and their biology briefly described.

4. Newfoundland Fleet Discarding Practices (SCR Doc. 86/95)

The discarding practices of the offshore fleet of Newfoundland trawlers in 1985 were examined and compared with other years. An increase in discard rate of all species combined (10%) was observed in 1985 to almost twice the 1981 level, and of cod, haddock, redfish and flatfish (8%) to almost three times the 1981 level. It was noted, however, that these levels of discard are moderate compared to levels in some fisheries in the Northeast Atlantic. Sizes of discarded cod in the Div. 2J+3KL fishery ranged from 22 cm to 55 cm with an average of 42.5 cm. The extent to which the increased discarding of small cod reflected improved recruitment was not quantified.

VI. OTHER MATTERS

1. Trawl Escapement and Selectivity Problems

The Scientific Council was requested by the Fisheries Commission to consider escapement and selectivity problems that are associated with the use of strengthening ropes, splitting straps and codend floats (FC Doc. 84/6, revised, para. 21). This topic initially appeared on the agenda for the September 1985 Meeting of the Scientific Council and was repeated on the agenda for the June 1986 Meeting and the present meeting. No scientific information on this matter has been submitted, and STACFIS is not aware of any research being undertaken to address these issues.

2. Report of *Ad Hoc* Working Group on Recruitment and Abundance Indices for Cod

STACFIS reviewed the progress made at its June 1986 Meeting toward deriving indices of abundance which could be used as standards in future assessments of the Div. 2J+3KL cod stock. The working group met during the first two days of the STACFIS meeting and considered all available data relating to abundance indices for this stock based on commercial and research data and recruitment indices based on research data.

At the present meeting, STACFIS concluded that the index based on the abundance estimates for ages 3-6 from Canadian autumn surveys during 1977-85 in Div. 2J and 1978-85 in Div. 3K and spring surveys during 1976-85 in Div. 3L, as constructed and used at the June 1986 Meeting (SCS Doc. 86/24, page 27), be adopted as the standard index of recruitment for estimating year-class size at the June 1987 Meeting.

With regard to a standard index of abundance for Div. 2J+3KL cod from survey data, it was agreed that the index based on the Canadian autumn surveys in Div. 2J, 3K and 3L, as constructed and used at the June 1986 Meeting (SCS Doc. 86/24, page 26), be adopted as one standard index for estimating abundance and calibrating the cohort analysis at the June 1987 Meeting.

With regard to a standard index of abundance for Div. 2J+3KL cod from commercial data, it was agreed that the index based on the standardized catch rate from the multiplicative model using 1979-85 data only, as constructed and used at the June 1986 Meeting (SCS Doc. 86/24, page 27), be adopted as another standard index for estimating abundance and calibrating the cohort analysis at the June 1987 Meeting.

The Chairman of STACFIS was requested to instruct the designated experts for assessment of the Div. 2J+3KL cod stock to utilize only these adopted standards for estimating abundance, calibrat-

sessment for the June 1987 Meeting. The indices, as constructed at the June 1986 Meeting, will obviously have to be updated with the 1986 research vessel and commercial fishery data, but any major reanalysis of these standard indices have to be included in a report separate from the standard assessment document. In other words, any reanalyses of data in an attempt to support indices of abundance or recruitment which are different from the adopted standard have to be presented in research documents separate from the assessment document, and the onus is clearly on the proponents of such revised indices to prove to STACFIS that such indices are superior to those which have been adopted for use.

Regarding the standard index of abundance from commercial data, substantial further work is necessary as follows:

a) Alternative means of linking the abundance indices for the two time periods, 1962-78 and 1979-85, should be investigated, and, in particular, the results of the Federal Republic of Germany survey series by age should be used to reevaluate the relationships between standardized CPUE and offshore exploitable biomass for the two periods. To this end, Federal Republic of Germany scientists are requested to supply the designated experts with the age compositions of their entire survey series by the end of 1986 for analysis prior to the June 1987 Meeting.

b) The standardized catch rates for the multiplicative model should be related to the Canadian survey results by division to investigate the possibility of a better relationship between the two indices.

c) The reliability of biomass estimates from surveys as weighting factors for divisional trends in the multiplicative model should be investigated.

d) Catch and effort information from the Canadian fleet on a smaller unit than NAFO division should be investigated, as well as appropriate temporal units.

e) Data from the Canadian observer program should be examined to determine patterns of fishing on a finer scale than NAFO division and on a time scale appropriate to describe the evolution of fishing patterns over the season.

f) Biomass estimates for the various spawning components in Div. 2J+3KL should be obtained.

3. Acknowledgements

There being no further business, the Chairman thanked the participants for their help and cooperation and the NAFO Secretariat for their usual efficient service throughout the course of the meeting.

APPENDIX 11. REPORT OF STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

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

The Committee met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, on 11 September 1986. In attendance were J. S. Beckett (Chairman), S. Kawahara (Japan), R. G. Halliday and A. T. Pinhorn (Canada), the Chairman of the Scientific Council (J. Messtorff), the Assistant Executive Secretary (V. M. Hodder) and the Administrative Assistant (W. H. Champion).

1. Editorial Matters

a) Editorial Board activities

The Council was pleased to note that 7 papers have been accepted for publication in Vol. 7 of the *Journal of Northwest Atlantic Fishery Science* and 13 others are under review.

b) Editorial Board appointments

No candidates for the position of Editor had been identified by the time of the meeting. It was agreed that the Chairman would contact the directors of relevant laboratories for suggestions on nominees, as this had not yet been done.

The possibility of contracting professional editorial services was investigated by the Chairman, and it was clear that costs would be significant (in excess of $5,000 annually).

c) Tentative editorial arrangements

It was decided that Associate Editors, who had all agreed to undertake complete editing until a new Editor was found, could reasonably be expected to continue doing this until June 1987 when the matter would be reconsidered. Since this is a fairly extensive period, clear guidelines on the relationship between Associate Editors and the Secretariat are required. Papers are to be submitted by authors to the Assistant Executive Secretary who will be responsible for an equitable distribution of these among Associate Editors. Associate Editors will submit completely edited and accepted papers to the Assistant Executive Secretary for technical preparation, typesetting and publication. Technical preparation of papers for publication will include formatting and correction of grammatical errors (e.g. spelling, tense and concordance) only, as responsibility for grammatical style and text clarity lies with the Associate Editor. If for any reason the Secretariat finds that a paper is not in a form considered to be ready for publication, it is to be referred back to the Associate Editor. It is the Secretariat's responsibility to provide authors with proofs of their papers which have been subject to the usual standards of quality control regarding accuracy, but it is, of course, the authors' responsibility to ensure that their papers are error-free. If, for any reason, the Secretariat considers that any change in a paper is required after proofs have received an author's approval, the paper must be referred back to the author for consideration of such a proposed change.

2. Promotion of Journal

a) Presentation of a draft brochure

It was regretted that a design proposal for an advertising brochure for the Journal was not available for consideration. The Committee requested that the Executive Secretary have a draft brochure circulated to STACPUB members by mail for consideration as soon as possible after the present meeting.

b) Development of a mailing list

It was agreed that extracts of the International Directory of Marine Scientists should be sent to National Representatives on the Scientific Council, as decided in June 1986, for them to identify people or organizations which are likely to be interested in the Journal. The results will be used as a mailing list for the brochure. It was noted that costs of production and mailing of a brochure would be insignificant.

c) Other suggestions

The Chairman indicated that he had the opportunity to discuss with the former Editor both the items on cooperation with ICES in publication matters and on invitational papers but that no new information resulted from these discussions.

3. Review of Papers for Publication

The Committee reviewed SCR documents that were submitted since June 1986 and proposed that the Assistant Executive Secretary contact authors of the following documents, expressing the Council's interest in having them submitted in suitable form for publication in the Journal or Studies: SCR Doc. 86/93, 96, 98, 99, 100, 101, 104, 105, 106, 108 (with figures), 109, 110, 111, 115, 116 and 119. The authors of SCR Doc. 86/90, 107, 112, 113 and 114 are requested to consider combining these into one paper for publication. The author of SCR Doc. 86/118 and 123 is invited to combine these and add a suitable discussion and interpretation section in a paper for consideration.

4. Other Matters

It was noted that the microfiche project was nearly complete at a total cost of about $16,000. Sets of these will be made available for purchase ($750 Can) before the end of the year.

It was proposed that the Council consider asking the Secretariat to purchase a portable microfiche reader and reserve one set of fiche for use at Scientific Council Meetings. This should be of particular value at meetings held outside of NAFO Headquarters.

5. Acknowledgements

The Chairman thanked the Secretariat for its support of the work of the Committee.

PART D

MISCELLANEOUS

CONTENTS

I. AGENDA FOR SCIENTIFIC COUNCIL MEETINGS, 1986

A. JANUARY 1986 MEETING

I. Opening (Vice-chairman: J. S. Beckett)

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

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

1. Assessment of Shrimp Stocks[1]

a) Shrimp in Subareas 0 and 1

i) Review of fishery trends
ii) Distribution and biology
iii) Catch and effort
iv) By-catches in shrimp fishery
v) Biomass estimates
vi) Total allowable catches
vii) Future research needs

b) Shrimp at East Greenland (Annex 1)

[Items (i) to (vii) as in 1(a) above]

c) Review of necessity for future midterm shrimp meetings

III. Other Matters

1. Review of Future Meeting Arrangements (if needed)
2. Adjournment

B. JUNE 1986 MEETING

I. Opening (Chairman: J. Messtorff)

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

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

1. General review of catches and fishing activity in 1984

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

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

3. Assessment of finfish and invertebrate stocks

a) Stocks within or partly within the Regulatory Area, as requested by the Fisheries Commission with the concurrence of Canada (Annexes 1 and 2):

- Cod (3M, 3NO)
- Redfish (3M, 3LN)

[1] The Canadian and Denmark (Greenland) requests for advice on management of the shrimp stocks in 1986 were contained in the requests considered at the June 1985 Meeting of the Scientific Council (see NAFO Sci. Coun. Rep. for 1985, pages 130-132).

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

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

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

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

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

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

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

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

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

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

a) Marine Environmental Data Service report for 1985
b) Review of environmental studies in 1985
c) Overview of environmental conditions in 1985
d) Update of remote-sensing activities
e) Squid larvae and juveniles re oceanography
f) Marine Environmental Ecosystems Subcommittee of CAFSAC
g) Environmentally-induced variations to stock assessments
h) Environmentally-related aspects of Special Session in September 1987 on "Biology of demersal resources of the North Atlantic continental slopes, with emphasis on Greenland halibut and grenadiers"
i) Other matters

5. Flemish Cap and Georges Bank projects

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

6. Ageing techniques and validation studies

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

7. Gear and selectivity studies

a) Escapement and selectivity problems associated with the use of strenghtening ropes, splitting straps and codend floats (NAFO FC Doc. 84/6 (rev.), para. 21; FC 82/2 (rev.))

b) Selectivity studies for shrimp in Davis Strait (NAFO SCS Doc. 86/1, page 12)
c) Trawl catchability (SCR Doc. 85/112)
d) Other relevant studies

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

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

9. Other matters

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

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

1. Statistics and sampling

a) CWP activities relevant to NAFO

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

b) Fishery statistics

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

c) Biological sampling

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

2. Biological surveys

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

3. Other matters

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

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

1. Review of scientific publications since June 1985

2. Editorial matters regarding scientific publications

   a) Editorial board activities
   b) Editorial board appointments

3. Promotion and distribution of scientific publications

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

4. Progress report on microfiche project

5. Papers for possible publication

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

6. Other matters

V. Amendments to Rules of Procedure

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

VI. Collaboration with other organizations

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

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

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

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

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

VII. Adoption of Reports

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

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

VIII. Future Scientific Council Meetings, 1986 and 1987

IX. Special Sessions

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

2. Theme for Special Session in September 1988

X. Other Matters

XI. Adjournment

C. ANNUAL MEETING, SEPTEMBER 1986

I. Opening (Chairman: J. Messtorff)

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

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

1. Report of Special Session on "Recent Advances in Understanding Recruitment of Marine Fishes, with Particular Emphasis on Georges Bank Herring and Flemish Cap Cod and Redfish Stocks" (held on 3-5 September 1986 with M. D. Grosslein as Convener), which involved the following topics:

   a) Brief synopsis of research to date and current knowledge of recruitment process for selected stocks

   b) Evaluation of sampling methods with major emphasis on first year life stages

      i) Sampling designs, gear and its efficiency relative to behavior
      ii) Methods of collecting and processing samples, measurement conventions
      iii) Ageing methods and their accuracy

   c) Estimation of key biological aspects of the recruitment process

      i) Fecundity and spawning
      ii) Distribution and dispersal (eggs, larvae, juveniles)
      iii) Abundance at age/size (accuracy of growth and mortality rates)
      iv) Recruitment and spawning stock estimates and their accuracy

   d) Estimation of recruitment variability and potential controlling factors

      i) Patterns of physical environment relative to spawning
      ii) Possible biological factors (recruitment *versus* food, predators, spawning stock, disease, parasites)

   e) Critique of hypotheses on factors controlling recruitment variability and implications for future research

2. Stock Assessments

   a) Further assessment of cod stock in Div. 3NO

   b) Silver hake in Div. 4VWX

      i) Standard method of calculating survey abundance indices
      ii) Future research requirements

   c) Further consideration of Fisheries Commission questions

      i) Stock discrimination of cod in Div. 2J, 3K and 3L
      ii) Stock discrimination of Greenland halibut in the Northwest Atlantic

3. Environmental Research

   a) Appointment of chairman (present chairman was appointed in September 1984)
   b) Other matters

4. Gear and Selectivity

   a) Escapement and selectivity problems associated with the use of strengthening ropes, splitting straps and codend floats

5. Future Special Sessions

   a) Special session in September 1987 (outline to be provided by convener)
   b) Proposed theme for special session in September 1988

6. Review of Arrangements for Conducting Stock Assessments

7. Other Matters

III. Research Coordination

1. Documentation of National Conversion Factors

2. Survey Design Procedures

a) Review of additional reported material
b) Establishment of working group for evaluation of reported material

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

1. Editorial matters

2. Promotion of Journal

a) Presentation of a draft brochure
b) Development of a mailing list

3. Review of papers for possible publication

a) Research documents deferred from June 1986 Meeting
b) Contributions to the present meeting

4. Other Matters

V. Amendment to Rules of Procedure

1. Progress report by Executive Secretary

2. Further consideration, if necessary

VI. Adoption of Reports

1. Provisional Report of Scientific Council, June 1986

2. Committee Reports of Present Meeting

VII. Review of Future Meeting Arrangements

1. Mid-term Meeting on Shrimp (final decision on time and place)

2. June 1987 Meeting (confirmed dates are 3-18 June 1987)

3. Special Session on Greenland Halibut and Grenadiers (9-11 September 1987)

4. Annual Meeting (14-18 September 1987)

5. Tentative dates for June 1988 Meeting

VIII. Other Business

IX. Adjournment

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

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

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

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

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

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

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

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

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

   f) Presentation of the result should include the following:

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

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

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

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

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

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

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

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

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

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

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

For capelin in Division 3L

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

For squid in Subareas 3 and 4

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

For cod in Division 3M

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

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

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

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

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

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

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

For roundnose grenadier in Subareas 2 and 3

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

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

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

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

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

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

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

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

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

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

management in 1987 of the following stocks:

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

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

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As a general reference point, the implications of continuing to fish at $F_{0.1}$ in 1987 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those expected at the $F_{0.1}$ level. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1987 and the long term.

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

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

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

ANNEX 3. EEC REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1987 OF THE COD STOCK IN SUBDIVISION 3Ps

1. The EEC requests the Scientific Council of NAFO to provide advice, subject to the concurrence of the other coastal states concerned, for the stock of Atlantic cod occurring in Subdivision 3Ps.

2. The present state of exploitation should be reviewed and options for management in 1987 given. Where possible, these should be expressed graphically in terms of catch in 1987 and the size of the spawning stock biomass on 1 January 1988 for a range of values of F which covers at least -50% to +25% of F in 1984, with the inclusion of the F_{max} value.

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

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

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1986 Meeting to provide advice on the status of the stocks and on the scientific basis for management in 1987

and as many years onward as the data allow for the following stocks:

a) Stocks occurring in Subarea 1

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

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

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

2. In the analyses on which management advice will be based, the following should be included:

a) For cod in Subarea 1, the current stock size and its composition and distribution should be analyzed and form the basis for management options in which catch and catch composition (by age-groups) and the resultant stock size and spawning stock size are to be given, with the examples of options:

i) F = F(0.1) from 1987 onward
ii) F = F(max) from 1987 onward
iii) F = F(1985) from 1987 onward
iv) A steady catch level from 1987 onward with the annual catch level equal to (1) the TAC for 1985, and (2) the catch for 1986 calculated by the above options for F(1987).

The maximum potential for rebuilding the spawning stock (i.e. complete stop of cod-fishing) should also be analyzed up to and including the stock size by January 1989.

A graph should be produced illustrating the resulting spawning stock by 1 January 1988 for any given catch level between zero and that for F(max), assuming that the catch level in 1986 is equal to the above-mentioned TAC for that year.

The report of the ICES Working Group on Cod Stocks off East Greenland, January 1986, indicates that year-classes 1984 and 1985 may be better than other year-classes in the present stock. The size of these year-classes should, if possible, be quantified and their expected spatial distribution in 1987 and 1988 described. The expected length and weight distribution of the catches calculated for 1987 and 1988 in the above-given options should be given, if possible by gear types.

b) For redfish and wolffish in Subarea 1, options for management should, if possible, be expressed graphically in terms of catches in 1987 and the stock and spawning stock biomass by 1 January 1988 for a range of F-values covering at least for the wolffish one-half to two times that in 1985 and for redfish one-half to four times that in 1985.

c) For Greenland halibut and roundnose grenadier in Subareas 0+1, the guidelines provided above for wolffish in Subarea 1, supplemented by any other guidelines provided by Canada, should form the basis for analyses and advice.

d) For northern shrimp in Subareas 0+1, advice is requested on stock size and management options. As previously, it is further requested, in the possible extent, to include into the advice a statement on size composition of the actual catch in relation to the supposed composition of the stock.

e) Furthermore, we request a separate assessment of the shrimp stock north of 70°52.5'N on the northwest coast of Greenland (i.e. only in Subarea 1).

3. As in the past, advice on status of stock and management options for shrimp at East Greenland should also be provided in cooperation with ICES.

4. The Scientific Council should feel free to report on such other invertebrate and finfish stocks in Subarea 1 and on such other scientifically-based management options for the above-mentioned Subarea 1 stocks as it feels applicable.

Einar Lemche
Greenland Home Rule Authorities
Nuuk, Greenland

II. LIST OF RESEARCH AND SUMMARY DOCUMENTS, 1986

RESEARCH DOCUMENTS (SCR)

Doc.	Ser.	
86/1	N1099	HALLGRÍMSSON, I., and U. SKÚLADÓTTIR. The Icelandic shrimp (*Pandalus borealis*) fishery in Denmark Strait in 1985. (10 pages)
86/2	N1100	SKÚLADÓTTIR, I., and I. HALLGRÍMSSON. The sustainable yield of shrimp (*Pandalus borealis*) in the Denmark Strait area, 1978 to 1984. (4 pages)
86/3	N1101	KANNEWORFF PER. Biomass of shrimp (*Pandalus borealis*) in NAFO Subarea 1 in 1981-1985 estimated by means of bottom photography. (42 pages)
86/4	N1102	PARSONS, D. G., and P. J. VEITCH. The northern shrimp (*Pandalus borealis*) fishery in Division 0A, 1985. (16 pages)
86/5	N1103	CARLSSON, D. M. Data on the shrimp fishery at East Greenland in 1985 compared to earlier years. (14 pages)
86/6	N1104	POULARD, J. C., B. FONTAINE, A. BATTAGLIA, and P. DERIBLE. Catch, effort and biological data of shrimp (*Pandalus borealis*) in the French fishery off East Greenland in 1985. (17 pages)
86/7	N1105	POULARD, J. C. Data on French shrimp fishery off West Greenland in 1985. (6 pages)
86/8	N1106	SMEDSTAD, O. M. Preliminary report of a cruise with M/T "MASI" to East Greenland waters in September 1985. (12 pages)
86/9	N1107	SMEDSTAD, O. M., and S. TORHEIM. Investigations on shrimp (*Pandalus borealis*) in the Norwegian fishery off East Greenland in 1985. (7 pages)
86/10	N1108	CARLSSON, D. M. Data on the shrimp fishery in NAFO Subarea 1 in 1984 and 1985. (42 pages)
86/11	N1113	BULATOVA, A. Yu., and P. I. SAVVATIMSKY. Distribution of cod on the Labrador-Newfoundland shelf in the fishery zone of Canada and outside it. (13 pages)
86/12	N1120	KULKA, D. W. Estimates of discarding by the Newfoundland offshore fleet in 1984 with reference to trends over the past four years. (20 pages)
86/13	N1122	BAKANEV, V. S., and V. S. MAMYLOV. Acoustic estimation of capelin abundance and biomass in NAFO Div. 2J+3K in 1985. (10 pages)
86/14	N1126	NAKASHIMA, B. S. School surface area of capelin schools from aerial photographs as an index of relative abundance. (7 pages)
86/15	N1127	NAKASHIMA, B. S., and R. W. HARNUM. The 1985 inshore capelin fishery in Div. 3L. (12 pages)
86/16	N1128	HALLIDAY, R. G., and A. F. SINCLAIR. Fishing grounds of groundfish longliners from the Cape Sable Island area (southwestern Nova Scotia) in 1982-84. (7 pages)
86/17	N1129	BECK, P. C., E. G. DAWE, and J. DREW. The 1985 fishery for squid (*Illex illecebrosus*) in the Newfoundand area, with length, sex and maturity composition from inshore commercial samples. (6 pages)
86/18	N1131	HUNT, J. J. Results of Canada-USSR silver hake otolith exchange. (3 pages)
86/19	N1132	STEIN, M., and J. MESSTORFF. An attempt to estimate environmental influences on the distribution of cod (Div. 2J). (4 pages)
86/20	N1133	STEIN, M. Again warm water off West Greenland. (7 pages)
86/21	N1134	BOWERING, W. R., and W. B. BRODIE. An evaluation of the status of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KL. (24 pages)

86/22 N1135 BOWERING, W. R. An evaluation of the witch flounder resource in NAFO Div. 3NO. (9 pages)

86/23 N1137 PINHORN, A. T. Relationship between inshore cod catch and abundance in the Div. 2J+3KL cod stock. (3 pages)

86/24 N1138 PINHORN, A. T. The use of fishing effort as a basis for estimating fishing mortality in Div. 2J+3KL cod. (4 pages)

86/25 N1139 AKENHEAD, S. A. The decline of summer subsurface temperatures on the Grand Bank, at 47°N, 1978-1985. (8 pages)

86/26 N1140 ROWELL, T. W., and F. G. SCATTOLON. The 1985 fishery and biological characteristics of *Illex illecebrosus* in Subarea 4. (12 pages)

86/27 N1141 POWER, D., and D. B. ATKINSON. An estimate of redfish year-class strength from surveys of the Flemish Cap. (14 pages)

86/28 N1142 POWER, D., and D. B. ATKINSON. An update of the status of redfish in NAFO Div. 3M. (7 pages)

86/29 N1143 ATKINSON, D. B., and D. POWER. An update of the status of roundnose grenadier in Subareas 0+1 and 2+3. (10 pages)

86/30 N1144 RICE, J., and G. EVANS. Reexamining target spawning biomass for the cod stock in NAFO Divisions 2J+3KL. (5 pages)

86/31 N1145 BRODIE, W. B., and J. W. BAIRD. An annotated bibliography of environmental factors affecting assessment of some fish stocks in the Newfoundland area during 1972-1985. (8 pages)

86/32 N1146 LEAR, W. H. The stock complex of Atlantic cod (*Gadus morhua*) in NAFO Divisions 2J, 3K and 3L. (14 pages)

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86/34 N1154 POULARD, J. C. Contribution to the assessment of the cod stock in Subdivision 3Ps. (7 pages)

86/35 N1149 BISHOP, C. A., and J. W. BAIRD. An assessment of the cod stock in NAFO Divisions 3NO. (25 pages)

86/36 N1150 BISHOP, C. A., and J. W. BAIRD. An assessment of the cod stock in NAFO Subdivision 3Ps. (31 pages)

86/37 N1151 ATKINSON, D. B., and D. POWER. The status of redfish in NAFO Divisions 3LN. (16 pages)

86/38 N1152 ATKINSON, D. B., and D. POWER. The stock complex of redfish in NAFO Divisions 3KLNOPs. (18 pages)

86/39 N1153 WALSH, S. J. Juvenile yellowtail surveys on the Grand Bank (NAFO Divisions 3LNO). (15 pages)

86/40 N1156 BRODIE, W. B. An assessment of yellowtail flounder in NAFO Div. 3LNO. (20 pages)

86/41 N1157 BRODIE, W. B. An assessment of the American plaice stock on the Grand Bank (NAFO Divisions 3LNO). (32 pages)

86/42 N1158 HANSEN, H. H., and K. M. LEHMANN. Distribution of young cod in coastal regions of West Greenland, 1985. (12 pages)

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86/44 N1160 RIGET, F. Distribution pattern of Atlantic wolffish (*Anarhichas lupus* L.) and spotted wolffish (*A. minor* Olafsen) in offshore waters of southwest Greenland. (8 pages)

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86/46 N1162 BUCH, E. Fluctuations in climate over Greenland and their influence on the marine environment and the cod stock. (13 pages)

86/47 N1163 BAIRD, J. W., and C. A. BISHOP. Assessment of the cod stock in NAFO Divisions 2J+3KL. (50 pages)

86/48 N1164 BUCH, E. A review of the hydrographic conditions off West Greenland in 1980-85. (15 pages)

86/49 N1165 SØRENSEN, E. F. Horizontal distribution of capelin (*Mallotus villosus*) during the spawning season in inshore areas off West Greenland. (11 pages)

86/50 N1167 BAIRD, J. W., and R. WELLS. An update on the status of the cod stock in Division 3M. (2 pages)

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86/52 N1169 ROWELL, T. W., and J. H. YOUNG. Biological characteristics and biomass estimates of the squid (*Illex illecebrosus*) on the Scotian Shelf (Div. 4VWX) in 1985. (11 pages)

86/53 N1170 CARSCADDEN, J. The Southeast Shoal (Div. 3NO) capelin stock. (7 pages)

86/54 N1171 KOELLER, P. A., P. PERLEY, and J. D. NEILSON. Canadian juvenile silver hake abundance estimates from joint Canada-USSR surveys on the Scotian Shelf. (11 pages)

86/55 N1172 HORSTED, Sv. Aa. Status of Subarea 1 cod and the fisheries (An extract of the Report of the ICES Working Group on cod stocks off East Greenland, January 1986). (19 pages)

86/56 N1173 SHOWELL, M. A., and D. E. WALDRON. Investigations into the relationship between shelf bottom temperature and the silver hake catch rate on the Scotian Shelf. (11 pages)

86/57 N1174 RIKHTER, V. A., V. F. TUROK, and I. K. SIGAEV. Distribution of silver hake and other numerous fish species on the Scotian Shelf slopes in 1985 from the data of Soviet observers. (22 pages)

86/58 N1175 RIKHTER, V. A., and V. V. PETEROPSH. Estimating of total instantaneous mortality rate for fishes using the weighting procedure by an example of Divisions 4VWX silver hake. (6 pages)

86/59 N1176 SENINA, A. P., and L. I. STULOVA. Comparison of the results of silver hake ageing from the USSR and Canada data. (6 pages)

86/60 N1177 NOSKOV, A. S. Assessment of the silver hake (*Merluccius bilinearis*) stocks and allowable catch on the Scotian Shelf (Div. 4VWX) in 1987. (9 pages)

86/61 N1178 BAJDALINOV, A. P., R. S. DOROVSKIKH, and L. I. STULOVA. On the transition to a new system of measurement of the North Atlantic roundnose grenadier (*Coryphaenoides rupestris*) length. (8 pages)

86/62 N1187 WALDRON, D. E., and L. P. FANNING. Assessment of the Scotian Shelf silver hake population in 1985. (27 pages)

86/63 N1180 AKHTARINA, T. A., and S. V. CHECHENIN. Results of ichthyoplankton survey on the Flemish Cap Bank in May-June 1985. (6 pages)

86/64 N1181 EFIMOV, N. I., A. N. SAVATEEVA, and V. L. TRETYAK. On a feasible formal description of the natural mortality rate variation in relation to age of beaked redfish and capelin from the Northwest Atlantic. (12 pages)

86/65 N1182 BAKANEV, V. S., L. N. KOROL, and V. S. MAMYLOV. Size of the Newfoundland capelin stock according to the results of acoustic surveys in Divisions 3LNO in May-June 1985. (11 pages)

86/66 N1183 BULATOVA, A. Y., and A. D. CHUMAKOV. USSR trawl surveys in NAFO Subareas 0, 2, 3. (13 pages)

86/67 N1184 SAVVATIMSKY, P. I. Changes in composition of the bottom fish catches at different depths along the continental slope in NAFO Subareas 0, 2 and 3 in 1970-85. (26 pages)

86/68 N1185 ALBIKOVSKAY, L. K., and G. B. RUDNEVA. Some aspects of reproduction, growth and distribution of *Benthosema glaciale* in the Grand Bank and Flemish Cap slope areas. (11 pages)

86/69 N1186 KARASIOVA, E. M., and A. I. SHERSTYUKOV. Species composition and abundance of ichthyoplankton in the area of the Atlantic Corner Seamounts. (13 pages)

86/70 N1188 DOMINGUEZ, R., and J. A. VAREA. Results of silver hake otolith exchange between Cuba, Canada and USSR. (4 pages)

86/71 N1190 DRINKWATER, K. F. Mean temperature and salinity conditions at the mouth of the Bay of Fundy, 1951-1980. (3 pages)

86/72 N1191 DRINKWATER, K. F., and R. W. TRITES. Overview of environmental conditions in the Northwest Atlantic in 1985. (31 pages)

86/73 N1192 STEIM, M. Some comments on paper by E. Buch entitled "Review of the hydrographic conditions off West Greenland in 1980-85" (NAFO SCR Doc. 86/48). (6 pages)

86/74 N1194 ARMSTRONG, R. S. Variation in the shelf water front position in 1985 from Georges Bank to Cape Romain. (8 pages)

86/75 N1195 INGHAM, M. C. Sea surface temperatures in the Northwestern Atlantic in 1985. (13 pages)

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86/78 N1198 KEELEY, J. R. Marine Environmental Data Service report for 1985/86. (15 pages)

86/79 (Rev.) N1200 MILLER, D. S. Estimates of capelin (*Mallotus villosus*) biomass from hydroacoustic surveys in Divisions 3LNO in 1985 and 1986. (11 pages)

86/80 N1201 LILLY, G. R. Variability in the quantity of capelin and other prey in stomachs of Atlantic cod off southern Labrador and northeastern Newfoundland (NAFO Divisions 2J+3K) during the autumns of 1978-85. (17 pages)

86/81 N1203 MESSTORFF, J. Biomass and abundance estimates for Atlantic wolffish (*Anarhichas lupus* L.) and spotted wolffish (*Anarhichas minor* Olafsen) in NAFO Subarea 1 from stratified-random bottom trawl survey results, 1982-1985. (4 pages)

86/82 N1204 WALDRON, D. E., and J. PARNELL. Comparison of Divisions 4VWX silver hake catch rates from the Scotian Shelf small-meshed fishery. (8 pages)

86/83 N1205 WELLS, R. Declines in the average length-at-age of cod in Divisions 2J and 3K during 1977-1985. (2 pages)

86/84 N1206 LILLY, G. R., and J. CARSCADDEN. Capelin in Division 3L and their occurrence in the NAFO Regulatory Area. (15 pages)

86/85 N1207 WALDRON, D. E., P. FANNING, and J. PARNELL. Standardization of Div. 4VWX silver hake catch rates from the Scotian Shelf small-meshed fishery. (12 pages)

86/86 N1208 HORSTED, Sv. Aa., and A. SCHUMACHER. Further analysis of Subarea 1 cod, 1985, and projections for subsequent years. (8 pages)

86/87 N1211 RICE, J. C. Report of the 1985 Meeting of Marine Environment and Ecosystems Sub-committee of CAFSAC. (4 pages)

86/88 N1213 WALDRON, D. E., and L. P. FANNING. Calibration of Divisions 4VWX silver hake VPA including calculations of yield-per-recruit. (15 pages)

86/89 N1214 FANNING, P. Correlations of silver hake abundance indices. (4 pages)

86/90 N1215 WELLS, R. On the validity of age determinations of cod from the Canadian research vessel cruises to the Flemish Cap, 1977-85. (17 pages)

86/91 N1217* VAZQUEZ, A., and M. G. LARRAÑETA. Recruitment of cod in Div. 2J+3KL and the physical environment. (4 pages)

86/92 N1218* MYERS, R. A., and K. DRINKWATER. The effects of entrainment of shelf water by warm core rings on Northwest Atlantic fish recruitment. (10 pages)

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86/94 N1220* GOMEZ-MUNOZ, V. M. Equilibrium yield of Flemish Cap cod from a general stock and recruitment curve. (11 pages)

86/95 N1221 KULKA, D. W. Estimates of discarding by the Newfoundland offshore fleet in 1985 with reference to trends over the past 5 years. (20 pages)

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86/98 N1224* TREMBLAY, M. J., and M. M. SINCLAIR. The horizontal distribution of larval sea scallops (*Placopecten magellanicus*) in the Bay of Fundy, on the Scotian Shelf and on Georges Bank. (15 pages)

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86/102 N1229 ANNAND, C., and D. BEANLANDS. A genetic stock structure study of dogfish in the Northwest Atlantic. (5 pages)

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86/106 N1233* RICE, J. C., and G. T. EVANS. Non-parametric prediction of recruitment from stock and the relationship of the residuals to water temperature for cod in NAFO Divisions 2J+3KL and 3M. (13 pages)

86/107 N1234* WELLS, R., and D. POWER. An estimate of redfish availability to cod on the Flemish Cap in the period 1978-85. (13 pages)

86/108 N1235* LILLY, G. R. Abundance and growth rate of juvenile redfish (*Sebastes* sp.) on Flemish Cap during the period 1978-1985. (5 pages)

86/109 N1236* LILLY, G. R., and G. T. EVANS. Inferences from juvenile redfish found in cod stomachs from Flemish Cap. (13 pages)

86/110 N1237* COHEN, E. B., D. G. MOUNTAIN, and R. G. LOUGH. Possible factors responsible for the variable recruitment of the 1981, 1982 and 1983 year-classes of haddock (*Melanogrammus aeglefinus* L.) on Georges Bank. (27 pages)

86/111 N1238* WALSH, S. J., R. WELLS, and S. BRENNAN. Histological and visual observations on oogenesis and sexual maturity of Flemish Cap female cod. (11 pages)

86/112 N1239* WELLS, R. Fecundity of cod on the Flemish Cap. (2 pages)

86/113 N1240* WELLS R. Condition factors of cod on the Flemish Cap in 1978-85. (11 pages)

86/114 N1241* WELLS, R. Variations in the gonad weight and the percentage occurrence at length of maturing female cod on the Flemish Cap. (4 pages)

85/115 N1242* CAMPBELL, D. E., and J. J. GRAHAM. An evaluated model of larval herring recruitment in coastal Maine. (20 pages)

86/116 N1243* ELLERTSEN, B., P. FOSSUM, P. SOLEMDAL, S. SUNDBY, and S. TILSETH. Effects of biological and physical factors on survival of Arcto-Norwegian cod and influence on recruitment variabiility. (25 pages)

86/117 N1244* NEDREAAS, K. Abundance and distribution of post larvae in the 0-group saithe survey in the North-East Arctic in 1985. (25 pages)

86/118 N1245 LEAR, W. H. A further discussion of the stock complex of Atlantic cod (*Gadus morhua*) in NAFO Div. 2J, 3K and 3L. (18 pages)

86/119 N1246* ILES, T. D. Interaction of external and internal factors in relation to recruitment. (24 pages)

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86/121 N1249 KISELEVA, V. M., and V. A. POLETAEV. Mesopelagic fishes (Suborder Stomiatoidei) in the Northwest Atlantic. (20 pages)

86/122 N1251 BAIRD, J. W., C. A. BISHOP, and R. WELLS. Estimates of age and length at maturity for cod in NAFO Divisions 2J+3KLNO. (3 pages)

86/123 N1252 LEAR, W. H. Results of tagging on winter concentrations of cod in NAFO Divisions 2J, 3K and 3L during 1978-83. (8 pages)

86/124 N1253 BISHOP, C. A., and J. W. BAIRD. An assessment update of the cod stock in NAFO Divisions 3NO. (14 pages)

[Asterisks (*) indicate papers presented at the Special Session on recruitment studies, 3-5 September 1986]

SUMMARY DOCUMENTS (SCS)

86/1 N1109 NAFO. Provisional Report of Scientific Council, January 1986 Meeting. (25 pages)

86/2 N1112 NAFO SECRETARIAT. Historical catches of selected species by stock area and country for the period 1963-84. (73 pages)

86/3 N1114 NAFO SECRETARIAT. Tagging activities reported for the Northwest Altantic in 1985. (6 pages)

86/4 N1115 CWP SECRETARY. Report of the *Ad hoc* Inter-agency Consultation on Atlantic Fishery Statistics, London, England, 5-6 October 1985. (4 pages)

86/5 N1116 GALLAGHER, E. EEC request for scientific advice on management in 1987 of the cod stock in Subdivision 3Ps. (1 page)

86/6	N1117	PARSONS, L. S. Canadian request for scientific advice on management in 1987 of certain stocks in Subareas 0 to 4. (1 page)
86/7	N1118	NAFO SECRETARIAT. Provisional index and list of titles of research and summary documents for 1985. (29 pages)
86/8	N1121	COADY, L. W., J. S. SCOTT, J. S. LOCH, and L. CLEARY. Canadian research report, 1985. (Sections I, II, III and IV). (23 pages)
86/9	N1123	MAURER, R. O., S. MURAWSKI, and F. M. SERCHUK. United States research report for 1985. (9 pages)
86/10	N1124	NAFO SECRETARIAT. ICES proposal for joint working group on harp and hooded seals. (2 pages)
86/11	N1125	NAFO SECRETARIAT. Solicited comments on proposal for second ageing workshop on shrimp. (3 pages)
86/12	N1130	LEMCHE, E. Denmark (Greenland) request for scientific advice on management of certain stocks in 1987. (2 pages)
86/13	N1136	VAZQUEZ, A. Spanish research report, 1985. (8 pages)
86/14	N1148	KAWAHARA, S. Japanese research report for 1985. (4 pages)
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86/17	N1179	CHUMAKOV, A. K., and V. A. BOROVKOV. USSR research report for 1985. (32 pages)
86/18	N1189	ROMINGUEZ, R., and J. A. VAREA. Cuban research report for 1985. (11 pages)
86/19	N1193	GODINHO, M. L. Portuguese research report, 1985. (5 pages)
86/20	N1199	NAFO SECRETARIAT. Preliminary list of sampling data, 1985. (32 pages)
86/21	N1209	NAFO SECRETARIAT. Notes on statistical activities and publications since June 1985. (3 pages)
86/22	N1210	NAFO SECRETARIAT. Provisional nominal catches in the Northwest Atlantic, 1985. (52 pages)
86/23	N1212	NAFO SECRETARIAT. Notes on NAFO sampling program. (8 pages)
86/24	N1216	NAFO. Provisional Report of Scientific Council, Dartmouth, Canada, 4-19 June 1986. (99 pages + Corrigenda)
86/25	N1226	FAO. Quantity conversion factors: Atlantic fish species - landed or product weight to live weight. (45 pages)
86/26	N1264	ERNST, P. German Democratic Republic research report for 1985. (20 pages)
86/27	N1265	NAFO. Report of Scientific Council Meeting, Annual Meeting, Halifax, Nova Scotia, Canada, 3-12 September 1986. (28 pages)
86/28	N1266	NAFO. Rules of procedure for the Scientific Council. (6 pages)

III. LIST OF PARTICIPANTS IN SCIENTIFIC COUNCIL MEETINGS, 1986

CANADA

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Baird, J. W.	" " " " " " "	B C
Bishop, C. A.	" " " " " " "	B C
Bowering, W. R.	" " " " " " "	A B C
Brodie, W. B.	" " " " " " "	C
Carscadden, J.	" " " " " " "	B
Dalley, E.	" " " " " " "	C
Evans, G. T.	" " " " " " "	C
Lear, W. H.	" " " " " " "	C
Lilly, G. R.	" " " " " " "	B C
Miller, D.	" " " " " " "	B
Myers, R. A.	" " " " " " "	C
Nakashima, B. S.	" " " " " " "	B C
Parsons, D. G.	" " " " " " "	A
Pepin, P.	" " " " " " "	C
Pinhorn, A. T.	" " " " " " "	B C
Pippy, J. H. C.	" " " " " " "	C
Power, D.	" " " " " " "	B C
Rice, J. C.	" " " " " " "	B C
Wells, R.	" " " " " " "	B C
Wheeler, J.	" " " " " " "	C
Winters, G. H.	" " " " " " "	A B
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Fanning, P.	" " " " " " "	B
Halliday, R. G.	" " " " " " "	B C
Hurley, P. C. F.	" " " " " " "	C
Koeller, P. A.	" " " " " " "	B C
McGlade, J.	" " " " " " "	C
Sinclair, A.	" " " " " " "	B
Waldron, D. E.	" " " " " " "	B C
Zwanenburg, K.	" " " " " " "	B
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Frank, K.	" " " " " " "	B C
Trites, R. W.	" " " " " " "	B C
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Perry, R. I.	" " " " " " "	B C
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IV. LIST OF RECOMMENDATIONS AND PROPOSALS, 1986

A. Special Meeting, January 1986

1. Research Requirements for Shrimp in Davis Strait (page 12)

a) Stratified-random trawl surveys should be conducted on a seasonal basis for a number of years to determine seasonal and annual changes in distribution and abundance.

b) Observer programs should be continued and extended to cover a greater portion of the fleet.

c) Interpretation of age and growth of shrimp, presented in 1985, should be verified and an attempt made to separate shrimp catch sampling data into year-classes.

d) An intensive sampling program should be established to monitor the trial fishery in Subarea 1 north of 70°52'N.

e) Efforts should be made to develop objective methods for estimating discards.

f) Sampling of commercial catches in Davis Strait should be intensified to cover all components of the fishery in order to adequately represent the total catches in terms of length, weight and age.

g) Research surveys should be conducted to determine the possible existence of nursery grounds for shrimp in the Davis Strait area.

2. Research Requirements for Shrimp in Denmark Strait (page 16)

a) Biological samples should be obtained from all components of the fishery in Denmark Strait on a monthly basis.

b) Research vessel trawl surveys of the area should be continued and expanded, and plankton surveys should be carried out to observe the distribution of shrimp larvae.

c) A study of environmental conditions in the region should be undertaken, particularly temperature, ice conditions and currents.

B. SCIENTIFIC MEETING, JUNE 1986

1. Cod Stock Complex in Div. 2J+3KL (pages 45, 51)

a) Further analysis of the purchase-slip data should include backward extension of the time series and breakdown of data by vessel size and gear.

b) Matter of discrimination of cod stock complex should be considered further at the September 1986 Meeting (see page 121-124 for details).

2. Database for Cod in Subdiv. 3Ps (page 57)

a) Canadian and French (SP) catch-rate series should be reexamined for trends over time and changes in catchability.

b) Research data from Canadian and French surveys in Div. 3P, 4R and 4S should be examined to account for differences in stock size estimates and possible influence on the estimates of cod migrating to Burgeo Bank from the eastern Gulf of St. Lawrence.

c) Efforts to obtain catch-rate data for the Canadian inshore fishery from purchase-slip data should be extended backward with a breakdown by gear and vessel size.

3. Redfish Stock in Div. 3LN (page 59)

Work should be carried out to clarify whether the redfish in Div. 3L and 3N represent a single management unit.

4. Silver-Hake in Div. 4VWX (pages 61-62)

Same method of determining abundance index from Canadian and USSR surveys should be adopted by both countries, and future surveys should cover as wide an area as possible including strata outside the core area where juveniles have been found.

5. American Plaice in Div. 3LNO (pages 64, 67)

a) CPUE data should be analyzed for patterns in seasonality by the multiplicative model.

b) Information on discards should be reviewed to determine if changes in discarding practices have occurred and whether the changes affect the assessments.

c) Apparent changes in catchability should be investigated.

6. Capelin in Div. 3LNO (page 77)

a) Research should be initiated to provide an index of recruitment for the capelin stock in Div. 3LNO (i.e. prerecruit surveys).

b) Acoustic survey results that have been used as the basis for management advice and the resulting projections should be evaluated.

7. Research Requirements for Short-finned Squid (page 79)

Larval-juvenile surveys to identify spawning areas and factors influencing recruitment of squid to the fishery should be continued, with expansion of the surveys in the northern areas off Georges Bank, Scotian Shelf and Grand Bank to more adequately cover the distributional range.

8. Proposed Second Workshop on Ageing Shrimp (page 85)

Available information indicated that work in the national laboratories has been insufficient to warrant a second workshop in 1986 and 1987. It was noted that some scientists have planned to take an information collective look at sampling data for West Greenland. STACFIS agreed that planning for the Second Shrimp Ageing Workshop should be discussed as its mid-term meeting in January 1987.

9. Discarding Practices of Offshore Newfoundland Trawlers (page 88)

An attempt should be made to collect samples of discarded fish for ageing purposes.

10. Reporting Problems with Catch Statistics (page 89)

The Scientific Council should request the Fisheries Commission to evaluate the estimates of catches from surveillance data and the estimation procedures involved and advise the Council on the appropriateness of using such estimates to derive total removals in future assessments.

11. Sea-surface Temperature Maps (page 95)

The Scientific Council should point out to the US National Weather Service the usefulness of the oceanographic analysis charts and request that the former coverage north to 50°N and east to 44°W should be continued.

12. Fishery Statistics of Non-member Countries (page 97)

Contracting Parties should inform the Secretariat of non-member countries identified as fishing in the Convention Area, and the Executive Secretary should then contact these countries requesting the data for inclusion in the NAFO database.

13. Conversion Factors (page 97)

The Secretariat should prepare, for the September 1986 Meeting, a document containing national conversion factors, including the latest information from FAO (see data in SCS Doc. 86/25).

14. Reporting Requirements of the STATLANT System (page 98)

The Secretariat should prepare a document for the June 1987 Meeting, containing complete and precise information on the catch and effort statistics to be submitted by Contracting Parties in respect of their obligations under Article VI(3).

15. Effort Data and Prorating (page 98)

An additional line should be added to the STATLANT 21B form requesting information on the percentage of prorated fishing effort.

16. Modification of Subarea 4/5 Boundary (page 101)

Catches in Subdiv. 5Ze should be reported as from two subdivisions, 5Zc (east of Canadian-USA boundary) and 5Zu (west of Canadian-USA boundary), with numerical codes of 55 and 56 respectively.

17. Promotion and Distribution of Scientific Publications (page 104)

An active advertising policy should be established, including development of a suitable brochure for widespread distribution, and advertising in the Allen Subscription Catalogue and through abstracting agencies.

C. ANNUAL MEETING, SEPTEMBER 1986

1. Trawl Escapement and Selectivity Problems (page 110)

National representatives on the Scientific Council should contact scientists in their institutes to determine if data are available concerning the effects of strengthening ropes, splitting straps and codend floats on selectivity of trawls and to present any forthcoming data at the June 1987 Meeting.

2. ICNAF Microfiche (page 111)

a) The Executive Secretary should ensure that the relevant laboratories of Contracting Parties and all libraries and organizations which had expressed some interest in purchase of microfiche when previously solicited, be informed that sets are now available.

b) Advertisements indicating the availability of microfiche should be placed on forthcoming issues of the Council's publications, a flyer should be prepared for widespread distribution, and all other opportunities should be taken to make the availability of microfiche known.

3. Amended Rules of Procedure (page 111)

The Executive Secretary should contact all Contracting Parties well in advance of the June 1987 Meeting and request those who do not intend to send a Scientific Council representative to the meeting to provide him with authority to cast a proxy vote, in accordance with Rule 2.3 of the amended Rules of Procedure.

4. Consideration of Reports of Special Midterm Meetings (page 112)

In the context of the discussion on time and place of the Midterm Meeting on Shrimp, concern was expressed about the poor representation of Contracting Parties. It was suggested, therefore, that the Scientific Council should, under those circumstances, restrict its activity to the provision of scientific advice on shrimp without considering matters of a more general nature which should be discussed in the presence of Scientific Council representatives from more Contracting Parties. It was also suggested that the Scientific Council, at its forthcoming June meeting, will review the report of the Special Meeting on Shrimp in January 1987 in order to see if there is any potential for improving the advice on shrimp at subsequent midterm meetings.

5. Cod Stock in Div. 3NO (page 121)

The possible reasons for discrepancies between biomass estimates for cod from Canadian and USSR surveys, be investigated, including differences in timing of surveys, gears and analysis techniques.

6. Silver Hake in Div. 4VWX (page 121)

The Canadian method of calculating abundance indices of prerecruit year-classes from the USSR-Canada cooperative juvenile surveys should be used in future.

7. Cod Stock Complex in Div. 2J+3KL (page 124)

a) The relative contribution of each spawning component of the cod stock to the offshore and inshore fisheries on that component and on other components should be quantified.

b) The effects of seasonal ice cover and extreme environmental conditions on the distribution of cod should be examined.

8. Changes in Hydrographic Station Positions (page 125)

a) The first station on the Lille Hellefiske Bank Section should be changed from 65°06'N 53°00'W (150 m) to 66°06'N 52°55'W (490 m).

b) The first station on the Fyllas Bank Section should be changed from 64°01'N 52°19'W (108 m) to 63°57'N 52°22'W (287 m).

9. Special Session in September 1987 (page 125)

Concerning the theme "Biology of Demersal Resources of the North Atlantic Continental Slopes, with Emphasis on Greenland Halibut and Grenadiers", an outline was adopted, and the Secretariat was requested to circulate an announcement as soon as possible.

10. Theme for Special Session in September 1988 (page 126)

The impact of changes in environmental conditions in the North Atlantic on the distribution, availability and abundance of marine species, with particular emphasis on the Labrador and Grand Bank regions in the early 1980's.