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PREFACE

This fourth issue of *NAFO Scientific Council Reports* contains the approved reports of three meetings held during the calendar year 1983: (A) Special Meeting during 19–24 January 1983; (B) Main Scientific Meeting during 8–23 June 1983; and (C) Annual Meeting during 14–23 September 1983. Part D contains the agenda, list of recommendations, list of research and summary documents, and list of participants relevant to meetings of the Scientific Council and its Standing Committees during 1983.

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

31 December 1983

V. M. Hodder
Assistant Executive Secretary

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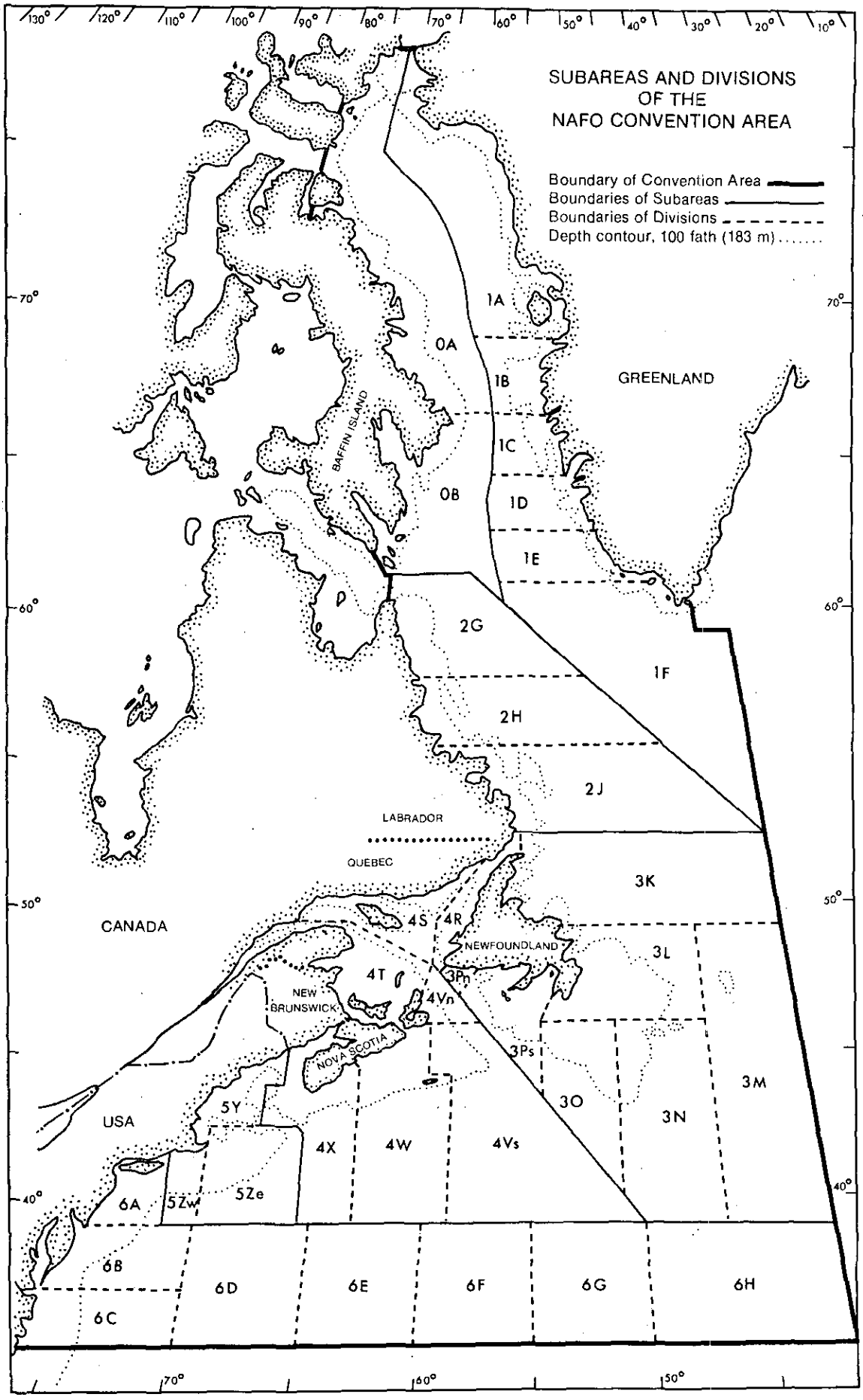
SUBAREAS AND DIVISIONS
OF THE
NAFO CONVENTION AREA
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Boundaries of Subareas
Boundaries of Divisions
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PART A

REPORT OF SCIENTIFIC COUNCIL

Special Meeting, January 1983

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REPORT OF SCIENTIFIC COUNCIL

Special Meeting, January 1983

Chairman: R. Wells Rapporteur: V. M. Hodder

The Council met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 19-24 January 1983 to provide advice for 1983 on conservation of the shrimp stocks in Subareas 0 and 1, as requested by Canada and the European Economic Community (EEC). In addition, at the request of the EEC, a review of the status of the shrimp stock off East Greenland was included in the agenda for this meeting. Representatives attended from Canada, EEC (Denmark, France, and the Commission of the European Communities), Iceland and Norway.

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

I. STOCK ASSESSMENTS (APP. I)

1. Assessment of Shrimp Stocks in Subareas 0 and 1

In 1979 and 1980, the offshore shrimp fishery in Subareas 0 and 1 was regulated by an overall total allowable catch (TAC) of 29,500 tons, the nominal catches being respectively 27,000 and 37,000 tons in these years. The same TAC was advised for 1981 and 1982 (NAFO Sci. Coun. Rep. 1981, page 109), but the allowable catch totalling 35,000 tons was set for each of these two years by the coastal states involved. Provisional statistics for 1982 indicate an offshore catch of about 37,300 tons (Table 1), the major fishing grounds being in the southern part of Div. 1B and northern part of Div. 1C during the first half of the year, with a shift to the northern and western part of Store Hellefiske Bank in Div. 0A and 1B during the second half of the year.

Table 1. Total catches (metric tons) of shrimp in Subarea 0 and the offshore part of Subarea 1 in 1973-82, with the corresponding TACs for 1977-82.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Catch	4,692	11,945	29,190	42,766	34,300	26,869	27,087	36,652	39,217	37,344[1]
Advised TAC	-	-	-	-	36,000	40,000	29,500	29,500	29,500	29,000
Effective TAC	-	-	-	-	36,000	40,000	29,500	29,500	35,000	35,000

[1] Provisional data.

All available biological information on length distribution and sexual components and all data on trends in catch rates, biomass estimates and stock composition were considered in advising on management of the fishery in 1983. It was noted that, after the decline in abundance observed during 1976-78, catch rates increased in 1980 and stabilized in 1981 and 1982. Data from the photographic survey indicated an increase in biomass in 1982 (more than 40% in relation to the revised estimate for 1981). This increase was interpretated as being due to growth of the abundant small shrimp observed during the photographic survey in 1981. However, the relative proportion of small shrimp decreased in 1982.

Although the fishable stock has remained stable since 1979, the Council noted the uncertainty about recruitment in 1983 and subsequent years, and agreed that there should be no change in the management regime of this fishery. The Council therefore advises that the overall TAC for the offshore grounds in Subarea 1 and adjacent parts of Subarea 0 in 1983 should remain at the same level (29,500 tons) as advised previously for 1981 and 1982.

In order to improve the basis for assessing the stock in Subareas 0 and 1, the Council endorses the recommendations of STACFIS regarding further research requirements (see Appendix I).

2. Assessment of Shrimp Stock in Denmark Strait

The shrimp fishery in this area expanded rapidly in 1977 and 1980. The total catch on both sides of the midline between Greenland and Iceland increased rapidly to 8,300 tons in 1980 (Table 2) and declined sharply to 4,800 tons in 1981, when the fishery was regulated by a TAC of 8,000 tons set by the EEC for the area west of the midline. A TAC of 4,500 tons was set by the EEC for 1982, based on the advice of the Scientific Council from its November 1981 Meeting (NAFO Sci. Coun. Rep. 1981, page 110). Provisional statistics indicate a nominal catch of about 4,600 tons in 1982. The 1982

fishery took place in the area of Strede and Dohrn Banks, as in earlier years, but in a more restricted zone compared to 1981 and especially to 1980. There was no fishery on the Icelandic side of the midline in 1982, due to ice cover. Although the catch rates in May 1982 were higher than those in May 1981, the average catch rates for 1982 were lower than those for 1981.

Table 2. Nominal catches (metric tons) of shrimp in Denmark Strait for 1978-82, with corresponding TACs for 1981-82.

	1978	1979	1980	1981	1982[1]
Catch	363	1,285	8,260	4,792	4,592
Advised TAC	-	-	-	-	4,200
Effective TAC	-	-	-	8,000	4,500

[1] Provisional data.

Available data for the period from March to June 1982 indicated that catches were still composed of larger shrimp than in other exploited stocks but the average size was slightly lower in 1982 than in 1981. Also, the data show that a significant proportion (30-50%) of the females do not spawn in each year.

In view of the sharp decline in spawning biomass implied from declining catch rates during 1980-82, and noting that this stock lives under extreme environmental conditions and may be very sensitive to over-exploitation, the Council urges that a cautious approach to exploitation should be maintained. Insufficient data were available on which to based a change in the TAC advised for 1982. The Council therefore advises that the overall TAC for 1983 should remain at the advised level for 1982 (4,200 tons).

In order to improve the basis for assessing this stock in Denmark Strait, the Council endorses the recommendations of STACFIS regarding future research requirements (see Appendix I).

II. FUTURE SCIENTIFIC MEETINGS

1. Scientific Council Meeting, June 1983

The Council confirmed that its next meeting will be held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 8-23 June 1983, to deal with its regular business, involving the work of the three standing committees (STACFIS, STACREC and STACPUB) and associated subcommittees and ad hoc working groups.

2. Annual Meeting, September 1983

The Council will meet during 14-23 September 1983, with 3 days (14-16 September) being allocated for the Special Session on "Trophic relationships in marine species relevant to fisheries management in the Northwest Atlantic". Other matters will be considered on 19 September and the closing session will take place on 23 September 1983. This meeting will be held in Leningrad, USSR.

III. ADJOURNMENT

The Chairman expressed his thanks to the Director of the Bedford Institute of Oceanography for use of conference rooms, to the NAFO Secretariat for their usual efficiency in servicing this meeting, to the Chairman of STACFIS (J. P. Minet), and to all participants for their cooperation and contributions. The meeting adjourned at 1900 hours on 24 January 1983.

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

Chairman: J. P. Minet

Rapporteurs: Various

The Committee met at Dartmouth, Nova Scotia, Canada, during 19-24 January 1983 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 the European Economic Community (EEC). In addition, as requested by the EEC, the Committee reviewed the status of the shrimp stock off East Greenland (see Part D, this volume). Scientists attended from Canada, EEC (Denmark, France, and the Commission of the European Community), Iceland and Norway. The results of the assessments are given in Sections I and II below.

I. ASSESSMENT OF SHRIMP STOCK IN DAVIS STRAIT (SUBAREAS 0 AND 1)

1. Fishery Trends

The nominal catch of shrimp in Subareas 0 and 1 increased from less than 10,000 tons prior to 1973 to 50,000 tons in 1976, decreased to about 35,000 tons in 1978 and 1979, and increased to a level of 45,000 tons in 1981 (Table 1). Preliminary statistics for 1982 indicate a total catch of about 42,300 tons in Subareas 0 and 1, of which 37,300 tons were taken on the offshore grounds. The inshore fishery at West Greenland was relatively stable at 7,000-8,000 tons yearly during 1972-81 (except 10,000 tons in 1974). Preliminary data indicate a decline in the inshore catch to 5,000 tons in 1982.

The offshore shrimp fishery has been regulated by total allowable catches (TAC) since 1977. In 1977 and 1978, the total offshore catches in the Davis Strait region were about 34,000 and 27,000 tons against TACs of 36,000 and 40,000 tons respectively. In 1979 and 1980, the offshore fishery was regulated by a TAC of 29,500 tons, with the nominal catch being 27,000 and 37,000 tons respectively.

Table 1. Nominal catches and TACs (metric tons) of shrimp (*Pandalus borealis*) in Subareas 0 and 1[1]

Area	Country	1974	1975	1976	1977	1978	1979	1980	1981	1982[2]
SA 0	Canada	-	-	-	-	-	-	59	1,590	873
	Denmark	-	-	-	68	86	67	-	1,923	1,082
	Faroes	-	-	-	239	-	115	-	1,686	700
	France	-	-	-	-	21	7	-	-	-
	Greenland	-	-	-	-	-	149	815	85	-
	Norway	-	-	65	150	15	791	-	-	-
	Spain	-	-	327	-	-	-	-	-	-
	Total	-	-	392	457	122	1,129	874	5,284	2,655
SA 1	Canada	-	-	-	-	-	245	590	-	-
	Denmark	308	1,142	2,717	5,842	3,382	1,327	872	995	1,935
	Faroes	2,023	5,300	11,179	12,612	8,070	6,867	3,554	1,234	1,229
	France	-	-	803	924	805	353	247	535	677
	F. R. Germany	-	-	-	31	-	-	-	-	-
	Greenland (a)[3]	10,064	8,700	7,300	7,800	7,600	7,500	7,500	7,500	5,000[4]
	Greenland (b)[3]	180	1,089	2,478	7,081	5,531	12,527	27,501	28,197	30,000[4]
	Japan	-	-	146	-	-	-	-	-	-
	Norway	5,917	8,678	11,658	7,353	8,959	4,639	3,014	1,055	848
	Spain	-	6,943	6,925	-	-	-	-	-	-
	USSR	3,517	6,033	6,458	-	-	-	-	-	-
	Total	22,009	37,890	49,674	41,643	34,347	33,458	43,278	39,516	39,689
	Offshore	11,945	29,190	42,374	33,843	26,747	25,958	35,778	32,016	34,689
0+1 Offshore Catch		11,945	29,190	42,766	34,300	26,869	27,087	36,652	37,300	37,344
0+1 advised offshore TAC		-	-	-	36,000	40,000	29,500	29,500	29,500	29,500
0+1 effective offshore TAC		-	-	-	36,000	40,000	29,500	29,500	35,000[5]	35,000[5]

[1] Data for 1974-78 pertain to ICNAF Statistical Area 0 and Subarea 1, and for 1979-81 to the new NAFO Subareas 0 and 1.

[2] Provisional data.

[3] a = inshore, b = offshore catches.

[4] Estimated catches.

[5] TAC of 30,000 tons in Subarea 1 and 5,000 tons in Subarea 0.

In 1981 and 1982, Canada and EEC set separate TACs of 5,000 and 30,000 tons for Subareas 0 and 1 respectively, although the Scientific Council had advised that the TAC for Subarea 1 and the adjacent parts of Subarea 0 should remain at the same level of the two preceding years (29,500 tons).

2. Distribution of Fishing Effort and Biomass (SCR Doc. 83/I/1, 2, 3, 5, 7, 8)

A pilot research trawl survey, with a limited number of trawling stations, was conducted by Denmark in Div. 1B in July-August 1982, but this cruise provided no information on the distribution of shrimp in the area. However, data were available on the distribution of fishing effort for the Greenland and French fisheries in Subarea 1 and the Canadian fishery in Subarea 0. Some information on the distribution of shrimp biomass was available from a Danish photographic survey in the region off West Greenland from 66°N to 71°N.

The distribution of fishing effort by Greenland vessels in 1982 did not exhibit the northward shift that was evident in 1980 and 1981. The fishery was severely hampered by ice conditions in the first 5 months of the year, during which the effort was concentrated in the southern part of Div. 1B and the northern part of Div. 1C, with some activity in January and May in the area north of 68°N and east of 55°W. From June to November, the Greenland vessels fished mainly west and north of Store Hellefiske Bank, with little or no fishing activity in Holsteinsborg Deep. Fishing north of 70°N, which occurred in 1980 and 1981, did not take place in 1982, except for a few hauls in October. The severe ice conditions in February-May 1982 thus caused the delayed achievement of the allowable catch and a change in the distributional pattern of the fishery throughout the year, compared to that in 1981. The special management area off Disko Bay was therefore fished more heavily and for a longer period in 1982 than in the preceding years.

Fishing effort by a French trawler in 1982 occurred between 67°N and 68°N in Div. 1B, and Canadian vessels fished in the adjacent part of Div. 0A generally between 58°W and 59°W, with no significant change in fishing patterns from the previous year. Fishing effort by Norwegian vessels in Div. 1D was higher in 1982 than in previous years, but the major part of the fishing activity likely took place in Div. 1B.

Data from the Danish photographic survey in Div. 1B indicated a southward displacement of shrimp abundance, which was possibly related to the observed decrease in bottom temperatures in 1982.

3. Biology (SCR Doc. 83/I/2, 3, 5, 8)

Information presented at the November 1981 Special Meeting indicated for the first time the presence of three modal groups of male shrimp (10-15 mm, 15-20 mm and 20-25 mm carapace length) and a group (25-30 mm) consisting of transitionals and females. In 1982, the 10-15 mm group was observed in Canadian length frequencies of discarded shrimp and in data from the Danish research survey, but the group was not evident in the French commerical data, in contrast to the previous year. The 15-20 mm group appeared in the Danish and Norwegian data for 1982, but it was less prominant in the Canadian and French data than in 1981. The 20-25 mm group appears in data from all sources in 1982, but normality was not clearly apparent in all samples. The 25-30 mm modal group of transitionals and females showed no significant change from the previous year in terms of length distribution.

No differences were observed in the size range of each sexual component of shrimp in the samples. However, in the Franch data for July-August 1982, the ratio of females with spines to transitionals was lower than in 1981, indicating a possible delay in sexual evolution from transitional to female. A similar delay in the transition from male to female might be the reason for the bimodality observed in the 20-25 mm size range of the 1982 samples. This bimodality may be related to the lower bottom temperatures observed in 1982 but could also have resulted from mixing of different components of the stock characterized by different growth rates.

In July-September 1982, transitionals and females with spines contained head roe, whereas a large proportion of the females without spines showed no evidence of maturing. This could explain why the proportion of non-ovigerous females in November 1982 was lower than in 1981. It also could be related to lower temperatures recorded for the area in 1982. Lacking an adequate time series of data, it is difficult at this time to quantify future recruitment.

4. Catch and Effort (SCR Doc. 83/I/2, 3, 5, 8)

Catch and effort information available for the shrimp fishery in 1982 included Canadian data for Subarea 0 based on vessel logbook records and observer reports, and French, Greenland and Norwegian data for Subarea 1 based on logbook records. The Canadian observer data showed an increase in mean catch rate (July-September) of approximately 19% from the value for the same period in 1981. Data for the French vessel, which fished in the same area west of Store Hellefiske Bank (Div. 1B) as in 1981, showed a decrease in mean catch rate (July-August) of about 17%. Norwegian data for Div. 1B and 1D showed increasing catch rates during May to July 1982, with those for Div. 1D being for the first time higher than those for Div. 1B. The mean catch rate for Div. 1B in July 1982 was 47% higher than the mean for July-August 1981.

Data for six trawlers (each 722 GRT) of the Royal Greenland Trade Department showed the same trend throughout 1982 as in previous years, with peak catch rates in Div. 1B in May (severe ice conditions hindered entrance to the fishing grounds early in 1982), declining catch rates from May to September and increasing rates in October and November. The mean monthly catch rates in Div. 1B were higher in 1982 than in 1981. In contrast to 1980 and 1981, there was virtually no fishery by these Greenland trawlers in Div. 1A in 1982.

Indices of mean catch rates for Greenland, Norwegian and French fisheries in Div. 1B (normalized to 1976) and for the Canadian fishery in Div. 0A (normalized to the average of the other indices for 1980) in the July-September period of 1976-82 are given in Table 2. Except for the French index in 1981, which seems abnormally high, all indices show the same general trend.

Table 2. CPUE indices for Canadian, Greenland, Norwegian and French fisheries for shrimp in parts of Subareas 0 and 1, 1976-82.

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

[1] July only.
[2] Normalized to the average of the other three index values for 1980.

5. Discarding of Shrimp (SCR Doc. 83/I/2, 3, 5)

The observed level of discarding by Canadian vessels in Div. 0A was about 3% by weight in 1982 compared to about 4% in 1981. Most of the discarded shrimp were from the 21 mm modal length group in 1982 whereas they were from the 19 mm group in 1981. Observations in Div. 1B indicated that about 2% of the shrimp caught by the French vessel were discarded by the automatic sorting machine (no data on additional sorting by hand), and that discarding by the Norwegian trawler was 12.3%, the highest value observed in 1977. In the latter case, the discards were distributed between two size-groups (modal lengths 17 and 21 mm), which were more prominant in the catches than usual.

6. By-catches in the Shrimp Fishery (SCR Doc. 83/I/2, 3, 5, 8)

Data available for seven Greenland trawlers indicated that the highest by-catch rates occurred in Div. 1B in May of both 1981 and 1982, the major component being redfish in 1981 and cod in 1982. In the latter case, the by-catches of cod were observed only in May and only in Div. 1B. Comparison with earlier years showed a sharp decline in by-catches from 23.1% by weight in 1978 to 0.7% in 1982. Except for the occurrence of cod in 1982, the dominant by-catch species has been redfish.

By-catches in the Canadian shrimp fishery in Div. 0A were dominated by redfish, but the proportions have continued to decline from the levels observed in 1980. Other species have usually represented less than 1% of the total catch (weight). Observations from one French trawler in Div. 1B indicated by-catches of redfish (1.5% of shrimp catch), Greenland halibut (<1%) and a few cod. Data for one Norwegian trawler in Div. 1B indicated increased by-catches of redfish compared to 1980 (no data for 1981), but these were still considerably lower than in 1976-79. A similar trend was observed for Greenland halibut, whereas by-catches of cod have remained very low.

7. Biomass Estimates (SCR Doc. 83/I/1)

Data from the bottom photographic surveys have been incorportated into a shrimp distribution model which was used to derive biomass estimates for the years 1977-82. The trend in biomass estimates for 1977-81 was in good agreement with that presented at the November 1981 Meeting (NAFO Sci. Coun. Rep. 1981, page 115). However, the Committee noted that utilization of 1982 data in the model resulted in a significant decrease in biomass estimates for earlier years, compared to the results presented at the November 1981 Meeting (e.g. a decrease in biomass estimate from 252,000 tons to 163,000 tons for 1981). The total biomass in the region from 66°00'N to 69°30'N was estimated at 230,000 tons for 1982, representing an increase of more than 40% in relation to the revised estimate for 1981. The large increase in biomass is most likely the result of growth of small shrimp, which were observed to have been abundant in the 1981 photographic survey data. However, the proportion of small shrimp was lower in 1982 than in 1981.

The distribution model, used since 1980, has been extended to include two additional parameters (longitude and bottom temperature). Consequently, the correlation coefficient increased significantly from 0.34 to 0.65, but an analysis of the sensitivity of the model to the input parameters is still needed. Because the model is very sensitive to the input values of temperature, the Committee considered it important to know how fluctuations in observed temperatures in the sampling area would influence the calculation of biomass estimates. STACFIS urged that a special study should be

undertaken on how to best utilize hydrographic conditions in the model to provide the best estimates of biomass. Although some improvement of the model has been achieved in terms of a higher correlation coefficient, it was noted that the variance associated with the photographic survey data remains fairly high and that cautious interpretation of the results should be maintained. The trend in biomass estimated from the model shows generally good correspondence with the trend in July-September catch rates of the large Greenland trawlers (Fig. 1). A more or less continuous decline in average weight of shrimp was noted in 1977-81 whereas there was a significant increase from 1981 to 1982.

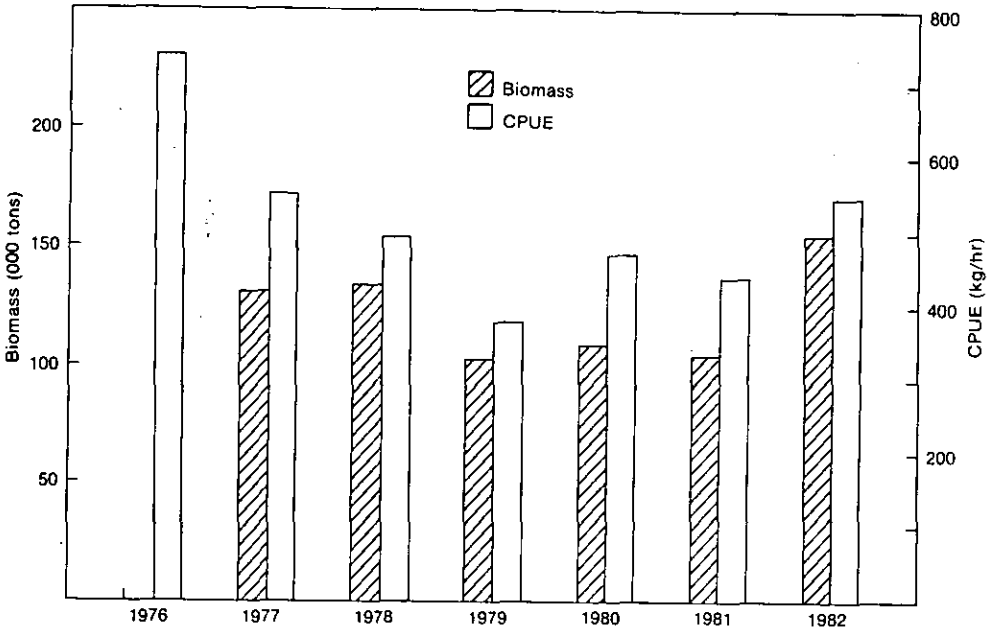

Fig. 1. Estimates of total biomass from photographic surveys and average CPUE values for commercial trawlers (July-September) in the area of 66°-69°30'N, 59°-60°W, in depths of 100-600 m.

8. Management Advice

Catch rates from Canadian, Greenland and Norwegian fisheries in Div. 0A and 1B for the July-September period increased somewhat from 1981 to 1982. Although the catch rate for the French trawler was lower in 1982 than in 1981, it was generally agreed that the more extensive data supported the occurrence of an increase, which was likely due to recruitment and growth of the 20-25 mm modal size-group observed in 1981. Results from the photographic surveys and the CPUE indices (Fig. 1) indicate that the stock has fluctuated around a relatively stable level since 1978 (see also Table 2). The Committee noted however, that the 1981 and 1982 catch rates may have been influenced by the introduction of new, more efficient trawls and thus not be directly comparable with the catch rates of earlier years.

The potential for recruitment to the fishery, based on data from the photographic surveys and from research and commercial length frequencies, indicate a decrease in the incidence of small shrimp (<20 mm) relative to the high level observed in 1981. These small shrimp were only partially recruited to the fishery in 1982 (possibly due to slower growth) but they should be fully recruited in 1983. It is not certain what effect this recruitment will have on the 1983 catch rates, but the lower abundance of small shrimp in 1982 may result in reduced catch rates in 1984 and 1985.

Although the stability of the fishable stock has continued since 1979, STACFIS noted the uncertainty about recruitment in 1983, with the possibility of reduced recruitment in subsequent years, and therefore advises that the overall 1983 TAC for the offshore grounds in Subarea 1 and the adjacent parts of Subarea 0 should remain at the level advised for 1979-82 (29,500 tons). STACFIS also agreed that the practice of allowing only a small portion of the TAC for the offshore grounds to be taken in the area from 68°00'N to 69°30'N, as a potential protective measure for recruitment to the inshore stock in Disko Bay, should be continued.

The Committee expressed concern about the catches since 1980 (37,000-39,000 tons) relative to the advised TAC (Table 1). It appears that removals in the offshore fishery are approaching the maximum catch level (43,000 tons) attained in 1976 (Fig. 2), after which catch rates declined until 1979. This may be increasingly important if anticipated declines in recruitment do, indeed, occur.

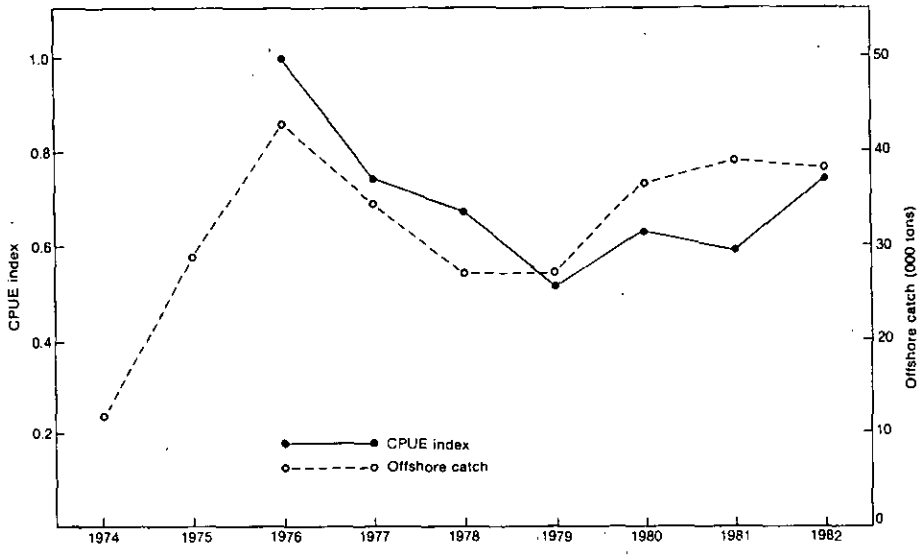

Fig. 2. CPUE index for Greenland trawlers in Div. 1B and total offshore catches in Subareas 0 and 1, 1976-82.

9. Future Research Requirements

As a result of recommendations from the November 1981 Meeting, some improvement was apparent in the quality of the 1982 data. Revision of the distribution model for the photographic data in 1982 greatly improved the confidence in the results. This survey also provided additional information on recruitment and temperature at various depths. A pilot trawl survey, using a stratified-random design, was conducted on the fishing grounds in Subarea 1, forming the basis for annual surveys. Efforts were made by countries participating in the shrimp fishery to continue their observer programs, to improve the quality of data that they collect, and to ensure that catches are accurately reported and well-documented. Since the Greenland shrimp fishery accounts for 75-80% of the total shrimp catch, it is important that all biological sampling data be analyzed and presented. Further improvements are necessary in the quality of information on discarding of shrimp. STACFIS therefore

recommends

i) that an in-depth analysis of a time series of biological data from the Greenland fishery be initiated in 1983;

ii) that the annual photographic survey be continued and efforts be made to redefine size categories for shrimp observed in the photographs;

iii) that stratified-random trawl surveys be conducted annually, possibly through cooperative arrangements between participating countries;

iv) that data indicating reproductive success, such as fecundity levels, proportion of non-maturing female, proportion of females spawning for the first time, incidence of non-viable eggs and larval abundance be routinely collected for future correlation with stock abundance indices and environmental records;

v) that the observer program be continued and efforts increased to improve the quality of data on discards; and

vi) that countries participating in the shrimp fishery continue efforts to ensure that fishing vessel logbooks are completed and made available to authorities as soon as possible.

II. ASSESSMENT OF SHRIMP IN DENMARK STRAIT (ICES Div. XIVb and Va)

1. Fishery Trends

This stock, previously referred to as the East Greenland stock, is distributed in Denmark Strait on both sides of the line between Iceland and Greenland. The shrimp fishery began in 1978 by an Icelandic vessel on the eastern side of the midline (Table 3). Nominal catches increased to 1,300 tons in 1979 when Norwegian trawlers participated in the fishery and exceeded 8,200 tons in 1980 with the additional involvement of Danish, Faroese, French and Greenland vessels. In 1981, the total catch

declined to 4,800 tons from both sides of the midline, well below the level of 8,000 tons aimed at for regulation of the fishery in the area west of the midline. In 1982, the fishery was regulated by a TAC of 4,500 tons set by the EEC for the western side of the midline, whereas the Scientific Council advised an overall TAC of 4,200 tons. Provisional data indicate a catch of 4,600 tons in 1982.

Table 3. Nominal catches (metric tons) of shrimp (*Pandalus borealis*) reported from Denmark Strait, 1978-82.

Country	1978	1979	1980	1981[1]	1982[1]
Denmark	0	0	702	581	646
Faroes	0	0	4,233	713	537
France	0	0	50	353	414
Greenland	0	0	200	1,004	1,115
Iceland	363	485	614	125	0
Norway	0	800	2,461	2,016	1,880
Total	363	1,285	8,260	4,792	4,592
Advised TAC	-	-	-	-	4,200
Effective TAC[2]	-	-	-	8,000	4,500

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

2. Distribution of Fishing Effort and Biomass (SCR Doc. 83/I/4, 6, 9)

The shrimp fishery in Denmark Strait in 1982 took place in the area of Strede and Dohrn banks, as in earlier years, but in a more restricted area than in 1981 and especially in 1980. Mostly due to ice cover, there was no fishery on the Icelandic side of the midline in 1982. On the western side of the midline, the overall fishing period extended from February to June, when the total allowable catch was achieved. The main fishing period occurred from March to May.

Forty-two vessels participated in the fishery in 1982. Danish, French and Norwegian data indicated that the fishery was restricted along and west of the 30°W meridian during March to May, with a northward shift in June, as in earlier years. While highest catch rates were obtained just north of 66°N in 1980, there was a northward shift in 1981. In 1982, however, highest catch rates were obtained south of 66°N in April and May, with declining catch rates north of 66°N compared to 1980 and 1981.

The possible influence of ice cover on the distribution of the fishery was discussed. In April 1982, ice may have hindered access to the northern part of the area exploited in earlier years. However, the higher catch rates in the southern part of the area and information from the Danish fishery indicated that ice cover on the western side of the midline may not have significantly influenced the distribution of the fishery.

The significance of the absence of high peak catch rates in 1982, due to lower concentrations of berried female shrimp in contrast to previous years, was discussed. This absence of peaks may have been due either to a different distribution of the shrimp stock in 1982 compared to the years before, or to a marked reduction of the female spawning stock through exploitation.

3. Biology (SCR Doc. 83/I/4, 6, 9)

The biology of shrimp in Denmark Strait is not well known, mainly because sampling, limited to commercial vessels, has been possible only for a part of the year and because the sampling area has been restricted in part of ice cover. Therefore, all information available for 1982 pertains to the short period from the end of March to the middle of June.

The size distribution of shrimp, based on French, Norwegian and Danish data, indicated that, as in 1981, most of the shrimp caught ranged in size from 24 to 36 mm carapace length, with a mode at 28.5 mm. However, the Danish and French observations showed a slight decrease in mean size in 1982 due to the lower abundance of large individuals. Length-weight relationships for ovigerous and non-ovigerous shrimp showed no major differences from results obtained for stocks in Davis Strait. Information on sexual components of catches from French and Danish data indicates that only adult shrimp were present on the fishing grounds. Males plus transitionals ranged in size from 19 to 31 mm and females from 25 to 36 mm. Sex reversal occurred at sizes of 25-31 mm. Most of the females taken during March-May were ovigerous and the French data indicated that hatching occurred in May-June, as in 1981. All transitionals and non-ovigerous females had ripening gonads during the spring, but only 30-50% of the ovigerous shrimp appeared to be maturing again. Thus, it is possible that a significiant proporition of females do not spawn on a yearly basis and that they can grow to larger sizes than observed in the Davis Strait stock. This is in agreement with the three modal size-groups noted in the French length frequency samples.

Although large concentrations of berried and hatching females were present south of Dohrn Bank, it is not known if the stock is self-sustaining. The absence of juveniles and males of sizes less than 19-20 mm in the 1981 and 1982 length frequencies indicates that young shrimp are not present on the fishing grounds. If the stock is self-sustaining, it must be assumed that the young shrimp inhabit the area north of the fishing grounds, because there are no areas with suitable depth south of the fishing grounds. Hydrographic observations indicate a possible northward drift of shrimp larvae. However, the possibility of recruitment from larvae hatched in the Icelandic plateau must be considered.

4. Catch and Effort (SCR Doc. 83/I/4, 6, 9)

Monthly catch rates and corresponding effort, based on logbook data for the Danish, French, Greenland, Iceland and Norwegian fisheries in 1980-82, are listed in Table 4. There has been a gradual shortening of the fishery season, possibly due to management of the fishery. In 1980 and 1981, catch rates were highest during March-April, whereas in 1982 catch rates were highest in May. Although May catch rates were higher in 1982 than in 1981, those for March and April were substantially lower in 1982, and catch rates on the average have been decreasing.

Table 4. Representative catch rates (kg per hour trawling) and corresponding effort (hours trawling) for the shrimp fishery off East Greenland in 1980-82.

		Denmark and Greenland		France		Iceland[1]		Norway	
Year	Month	Cpue	Effort	Cpue	Effort	Cpue	Effort	Cpue	Effort
1980	Mar	-	-	-	-	-	-	904	398
	Apr	672	35	-	-	-	-	704	793
	May	392	1,295	-	-	125	1,425	378	1,071
	Jun	139	315	-	-	90	1,478	98	714
	Jul	71	60	62	40	104	1,176	-	-
	Aug	17	32	-	-	123	851	95	874
	Sep	181	482	-	-	96	806	145	2,883
	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	99	...[2]	119	1,101
	Jul	-	-	-	-	78	...[2]	-	-
	Aug	-	-	-	-	39	...[2]	42	167
	Sep	-	-	-	-	-	-	46	65
1982	Mar	162	764	-	-	-	-	228	627
	Apr	192	1,570	216	331	-	-	171	2,562
	May	277	1,395	264	563	-	-	226	1,885
	Jun	-	-	185	238	-	-	-	-

[1] Data from Iceland side of midline; data from other countries from the Greenland side of the midline.

[2] Monthly data not available; total effort is 1,480 hours.

5. Discarding of shrimp (SCR Doc. 83/I/4, 6, 9)

Data on discarding of shrimp in Denmark Strait were available only for Norwegian and French vessels. Because of the large size of the shrimp, no discarding was observed in the French fishery, except damaged individuals. Discarding on Norwegian vessels was 3.7% of the total catch (weight) in 1982 compared to 11.5% in 1981. Thus, there seemed to have been less discarding in 1982 than in earlier years.

6. By-catches (SCR Doc. 83/I/4, 6, 9)

Data on by-catches of fish in the shrimp fishery were reported for French and Norwegian vessels. The total by-catch of fish taken in the shrimp fishery by French vessels was composed mainly of redfish (5 tons) and capelin (1-2 tons). In the Norwegian shrimp fishery, redfish dominated in the by-catches, although the mean number of cod per haul increased from 1 in 1981 to 23 in 1982. The mean number of fish per kg of shrimp caught decreased from 0.76 in 1981 to 0.16 in 1982.

7. Biomass Estimates

No estimate of the shrimp biomass in Denmark Strait could be made from the data available.

8. Advice on Management

No reliable estimates of the stock in Denmark Strait were available, but the Committee noted the following points: (a) the commercial catch rates, on the average, are decreasing without indications of levelling off, the decrease being primarily related to the current absence of peak catches in spring, which may reflect a sharp decline in the spawning biomass of females from 1980 to 1982; (b) a substantial part of the female component may not spawn each year (compared to other exploited stocks), which, combined with lower abundance, could result in relatively low recruitment; (c) about 5 years of growth are necessary from the larval stage to the spawning female, and the effects of fishing on future recruitment are not yet measurable; and (d) the stock may be living under extreme and unstable environmental conditions.

STACFIS expressed concern that this stock may be very sensitive to possible over-exploitation and therefore advises that the overall TAC for 1983 should not exceed the advised level for 1982 (4,200 tons). STACFIS further notes that, in light of a possible drastic reduction in the female component of the stock, the advised TAC might be considered too high.

9. Future Research

Although some improvement has been achieved in the knowledge of the stock of shrimp in Denmark Strait in 1982 particularly with regard to biological characteristics, the lack of information on a year-round basis was again strongly stressed by STACFIS. Information is specially needed on seasonal variation in distribution and abundance and on the life-cycle of shrimp in the area. The interaction of this stock with those of other areas should also be investigated, with special regard to larval drift and migration patterns of adults. The lack of data on environmental factors affecting the area, such as the influence of pulsations of Polar and Atlantic waters over the shrimp grounds, was again emphasized. Such studies are specially important because the stock in this area seem to be living at or near the environmental limit of its natural habitat. Consideration should be given to studying the deplacement of this stock, because a considerable proportion of females do not appear to be available to the fishery during the whole year. Under such conditions, STACFIS can only reiterate the great concern expressed at the November 1981 Meeting, and therefore.

recommends

i) that catch-rate data and biological samples from this stock in its whole area of distribution on a year-round basis be obtained;

ii) that plankton surveys be carried out to observe the drift of shrimp larvae;

iii) that a tagging experiment be carried out to determine the migration patterns of various size groups of shrimp; and

iv) that a study on environmental conditions be undertaken, including the current circulation in the area.

III. ACKNOWLEDGEMENTS

There being no further business, the Chairman of STACFIS expressed his thanks to all participants, especially to the various rapporteurs, for their keen interest and cooperation during the course of the meeting. He also expressed his appreciation to the NAFO Secretariat for their usual efficient work in preparing documents and reports.

PART B

REPORT OF SCIENTIFIC COUNCIL

June 1983 Meeting

CONTENTS

REPORT OF SCIENTIFIC COUNCIL

June 1983 Meeting

Chairman: R. Wells Rapporteur: V. M. Hodder

The Council and its Standing Committees met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia Canada, during 8-23 June 1983, to consider and report on the various matters listed in its agenda (see Part D, this volume). In addition to dealing with matters of general scientific interest, the Council considered requests by the Fisheries Commission and the coastal Contracting Parties (Canada and the European Economic Community) for advice on management in 1984 of a number of stocks in Subareas 0 to 4, including the harp and hooded seal stocks. The provisional agenda was adopted at the first session of the Council and a plan of work was established for the various committees and working groups. Representatives attended one or more of the Council and Committee meetings from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France, Great Britain, Netherlands, and the Commission of the European Communities), Japan, Norway, Portugal, and the Union of Soviet Socialist Republics (USSR), and observers were present from Spain and the United States of America (USA) (see Part D, this volume).

The reports of the Standing Committees, as adopted by the Council on 23 June 1983, are given in Appendix I (STACFIS), Appendix II (STACREC), and Appendix III (STACPUB). Lists of research and summary documents are given in Part C of this volume. Brief summaries of the committee reports and other matters considered by the Council are given in Section I to VII below. [Due to 1982 fishery statistics being incomplete at this meeting, Section I(1) below was approved at the September 1983 Meeting of the Council.]

I. FISHERY SCIENCE (APP. I)

1. General Fishery Trends

The total nominal catch of all species (except seaweeds) in the Northwest Atlantic (Subareas 0 to 6) was 2.68 million tons in 1982, a decrease of 6% from the 1981 catch of 2.86 million tons (see Appendix I, Table 1). The total catch of "groundfish" species increased slightly from 1.25 million tons in 1981 to 1.30 million tons in 1982 (4%), due mainly to increased catches of Atlantic cod and silver hake. The total catch of "Pelagic fishes" was 541,000 tons in 1982, a decrease of 9% from the catch of 584,000 tons in 1981, due mainly to a significant decline (20%) in the catch of Atlantic herring. For the "other finfish" group of species, the 1982 catch of 81,000 tons was 18% lower than the 1981 catch of 98,000 tons. The total catch of "invertebrates" species declined from 923,000 tons in 1981 to 753,000 tons in 1982 (18%), due to significant decreased in catches of squids (47%), scallops (23%), oysters (66%), shrimps (26%) and crabs (25%).

With respect to the total nominal catches of finfishes and invertebrates by subarea, an increase was recorded for Subarea 2 (72,000 to 134,000 tons), and decreases were recorded for Subarea 0 (5,400 to 2,800 tons), Subarea 1 (118,000 to 110,000 tons), Subarea 3 (500,000 to 469,000 tons), Subarea 4 (751,000 to 735,000 tons), Subarea 5 (580,000 to 490,000 tons) and Subarea 6 (833,000 to 738,000 tons)

2. Assessment of Finfish and Invertebrate Stocks

STACFIS reviewed that status of certain stocks in Subareas 0 to 4, as requested by Canada and the EEC (SCS Doc. 83/VI/2 and 83/VI/3), and three stocks in Div. 3M, as required by the Fisheries Commission, and advised 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, except for the capelin and squid stocks which required different management criteria. 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 Appendix I. Some general observations are as follows:

a) For the cod stocks in Subarea 1 and in Div. 2J+3KL, management options at various levels of fishing mortality are presented (see relevant sections of Appendix I).

b) For the cod stock in Div. 3M, no exploitation is advised for 1984. Although the results of research vessel surveys indicate good recruitment, the fishable stock remains in a depleted state. Too early exploitation of the 1980 and 1981 year-classes would reduce considerably their expected contribution to the fishable biomass and subsequently to the spawning stock.

c) No changes in TAC are advised for cod in Div. 3NO, redfish in Div. 3M and 3LN, American plaice in Div. 3M and 3LNO, witch flounder in Div. 3NO, Greenland halibut in Subareas 0+1, roundnose grenadier in Subareas 0+1 and 2+3, and squid-*Illex* in Subareas 3+4.

Table 1. Summary of recent catches (1977-82) and TACs (1977-83) for stocks reviewed at the June 1983 Meeting of STACFIS, together with the advised TACs for 1984.

Species	Stock area	Nominal catches (000 tons)						TACs (000 tons)							
		1977	1978	1979	1980	1981	1982[1]	1977	1978	1979	1980	1981	1982	1983	1984
Cod	1	38	39	48	47	53	55	31	...	...	...	50	...	...	( )[2]
	2J+3KL	173	139	167	176	171	228	160	135	180	180	200	237	260	( )[2]
	3M	27	33	30	11	14	13	25	40	40	13	12.7	12[4]	12[4]	(0)[3]
	3NO	18	15	28	20	24	32	30	15	25	26	26	17[4]	17[4]	(26)
Redfish	1	31	8	9	8	6	8	-	-	13	...	...	...	...	( )[2]
	3M	20	17	20	16	14	15	16	16	20	20	20	20	20	(20)
	3LN	17	12	14	16	24	22	16	16	18	25	25	25	25	(25)
Silver hake	4VWX	37	48	52	45	41	60	70	80	70	90	80	80	80	(100)
A. plaice	3M	2	1	1	1	1	1	2	4	2	2	2	2	2	(2)
	3LNO	44	50	49	49	50	51	47	47	47	47	55	55	55	(55)
Witch flo.	3NO	6	3	3	3	2	4	10	10	7	7	5	5	5	(5)
Yellowtail	3LNO	12	16	18	12	15	12	12	15	18	18	21	23	19	(17)
G. Halibut	0+1	13	12	19	8	6	7	20	20	25	25	25	25	25	(25)
	2+3KL	32	39	34	33	31	26	30	30	30	35	55[5]	55[5]	55[5]	(55)[5]
R. grenadier	0+1	3	6	7	2	+	+	8	8	8	8	8	8	8	(8)
	2+3	15	21	8	2	7	4	35	35	35	30	27	27	11	(11)
Wolffishes	1	6	6	17	5	4	4	-	-	-	...	...	...	...	(5-6)
Capelin	2+3K	152	55	11	6	12	14	212	212	75	5	10	13	50	( )[2]
	3LNO	74	30	12	14	24	27	200	200	10	16	30	30	60[6]	( )[2]
Shrimp	0+1	42	34	35	44	45	43	36	40	29.5	29.5	35	35	...	( )[7]
Squid-*Illex*	2-4	83	94	162	70	32	13	-	100	120	150	150	150	150	(150)

1 Provisional statistics
2 See relevant section of STACFIS Report (Appendix I).
3 No directed fishery.
4 Excludes expected catches by Spain.
5 TAC pertains to Div. 2J+3KL.
6 TAC pertains to Div. 3L only.
7 Deferred to later mid-term meeting.

d) In the case of Greenland halibut in Subarea 2 + Div. 3KL, no change in TAC is advised for Div. 2J+3KL. It was noted that Canada had implemented a TAC of 20,000 tons in Div. 2GH for 1983, and it is advised that a catch in the order of 20,000 tons in 1984 from these divisions would not adversely affect the stock.

e) An increase in TAC is advised for silver hake in Div. 4VWX. At the June 1982 Meeting of STACFIS, the catch rate series was difficult to interpret, but a relationship between numbers caught in Canadian research vessel surveys and numbers estimated from virtual population analysis enabled the assessment to be completed at this meeting. The projected yield in 1984 at $F_{0.1}$ is subject to some uncertainty due to the input of assumed recruitment values which determine the major part of the calculated yield.

f) A decrease in TAC is advised for yellowtail flounder in Div. 3LNO.

g) No firm assessments of the stocks of redfish and wolffishes in Subarea 1 were possible due to lack of adequate biological and statistical data. However, it was noted that the redfish yield corresponding to two-thirds of fishing effort associated with the maximum sustainable yield is about 9,000 tons, and that a combined catch in 1984 of 5,000-6,000 tons of spotted and Atlantic wolffishes would be reasonable.

h) For capelin in Div. 3L, the catch level advised for 1984 corresponds to 10% of the projected population biomass in 1984. No catch is advised for capelin in Div. 3NO due to uncertainty about year-class strength and the low level of biomass. If the 10% exploitation rate, which has been advised for capelin in Div. 3L for a number of years, is applied to the projected capelin biomass in Div. 2J and 3K in 1984, the result would be a TAC level of 100,000 tons for the autumn of 1984.

i) For squid-*Illex* in Subareas 3+4, the advised TAC of 150,000 tons for 1984 is intended to avoid excessive fishing mortality if the population in that year is of moderate abundance. If the population in 1984 is quite low, it is expected that fishing effort would be diverted from the fishery because of low catch rates. This management regime implies a loss in yield in years of high abundance.

j) Advice on management in 1984 of the shrimp stock in Subareas 0 and 1 and in Denmark Strait could not be provided at this meeting. Considering the substantial contribution of shrimp recruitment to annual yields and the current inability to predict recruitment accurately, it was agreed that a mid-term meeting, preferably in early 1984, would be appropriate.

3. Assessment of Seal Stocks

a) Harp seals

The most recent analysis of the Northwest Atlantic harp seal populations (Roff and Bowen model) was reviewed, with the conclusion that the range of feasible values of natural mortality (M) is 0.05-0.11. The most likely estimates of M = 0.0725 (for $M_0 = 3M_1$, where M for animals younger than 1 year equals three times M for age 1 and older animals) and M = 0.0750 (for $M_0 = M_1$) lie outside the feasible range of M (0.08-0.11) indicated by the ICES *Ad Hoc* Working Group on Assessment of Harp and Hooded Seals in the Northwest Atlantic (ICES Coop. Res. Rep., No. 121, April 1983). This difference is due to the sensitivity of M to the 1967 population age structure used to initialize the Roff and Bowen model. This age structure was considered to be closer to the true population age structure than that used in the ICES analysis.

Analysis of tag returns for the 1978-80 cohorts indicated that Gulf-tagged seals were more catchable in the Gulf of St. Lawrence than at the Front, and that the use of combined recaptures in a modified Petersen index could bias the estimates of pup production downward by 10-20%. It was concluded that pup production in 1978-80 was in the range of 350,000-600,000.

Estimates of replacement yield in 1984, based on a catch of 80% young-of-the-year and the above range of pup production, ranged from 160,000 to 600,000 animals. The harp seal population is predicted to increase from 1983 to 1984 for all values of 1984 replacement yield. With a catch of 200,000 animals in 1984, the population would increase unless the replacement yield was close to the lowest quoted value. Since the present population contains a high proportion of immature animals, a continuation of the current mortality schedule implies that sustainable yield will exceed the replacement yield.

b) Hooded seals

The 1983 catch is expected to be low (about 6,000 animals) because of the low demand for the skins of pups. Estimated age-at-maturity from new data was not significantly different from earlier estimates by the same method. Estimates of Z for females, sampled at the Front and at Greenland, were lower in the late 1970's than in the early 1970's and are consistent with the reduced kill of breeding females at the Front since 1977. A preliminary analysis of total and hunting mortality rates indicates a probable range of M of 0.07-0.13.

No reliable estimates of current pup production were available, but it was concluded that pup production at the Front in 1979 was at least 15,000, considering that the catch in that year was 12,000 pups. Estimates of replacement yield in 1984 ranged from 3,500 to 23,000 animals, for M in the range of 0.07-0.13 and pup production in 1979 equal to the minimum level of 15,000 and arbitrary higher levels of 20,000 and 25,000. These values are underestimates, if there is a substantial degree of interchange between the Front and Davis Strait herds.

The Council enthusiastically endorsed the proposed Bergen Workshop on hooded seals in late 1983 and considered it feasible for NAFO to publish the proceedings of the workshop, since no additional costs will be involved for NAFO.

4. Flemish Cap Project

The Council noted that the *ad hoc* Working Group had met on 10 June 1983 and reviewed recent studies concerning the oceanographic regime and the biology and dynamics of larvae, juveniles and adults of cod and redfish. Considerable data relevant to factors influencing the production of good and poor year-classes remain to be analyzed, and it was agreed that further meetings of the Working Group should be scheduled only when there is reasonable assurance that substantial information will be available for consideration.

5. Environmental Research

The Council noted that the Environmental Subcommittee, which was established in 1981, held its second meeting on 8-9 June 1983, with Dr. R. W. Trites as Chairman. The full report of the Subcommittee is at Annex 1 to the Report of STACFIS (Appendix I).

The Council welcomed the decision on the establishment of base periods for use in analyzing environmental data, but expressed concern about the small amount of documentation presented and the low level of participation by oceanographers. The apparent lack of interest led to a brief discussion

on the future of the Subcommittee and deferment of the matter for further consideration at the September 1983 Meeting.

6. Ageing Techniques and Validation Studies

The Council noted that work was in progress on previous recommendations regarding problems of age determination of redfish (Canada and Federal Republic of Germany), roundnose grenadier (Federal Republic of Germany and German Democratic Republic), cod in Div. 3M (Canada and USSR) and silver hake in Div. 4VWX (Canada and USSR). The report of the Shrimp Ageing Workshop, held in 1981, will be published in NAFO Scientific Council Studies in late 1983.

7. Outstanding Matters on Herring Research

The Council welcomed the presentation of the comprehensive report of the *ad hoc* Working Group on Herring Tagging, which met in January 1982, and noted that the Task Force on Larval Herring was expected to finalize its activities at the June 1984 Meeting.

8. Presentation of Stock Assessment Summaries

The Council endorsed the proposals of STACFIS regarding the need for standardizing the presentation of stock assessments in accordance with the basic principle that sufficient detail should be provided to enable the calculations to be checked and repeated, if necessary. This matter will be considered at the September 1983 Meeting.

9. Special Session on Trophic Relationships in Marine Species Relevant to Fisheries Management in the Northwest Atlantic

The Council noted that the Special Session in September 1983 should be a successful and interesting one, with the anticipated presentation of approximately 30 contributions covering a wide range of topics on the subject.

II. RESEARCH COORDINATION (APP. II)

1. Statistics and Sampling

a) CWP activities relevant to NAFO

The Council noted NAFO's involvement in the 11th Session of the CWP (Coordinating Working Party on Atlantic Fishery Statistics), which was held at Luxembourg during 21-28 July 1982. The report of that session (SCS Doc. 83/VI/10) was presented by Mr. D. G. Cross, Deputy Secretary of the CWP. The Council was informed that the 12th Session of the CWP will be held at ICES Headquarters, Copenhagen, Denmark, during 25 July-1 August 1984, and agreed that NAFO be represented by the Chairman of STACREC, the Assistant Executive Secretary, and a participant from the fisheries statistical office of the USSR.

b) Fishery statistics

The Council noted that, although there was some improvement in the submission of STATLANT 21A reports for 1982 compared with the previous year, the available data were insufficient for the Secretariat to prepare the usual summary document containing 1982 nominal catches by species and division. Consequently, the "Fishery Trends" section of the STACFIS Report (Appendix I) and the corresponding summary for the Council's Report (Section I(1) above) could not be completed until the September 1983 Meeting. The Council again urges its representatives to take an active role in ensuring that national statistical officers give priority to the submission of the required STATLANT 21A and 21B reports in accordance with the designated deadlines.

c) Sampling data

The Council noted that the Secretariat had received no requests for the detailed sampling data which had accumulated since 1978, because such data were not suitable for assessment purposes without being summarized by month and division. The Council also noted that the *ad hoc* Working Group on Sampling could not recommend standard guidelines to enable the Secretariat to produce these monthly summaries due to difficulties in determining appropriate weighting of the individual samples. Considering the recommendations of STACREC and noting the difficulties that might be encountered in some laboratories regarding the resubmission of 1979-82 data, the Council

recommends

i) that length frequencies and age-length keys be submitted to the Secretariat in summarized form by time periods and areas appropriate for stock assessments, starting with data for 1983, and

ii) that the fisheries institutes which had submitted detailed sampling data for 1979-82 be requested to resubmit these data in the same summarized form during the next few years.

The Assistant Executive Secretary was requested to contact the various institutes which submit data to obtain the opinions of experts on appropriate formats for submitting data on the various species. This information will be considered by a small *ad hoc* working group which would advance proposals for consideration by the Council at the September 1983 Meeting.

d) Scientific observer program

Canada reported that the program is being actively pursued and that bilateral agreements were in effect for most countries fishing within the Regulatory Area.

e) List of fishing vessels for 1983

The Council requested the Secretariat to proceed with plans to acquire the 1983 data for inclusion in the triennial volume of List of Fishing Vessels.

f) Tagging activities (SCS Doc. 83/VI/8)

The Council endorsed the Secretariat's effort to acquire and distribute through its Circular Letter series information on tagging activities in the Northwest Atlantic.

2. Biological Surveys

a) Survey activities

The Council noted that STACREC had reviewed research vessel survey activities in the Northwest Atlantic in 1982 and survey plans for 1983 and early 1984, the details of which are listed in Tables 1 and 2 of the Report of STACREC (Appendix II).

b) Stratificiation schemes

The Council noted that the outstanding survey stratification scheme for Div. 2G and 2H would be prepared by Canadian scientists as soon as the new navigational charts become available.

c) Coordination of squid surveys

The Council noted that no proposals were presented to STACREC for consideration regarding oceanic squid surveys in Subareas 3 to 6 during early 1984.

III. PUBLICATIONS (APP. III)

1. Review of Publications

The Council, in accepting STACPUB's review of the status of publications in the proceding 12 months, noted in particular the rapid progress being made in the preparation of Vol. 4 of the Journal of Northwest Atlantic Fishery Science for publication this summer and expressed appreciation for the efforts of the Editor and Secretariat staff involved.

2. Editorial Policy Regarding Publications

The Council shared STACPUB's regret that Mr. B. Parrish could not continue as Associate Editor of the Journal, following his appointment as General Secretary of ICES. It was agreed that two associate editors were required to deal with submitted manuscripts relating to Vertebrate Fisheries Biology, and the Council accepted STACPUB's recommendation that the Editor invite Dr. R. G. Halliday (Canada) and Dr. M. D. Grosslein (USA) to serve as Associate Editors in this field, their appointments to be effective on 1 July 1983.

The Council, noting that STACPUB had no new ideas for promoting the distribution of the Journal, requested Council members as a whole to consider this matter and provide any suggestions to STACPUB members. With regard to the distribution policy for NAFO Scientific Council Studies, it was agreed that the policy for distribution and annual review thereof should be the same as that for the Journal except that a few exchanges may be undertaken for goodwill purposes.

3. Papers for Possible Publication

The Council agreed with STACPUB that papers presented to the Special Session on Stock Discrimination in September 1982 be published in regular issues of the Journal or Studies as suitable manuscripts become available. It was noted that 11 documents had been selected, from the research

documents presented to the Council so far in 1983, for possible publication in one of the Council's publication series, subject to revision by the author and acceptance by the Editor. It was agreed that the Report of the Working Group on Herring Tagging (SCS Doc. 83/VI/18) would be published as an annex to the STACFIS Report if the scientists who were involved in the research upon which the Working Group report is based do not agree to its publication in the Studies series. [Subsequent opinions of the scientists involved resulted in the Report of the Herring Working Group being published as Annex 2 to the STACFIS Report (Appendix I).]

4. Utilization of Microfiche

The Council, while noting some encouraging progress, particilarly in obtaining the support of Canadian Department of Fisheries and Oceans libraries, considered that many questions concerning the technical and financial aspects of this proposal remained unanswered and that remedying this problem was a prerequisite to obtaining broad support of all members of the Council. Consequently, the Council could not support an approach to the General Council for financial authorization at this time, as proposed by STACPUB, but

recommends

a) that the Executive Secretary obtain and forward as soon as possible to national representatives on the Scientific Council technical specifications for the microfiche proposal, including (i) firm cost of copying the historical research and summary documents which are actually necessary to be copied, (ii) cost of equipment necessary within the Secretariat, (iii) type and approximate cost of equipment necessary for national laboratories to utilize microfiche copies, and (iv) an actual microfiche copy of a research document of the quality to be expected;

b) that Scientific Council representatives be requested, after receiving the material noted in (a) to approach their appropriate national authorities and/or institutions to obtain as clear expressions of interest and support as possible for this project; and

c) that the representatives inform the Executive Secretary of responses which they have received in time for consideration at the September 1983 Meeting of the Scientific Council.

It was noted that the time between this meeting and the September 1983 Meeting was very short and that full implementation of (c) above may not be possible. Nevertheless, it is hoped that there will be sufficient replies by that time to establish support for the project among national institutions.

IV. COLLABORATION WITH OTHER ORGANIZATIONS

1. Joint NAFO/ICES Study Group on Redfish at Greenland (SCS Doc. 83/VI/6)

The Council considered the report of the Study Group which met for the first time at ICES Headquarters, Copenhagen, Denmark, during 21-23 February 1983, to examine the biological relationships of the West Greenland and Irminger Sea redfish stocks. It was noted that the Study Group had reviewed the state of knowledge on this stock complex, involving the following topics: environmental conditions, species identification, stock components, areas and time of spawning, drift of larvae, nursery areas, and migration. Major deficiencies in information were apparent, especially regarding the relationships among the different stocks or stock components in the Irminger Sea and adjacent areas, including West Greenland. Even the possibility of relationships between the stocks at West Greenland and those off Labrador and Newfoundland could not be excluded. The Group concluded that at least two main questions have to be answered to clarify these biological relationships: (a) Where are the spawning grounds of the West Greenland redfish population(s)? (b) Where is the origin of the young redfish observed off West Greenland?

According to its terms of reference, the Study Group formulated future research requirments and recommended the following courses of action:

i) Existing material, including environmental data, from previous research activities in the region should be scrutinized with a view to deriving additional information relevant to the questions.

ii) Although the tagging of redfish in offshore areas is known to be virtually impossible, the feasibility of tagging *Sebastes marinus* in Godthåb fjord should be investigated.

iii) Direct observations of drift, in connection with the relevant environmental conditions, of redfish fry to West Greenland should be obtained, in order to determine the origin of the small redfish present off the West Greenland coast. This approach will require an entensive multiship research program extending over several months and possibly years.

The Study Group agreed that work on item (i) above should be done as soon as possible, and that a further meeting should be convened when the results are available.

The Scientific Council endorsed the recommendations of the Study Group and agreed that its activities should be continued. However, it was pointed out that a considerable amount of coordinated research effort would be involved in implementing the third proposal of the Study Group.

2. Twelfth Session of the CWP

The Council noted that the 12th Session of the CWP will be held at ICES Headquarters, Copenhagen, Denmark, during 25 July-1 August 1984, and that NAFO is expected to be represented by the Chairman of STACREC, the Assistant Executive Secretary, and a participant to be designated by the USSR.

V. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting, September 1983

The Scientific Council and its Standing Committees will meet during the Fifth Annual Meeting of NAFO (14-23 September 1983) at Leningrad, USSR, to consider the following items:

a) Special Session on "Trophic Relationships in Marine Species Relevant to Fisheries Management in the Northwest Atlantic" (Conveners: V. A. Rikhter and G. R. Lilly).

b) Future of the Environmental Research Subcommittee, and the feasibility of continuing the preparation of an annual overview of environmental conditions in the NAFO Area.

c) Appointment of convener(s) for the Special Session on "Biology and Ecology of the Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic".

d) Proposed change in presentation of STACFIS report to be considered by a small working group of assessment experts.

e) Matters relevant to proposals by STACPUB for publication of papers presented to the Special Session, and progress on proposal to microfiche historical scientific meeting documents.

f) Further consideration of procedures for reporting sampling data to the Secretariat.

g) Election of officers for 1983/85.

h) Plans for future meetings.

2. Mid-term Meeting for Assessment of Shrimp Stocks

The Council agreed with the proposal by STACFIS that the best time for a meeting to assess the shrimp stocks would be in early 1984. However, a final decision on whether this meeting would be held in late 1983 or early 1984 was deferred to the September 1983 Meeting, pending the receipt of proposals from interested parties about the timing of the mid-term meeting.

The Council agreed with STACFIS that better advice for management in 1984 of the capelin stocks in Subareas 2 and 3 could be provided in early 1984, when the results of research conducted in 1983 would be available.

3. Scientific Council Meeting, June 1984

The Council and its committees and working groups will meet at the Bedford Institute of Oceanography, Dartmouth, Nova Scoita, Canada, during 6-21 June 1984.

4. Annual Meeting, September 1984

The 1984 Annual Meeting of the Scientific Council will be held during the Sixth Annual Meeting of NAFO, the dates of which have yet to be confirmed by the General Council.

5. Scientific Council Meeting, June 1985

Tentative dates for this meeting will be decided at the Annual Meeting in September 1983.

VI. OFFICERS FOR 1983/85

1. Election of Officers

The Chairman appointed a small nominating committee to solicit the views of the representatives of the six Contracting Parties represented at the meeting regarding potential candidates for the various offices open for election. The Council accepted the proposal of the nominating committee that the following slate of candidates be put forward for election to the respective offices:

Chairman of Scientific Council	: Dr. V. A. Rikhter (USSR)
Vice-Chairman of Scientific Council	: Dr. J. Messtorff (EEC)
Chairman of STACFIS	: Dr. J. Carscadden (Canada)
Chairman of STACREC	: Mr. J. Moller Jensen (EEC)
Chairman of STACPUB	: (The Vice-chairman of the Scientific Council becomes *ex officio* Chairman of this Committee)

It was noted that these candidates have all agreed to occupy the respective offices, if elected. There being no further nominations and in the absence of the necessary quorum, the Executive Secretary was requested to conduct a postal vote and report the results at the beginning of the September 1983 Meeting of the Council.

2. Publications Committee

The Council appointed Sv. Aa. Horsted (EEC) and S. Kawahara (Japan) as members of the Standing Committee on Publications (STACPUB), replacing J. Messtorff (EEC) and H. Hatanaka (Japan) respectively.

VII. OTHER MATTERS

1. Theme for Annual Meeting in September 1985

The Council endorsed the proposal of STACFIS, regarding the theme for a special session in September 1985, as folows: "Design and Evaluation of Biological Surveys in Relation to Stock Assessments".

2. Cancellation of November 1982 Mid-term Meeting for Assessment of Seal Stocks

In accordance with the Canadian request for scientific advice on management of the harp and hooded seal stocks in 1983, the Council agreed to meet at NAFO Headquarters during 12-17 November 1982 (NAFO Sci. Coun. Rep., 1982, page 74). Shortly after the Secretariat had made arrangements for this meeting and had notified Contracting Parties accordingly, the meeting was abruptly cancelled at the request of the coastal state concerned and the matter was referred to another international organization (ICES) for consideration.

3. Provisional Report of January 1983 Meeting

The Council reviewed and formally approved with minor amendments the report of its meeting on 19-24 January 1983 at Dartmouth, Nova Scotia, Canada (see Part A, this volume).

VIII. ADJOURNMENT

The Chairman noted that Mr. Robert H. Letaconnoux, who was the first Chairman of the Scientific Council, had recently retired from active service and that the Council will miss his clear and thoughtful guidance. The Council wishes him a long and happy retirement. Appreciation was also expressed for the long and faithful service of Dr. Arthur Mansfield as Convener of the Working Group on Seals.

The Chairman expressed his thanks to the chairmen and conveners of the various committees and working groups and to all other participants for their cooperation and contributions to the success of this meeting. He also thanked the Secretariat staff for arranging the meeting facilities and for their efficiency in servicing the meeting. The final session was adjourned at 1230 hours on 23 June 1983.

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

Chairman: J. P. Minet Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 8-21 June 1983 to consider and report on various matters 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 and harp and hooded seal stocks in the Northwest Atlantic (see Part D, this volume, for agenda). Scientists attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France, and the Commission of the European Communities), Japan, Portugal, Spain, USSR and USA.

Various scientists, designated by the Chairman, assisted in the initial preparation of draft reports on the various assessment topics considered by the Committee (Section II). The sections of this report, initially considered by *ad hoc* Working Groups, were organized by the conveners of these groups: G. H. Winters for Seals (Section III), and J. T. Anderson for the Flemish Cap Project (Section IV). The report of the Subcommittee on Environmental Research (Chairman: R. W. Trites) is introduced in Section V of this report and given in detail in Annex I. Sections VI to IX deal with various other matters considered by the Committee. [Section I of this report entitled "Fishery Trends" could not be completed at this meeting due to the absence of some 1982 fishery statistics; it was subsequently completed and adopted at the September 1983 Meeting of the Committee.]

I. FISHERY TRENDS

1. General Trends for the NAFO Area

The fishery statistics summarized in Table 1 are based on provisional data reported for 1982 (SCS Doc. 83/IX/22) and published reports for 1981 (NAFO Stat. Bull. Vol. 31). The overall nominal catch of all finfish and invertebrates decreased slightly (6%) from 2.86 million tons in 1981 to 2.69 million tons in 1982, after having declined slightly from 2.89 million tons in 1980. The total groundfish catch, which represented 48% of the overall nominal catch in 1982, increased (4%) from 1.25 million tons in 1981 to 1.30 million tons in 1982, due mainly to increases for Atlantic cod (12%) and silver hake (30%), whereas decreases were noted for haddock (20%) and redfish (4%). The total pelagic fish catch, which represented 20% of the overall nominal catch in 1982, decreased (7%) from 584,000 tons in 1981 to 541,000 tons in 1982, due mainly to a significant decline in the catch of herring (20%) which constituted about 34% of the total for this group. The total "other finfish" catch declined (17%) from 98,000 tons in 1981 to 81,000 tons in 1982, due to decreased catches of several species in this group despite the increase (8%) in the catch of capelin, which represented 50% of the total for this group. The total catch of invertebrates, which represented 28% of the overall nominal catch in 1982, declined significantly (16%) from 923,000 tons in 1981 to 766,000 tons in 1982, due mainly to decreased catches of squids (47%), scallops (23%) and other molluscs (mainly oysters) (63%), despite the increased catch of clams (20%).

2. Subarea 0

The usual low catch of 2,800 tons in 1982 was only slightly more than half of the 1981 catch of 5,500 tons, with shrimp being the dominant species taken.

3. Subarea 1

The total nominal catch of all species increased (5%) from 118,000 tons in 1981 to 124,000 tons in 1982, due to slight increases in the catches of Atlantic cod (4%) and shrimp (5%), these two species constituting 78% of the total "all species" catch in 1982.

4. Subarea 2

The total nominal catch of all species increased sharply (86%) from 72,000 tons in 1981 to 134,000 tons in 1982, due mainly to the increased catch of Atlantic cod (111%), which constituted 71% of the total in 1982, with increases being noted also for Greenland halibut and redfishes.

5. Subarea 3

The total nominal catch of all species decreased (6%) from 500,000 tons in 1981 to 469,000 tons in 1982. Although the Atlantic cod catch, which constituted about 50% of the total catch in this subarea, increased slightly in 1982 (7%), decreases were noted for redfishes (16%), American plaice (10%), Greenland halibut (58%), Atlantic herring (73%) and squid (39%).

6. Subarea 4

The total nominal catch of all species (except seaweeds) declined slightly (2%) from 751,000 tons in 1981 to 735,000 tons in 1982. Decreased catches of Atlantic cod (5%), haddock (22%), pollock (11%),

flounders(12%), white hake (17%), Atlantic herring (3%) and squid (86%) were mostly offset by increased catches of silver hake (46%) and crustaceans (25%).

7. Subarea 5

The total nominal catch of all species decreased (16%) from 580,000 tons in 1981 to 490,000 tons in 1982. Although increases were noted for Atlantic cod (31%), silver hake (22%), flounders (28%) and clams (53%), these were more than offset by decreased catches of haddock (19%), Atlantic herring (48%), Atlantic menhaden (56%), and scallops (35%).

8. Subarea 6

The total nominal catch of all species decreased (11%) from 833,000 tons in 1981 to 738,000 tons in 1982, due mainly to decreased catches of "other molluscs" (mainly oysters) (67%) and crustaceans (mainly crabs) (60%), although increased catches were noted for Atlantic menhaden (17%) and clams (16%).

Table 1. Nominal catches (000 tons) for 1981 and 1982[1]. (The symbol + indicates less than 500 tons.)

	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
Species items	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
Atlantic cod	-	+	53	55	45	95	222	238	245	232	55	72	+	+	621	693
Haddock	-	-	-	-	-	+	1	1	51	40	31	25	+	+	83	66
Atlantic redfishes	-	+	6	8	4	8	73	61	40	42	8	7	+	-	131	126
Silver hake	-	-	-	-	-	-	+	+	41	60	9	11	10	6	60	78
Red hake	-	-	-	-	-	-	-	+	+	+	3	2	2	1	5	2
Pollock	-	-	-	-	-	-	+	1	37	33	22	20	+	+	59	54
American plaice	-	-	+	1	+	+	62	56	17	14	13	15	+	+	92	86
Witch flounder	-	-	-	-	+	+	7	7	4	3	3	5	+	+	14	15
Yellowtail flounder	-	-	-	-	-	+	15	13	3	3	15	26	1	1	34	42
Greenland halibut	+	1	6	5	5	15	26	11	3	2	-	-	-	-	40	35
Other flounders	-	-	1	1	+	+	1	2	7	8	19	18	8	7	36	36
Roundnose grenadier	-	+	+	+	3	2	4	3	-	-	-	-	-	-	7	4
White hake	-	-	-	-	-	+	3	2	18	15	6	7	+	+	27	24
Wolffishes	-	-	4	4	+	+	3	3	3	3	1	1	+	-	10	11
Other groundfish	-	-	6	5	+	+	1	+	7	9	12	11	9	6	35	31
Atlantic herring	-	-	+	+	+	+	11	3	150	145	65	34	+	+	226	182
Atlantic mackerel	-	-	-	-	+	-	7	+	13	16	1	1	7	9	28	26
Atlantic butterfish	-	-	-	-	-	-	-	-	-	-	5	8	1	1	6	9
Atlantic menhaden	-	-	-	-	-	-	-	-	-	-	79	35	235	274	314	309
Other pelagics	-	-	-	-	-	-	1	1	1	1	2	6	7	7	11	15
Capelin	-	-	+	+	10	10	26	32	2	+	-	-	-	-	39	42
Other finfish	-	-	2	3	1	1	5	3	12	10	10	11	29	11	59	39
Squids	-	-	-	-	-	-	18	11	14	2	13	4	25	20	70	37
Clams	-	-	-	-	-	-	-	-	5	6	30	46	256	297	291	349
Scallops	-	-	-	-	+	+	+	6	23	23	149	97	17	19	189	145
Other Molluscs	-	-	+	-	-	-	+	-	2	2	9	8	165	55	176	65
Shrimp	5	1	40	42	3	3	+	+	9	9	1	2	+	-	58	57
Other crustaceans	-	-	-	-	+	+	16	15	44	57	18	17	60	24	138	112
Other invertebrates	-	-	-	-	-	-	-	-	-	-	1	1	+	+	1	1
Total	5	3	118	124	72	134	500	469	751	735	580	490	833	738	2860	2692

[1] Provisional data for 1982 from SCS Doc. 83/IX/22.

II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 83/VI/60)

a) Fishery trends

Provisional statistics for 1982 show a nominal catch of about 55,500 tons, which is virtually the same quantity (55,000 tons) used as the basis for forecasts made in last year's assessment (NAFO Sci. Coun. Rep., 1982, page 16). This catch is slightly more than the catch of 53,460 tons reported in 1981. The 1980 catch was about the same level. Only Greenland fishermen were allowed directed fishing for cod in 1978-81. Their quota was set at 50,000 tons in 1981. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)[1]	60	45	31	...	...	20[2]	50[3]	62[3]	...
Catch (000 tons)	48	33	73[4]	73[4]	99[4]	54[4]	53	55[5]	

[1] Catches limited to Greenlander's fishery and to by-catch in 1978-81.
[2] Quota for offshore Greenland fishery only.
[3] Quota for offshore plus inshore Greenland fishery.
[4] Estimates used for stock assessments.
[5] Provisional data.

b) Trends in distribution, abundance and stock composition

The distribution of catches by division and gear changed somewhat from 1981 to 1982. The offshore catch by trawlers (Greenland and Federal Republic of Germany) in 1982 nearly doubled from that in 1981, when only Greenland trawlers were allowed a directed fishery for cod. The inshore catch declined sharply from 39,000 tons in 1981 to 26,000 tons in 1982, the decrease occuring mainly in Div. 1E and 1F whereas catches in Div. 1B to 1D remained stable. The high catches in Div. 1E and 1F in 1979-81 were based on the southerly distribution of the 1973 year-class, which is now very much reduced due to fishing, emigration and natural mortality.

Catch rates for Greenland trawlers decreased from a very high level of 3.3 tons per hour in 1981 to 2.2 tons per hour in 1982. The later catch rate was well above the 1980 level of 1.2 tons per hour but similar to the 1979 level of 2.4 tons per hour. The catch rate of Federal Republic of Germany trawlers was about half that of Greenland trawlers, but species other than cod (primarily redfish) made up 58% of the total catch of Federal Republic of Germany trawlers whereas cod made up 95% of Greenland trawler catches.

Both the inshore and offshore fisheries in 1982 were dominated by the 1977 year-class, which accounted for 67% by number and 55% by weight of the overall landings. The mean weight of cod landed (whole fish) increased from 1.8 kg in 1981 to 2.1 kg in 1982. The 1979 year-class is expected to be a major contributor to the fishery in the next few years, together with the 1977 year-class, and samples of the catches are expected to show a clearly bimodal length distribution.

c) Survey results

A stratified-random survey was carried out by the Federal Republic of Germany research vessel *Walther Herwig* in November-December 1982. The survey covered an area of nearly 20,000 sq. naut. miles, and the minimum trawlable biomass of cod, deduced from 98 successful hauls, was 180,000 tons ± 37% (95% confidence limits). Only 1% of the biomass was found in Div. 1B and 4% in the northern part of Div. 1C, whereas 46% occurred in Div. 1D and about 50% in Div. 1EF. The 1977 and 1979 year-classes dominated in the catches, the former in the southern part and the latter mainly in the northern part of the area.

The results from a groundfish survey by the French research vessel *Thalassa* in June 1982, consisting of 61 hauls in Div. 1C to 1F, generally agreed with the distribution and age composition of the cod stock as described above. Information from a trawl survey for shrimp in Div. 1A and 1B in July 1983 support the indication of extremely low density of cod in the offshore parts of Div. 1A and 1B.

d) Assessment parameters

i) Maturity at age

In previous assessments of the cod stock in Subarea 1, the spawning stock biomass (SSB) has been defined as the weight of that part of the stock consisting of age 6 and older fish (age on 1 January). Age 6 was chosen as the minimum age because about half of the individuals of this age-group are mature. However, younger age-groups contain smaller proportions of mature fish, and some individuals of older age-groups are still immature. Therefore, a proper calculation of SSB should take the maturity ogive into account. New data enabled the comparison of trends in SSB as calculated by the two methods (Fig. 1). The difference depends largely on the actual composition of the stock, but the knife-edge definition of maturity generally leads to higher estimates of SSB than the age-specific maturity definition.

ii) Mortality and partial recruitment

The 1980-82 catch curve, averaged for age-groups 5-8 (excluding the 1973 and 1977 year-classes), gave a total mortality (Z) estimate of 0.79. Deducting natural mortality (M) of 0.20 and emigration coefficient (E) of 0.05 leads to an estimate of F of 0.54 for fully

recruited age-groups. This value is the same as the terminal F for 1981 used in last year's assessment of the stock. Considering that estimates of Z (and F) from catch curves involve certain assumptions which are seldom met, the Committee compared the VPA (virtual population analysis) results based on terminal F = 0.54 for 1982 with an analysis of data from the survey in November-December 1982. The age composition of the surveyed stock was taken as that existing on 1 January 1983 after upgrading age-groups by one year. Applying the catch by age-groups for 1982 of this stock structure indicates that mean F for age-groups 5-8 in 1982 was 0.34.

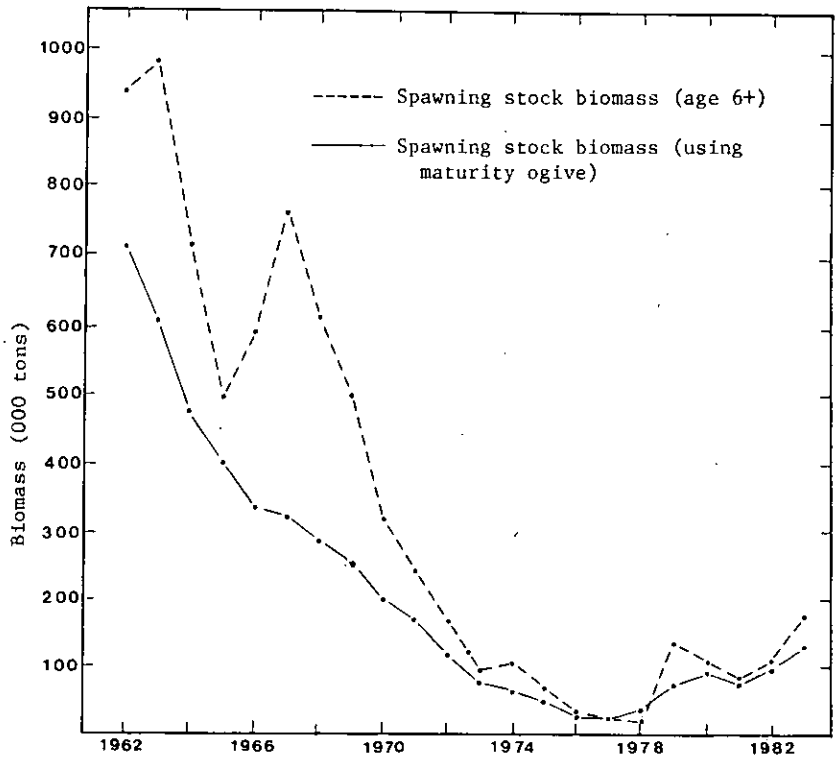

Fig. 1. Subarea 1 cod: trends in spawning stock biomass for two methods of defining the age at maturity, 1962-83.

The two analyses were compared by correlating (i) average fishing mortality on ages 5-8 for the years 1975-80 with data on total fishing effort in Greenland trawler units, and (ii) the exploitable biomass with catch rates for the Greenland trawlers. Considering the resultant regression coefficients and the distance of the 1981 and 1982 data-points (not included in the regressions) in relation to the regression lines, the Committee concluded that the VPA based upon the survey data reflected the stock situation better than the analysis with an F-value of 0.54 in 1982.

To obtain relative F-values for age-groups 3 and 4, their positions in relation to the 1980-82 catch curve for age-groups 5-8 were used. The resultant values were respectively 3.9% and 52% of F for age-groups 5-8 (assumed to be fully recruited). For the final calculations, M was assumed to be 0.20 (0.30 for age-group 3) and E was set at 0.05.

iii) Mean weights at age

These values were derived from Danish samples of commercial catches in 1982 (Table 2). They were somewhat lower than the values observed in 1981 and used in last year's assessment.

iv) Recruiting year-class estimates

On the basis of temperature and larval observations in the years when the 1980, 1981 and 1982 year-classes were born, recruitment values (numbers at age 3) have been initially judged to be 75, 20 and 200 million fish respectively. Thus, the 1982 year-class is expected to be a very good one, but its abundance will have to be evaluated further by young-fish surveys before firmer conclusions are made. The strength of the 1979 year-class is probably close to the upper limit of the range (75-150 million fish) used in last year's assessment, and, consequently a value of 150 million was used in the present prognosis.

Table 2. Subarea 1 cod: parameters used for projections of catch and stock size.

Age (yr)	Population No. (000)	Relative M	Mean wt. (kg)	Percent mature	Relative F
3	75,000	1.50	0.83	1	0.039
4	110,090	1.00	1.11	3	0.52
5	10,821	1.00	1.70	15	1.0
6	38,789	1.25	2.35	48	1.0
7	13,618	1.25	3.20	83	1.0
8	4,754	1.25	4.20	96	1.0
9	1,047	1.25	6.50	99	1.0
10	2,006	1.25	9.02	100	1.0
11	126	1.25	9.32	100	1.0
12	85	1.25	9.32	100	1.0
13	70	1.25	9.32	100	1.0
14	3	1.25	9.32	100	1.0
15+	10	1.25	9.32	100	1.0
			1984	1985	1986
Recruitment at age 3 (millions)			20	200	20

e) Results of assessment

Trends in spawning stock biomass, recruitment at age 3 and fishing mortality from the VPA, together with the trend in catch, are illustrated in Fig. 2 for the 1962-82 period. Among the recent year-classes up to 1981, those of 1973 and 1977 were the strongest, with recruitment at age 3 of 228 million and 139 million fish respectively.

f) Forecasts

Without sophisticated calculations, it can be readily predicted that catches in 1983-85 will be greatly dependent on the 1977 and 1979 year-classes. Many catches are likely to be clearly bimodal in their length distributions, most pronounced in 1983, but less in 1984-85 when the two year-classes will have greater overlap in their length distributions. It seems likely that the major part of the catches will be obtained in Div. 1C and 1D, followed by Div. 1E. By 1985, the 1982 year-class is expected to appear in the catches, possibly as large numbers of undersized fish in poundnets. If this year-class is as large as expected, catches in 1986 will be composed of fish with relatively low mean weight and a new bimodal length distribution can be expected, with one group consisting of fish of the 1982 year-class and the other group consisting of large fish mainly of the 1977 and 1979 year-classes.

The EEC (European Economic Community) has requested that several fishery strategies be considered in prognoses for the Subarea 1 cod stock, using as a general guide the assumption that the catch in 1983 will be the same as the TAC for 1982 (i.e. 62,000 tons). The parameters used for projections of catch and spawning stock size are given in Table 2. Forecasts of spawning stock biomass and catch for five levels of fishing mortality and the spawning stock biomass for a stable catch of 62,000 tons are given in Table 3 and illustrated in Fig. 3. The projected yield in 1984 and the spawning stock biomass at the beginning of 1985, for a wide range of fishing mortality, are depicted in Fig. 4.

g) Yield per recruit

The yield-per-recruit curve, constructed on the basis of the revised values of mean weight by age and of partial recruitment, shows that the reference points $F_{0.1}$ and F-max are somewhat lower than those used in previous assessments. Present values are $F_{0.1} = 0.184$ and F-max = 0.348. Recent (1981 and 1982) levels of F are about the level of F-max.

h) Stock-recruitment relationship

The EEC has requested that the stock-recruitment relationship be analyzed, taking into account environmental factors (sea temperature). Data on year-class strength since 1947 indicate two clearly distinct periods of recruitment: the 1947-63 period of high recruitment (average of 280 million fish at age 3) and the 1964-80 period of relatively low recruitment (average of 75 million fish at age 3). Because estimates of spawning stock biomass are available only since 1962, it has been possible to analyze the stock-recruitment relationship only for the period of low recruitment. The 1969-72 year-classess were excluded from the analysis because low water temperature is known to have been the primary factor in determining year-class strength in these years. Also, the 1973 year-class was excluded because it was mainly of East Greenland origin. For the remaining years

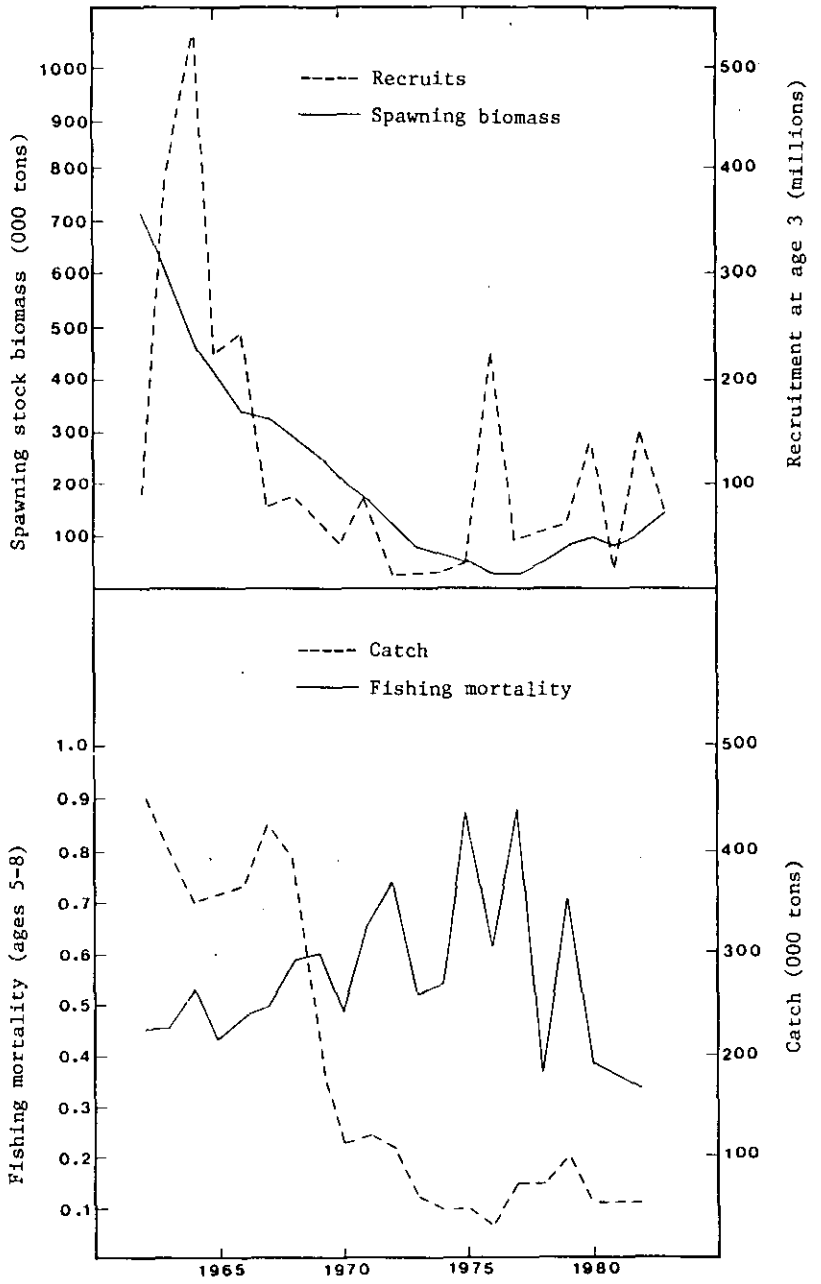

Fig. 2. Subarea 1 cod: trends in spawning stock biomass (SSB), recruitment, fishing mortality and catch, 1962-82.

of the low-recruitment period (i.e. 1964-68 and 1974-80), the relation between spawning stock biomass and recruitment is shown by the solid line in Fig. 5. The curve, with a correlation coefficient of 0.84, indicates maximum production at a SSB-level of 175,000 tons. However, inclusion of the only two data points for the good-recruitment period (1962 and 1963) changes the curve to give maximum recruitment at a SSB-level of about 325,000 tons (correlation coefficient, 0.67). The change in the curve by the inclusion of the two data points indicates that the SSB-level would be even higher if data points for the high-recruitment period were available. The Committee therefore suggests that the SSB-level of 175,000 tons could serve as a preliminary minimum level for management purposes pending further analysis.

i) Interrelationship of cod and shrimp stocks

The EEC has requested that the possible effects of an increased stock of cod on that of shrimp be examined. Although cod is known to prey on shrimp, the question of the effects of increased abundance of cod on the shrimp stock is much more complicated than merely the interaction

Table 3. Subarea 1 cod: projection of spawning stock biomass (SSB) at the beginning of each year and catch during the year for various levels of fishing mortality (F) and for a constant catch of 62,000 tons.

Year	Parameter	Constant catch	Fishing mortality in 1984-86 = $F_{0.1}$	F_{max}	F_{81}	$1.25 \times F_{81}$	0.6
1983	SSB (000 tons)	137	137	137	137	137	137
	Fishing mortality	0.294	0.294	0.294	0.294	0.294	0.294
	Catch (000 tons)	62	62	62	62	62	62
1984	SSB (000 tons)	157	157	157	157	157	157
	Fishing mortality	0.240	0.184	0.348	0.363	0.454	0.600
	Catch (000 tons)	62	49	86	89	107	133
1985	SSB (000 tons)	194	204	174	172	158	137
	Fishing mortality	0.236	0.184	0.348	0.363	0.454	0.600
	Catch (000 tons)	62	52	80	81	91	100
1986	SSB (000 tons)	226	250	184	179	151	116
	Fishing mortality	0.204	0.184	0.348	0.363	0.454	0.600
	Catch (000 tons)	62	61	86	88	94	100
1987	SSB (000 tons)	247	275	180	174	139	98

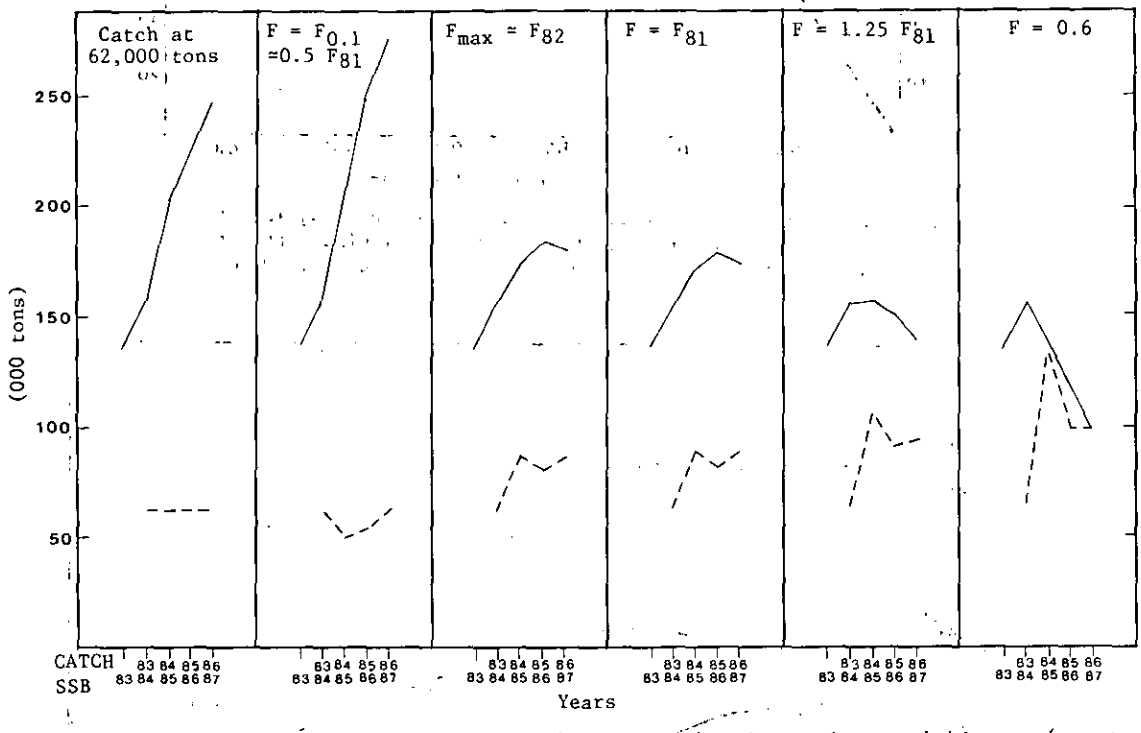

Fig. 3. Subarea 1 cod: projected catches (lower curve) and spawning stock biomass (upper curve) by various fishing strategies and assuming a catch of 62,000 tons in 1983. (Spawning stock biomass as on 1 January of the years indicated in the bottom row.)

between these two species. For instance, Greenland halibut is known to be an important (probably the most important) predator on shrimp, and the stock of Greenland halibut may be directly influenced by changes in the cod stock due to cod feeding on larvae of Greenland halibut. Also, the stocks of cod and Greenland halibut may fluctuate differently due to different reactions to environmental conditions. The Committee noted that, although cod are at present nearly absent from the shrimp grounds in Div. 1A and 1B, shrimp were found in commercially-fishable quantities on the offshore grounds in Div. 1A, 1B and 1C at the beginning of the 1960's when cod had a more northerly distribution than at present. Therefore, the question of cod-shrimp interaction was considered to be less critical at present than in preceding periods. The Committee further noted that very thorough studies of the whole ecosystem are necessary to allow incorporation of species interaction into management advice.

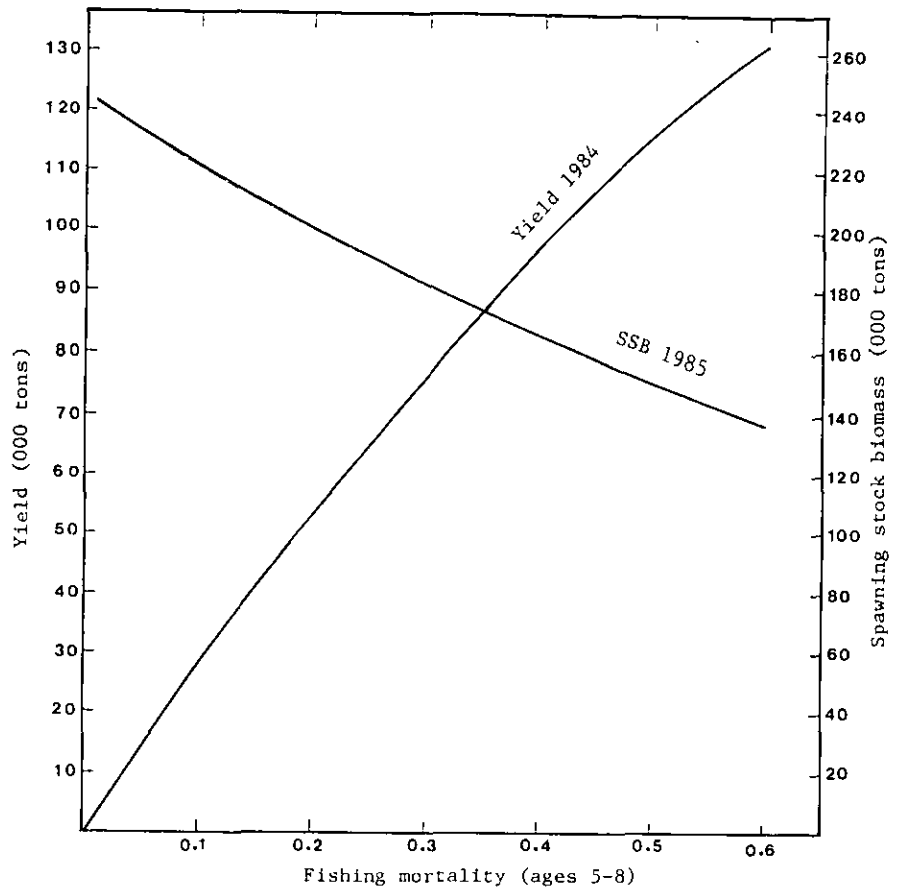

Fig. 4. Subarea 1 cod: estimated yield in 1984 and spawning stock biomass in January 1985 for a range of fishing mortality (ages 5-8) in 1984, assuming a 1983 catch of 62,000 tons.

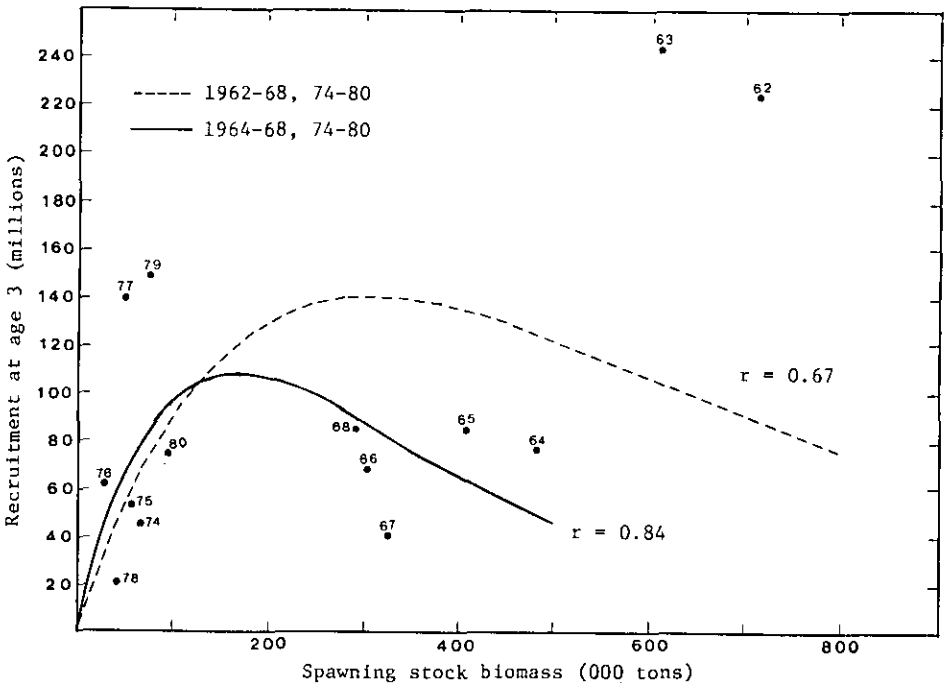

Fig. 5. Subarea 1 cod: relationships of recruitment and spawning stock biomass, 1962-80.

2. Cod in Divisions 2J, 3K and 3L (SCR Doc. 83/VI/54, 63)

a) Fishery trends

Since the mid-1960's, nominal catches have ranged from a high of 800,000 tons in 1968 to a low of 139,000 tons in 1978. The overall catch in 1982 was the highest since 1975, and the catch by inshore gears was at its highest level since the mid-1960's, accounting for approximately 50% of the total. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	554	300	160	135	180	180	200	237	260
Catch (000 tons)	288	214	173	139	167	176	171	228[1]	

[1] Provisional data.

b) Abundance

Trawl surveys conducted by Canada showed a modest increase in abundance from 1981 to 1982 in Div. 2J and 3L with little or no change in Div. 3K. There was a slight decline in biomass estimates for Div. 2J but no change for Div. 3K and 3L. From trawl surveys conducted by Federal Republic of Germany in Div. 2J, estimates of population number and biomass in 1982 were lower than those for 1981 but higher than those in 1980.

An abundance index, derived from catch and effort data for Canadian, Portuguese and Spanish otter trawlers since about 1960, showed a decline from the late 1960's to the mid-1970's and an increase in subsequent years. The 1982 value is about the same as that for 1970.

c) Assessment parameters and results

Length and age samples of commercial catches were used to estimate the age composition, mean length and mean weight-at-age of removals in 1982. The dominant year-classes in the catch were those of 1973, 1974, 1975, and 1978. The same year-classes appeared strong in data from research surveys carried out by Canada, Federal Republic of Germany, France and USSR. Mean weight-at-age values for 1982 were similar to those for 1981 but lower than those for 1980.

Virtual population analyses (VPA) with M = 0.20 were performed for a range of fishing mortality values in 1982. Relationships between the catch-rate index and mid-year exploitable biomass gave the best agreement, with a fishing mortality estimate of 0.225 for 1982. Partial recruitment estimates for 1982 were obtained by averaging the selectivity coefficients for the 1975-80 period.

Regressions between the number of age 4+, 5+ and 6+ fish per standard set from Canadian surveys and population numbers at ages 5+, 6+ and 7+ fish in the following year from the VPA at F = 0.225 in 1982 were significant for the 1977/78-1981/82 period. However, ages 5+ and 6+ population numbers projected by the VPA for 1983 were substantially higher than would have been predicted from the abundance of ages 4+ and 5+ fish in the 1982 surveys. This appears to be due to underestimation of the abundance of ages 4 and 5 fish from the Canadian surveys in 1982 relative to the abundance of these age-groups in earlier years. These age-groups were well represented in the survey by Federal Republic of Germany in the autumn of 1982.

Examination of the abundance estimate for the 1978 year-class from the survey results indicated that the estimated size of this year-class from the VPA may be too high. Selectivity coefficients for recent years showed that partial recruitment at age 4 was generally higher in years when a strong year-class was available. Due to these considerations, the partial recruitment at age 4 in 1982 was replaced by the highest value observed in the 1975-80 period. Recruitment at age 4 in 1983 and 1984 was taken as the long-term geometric mean of 1962-81 values (400 million fish). The mean weights-at-age used in the projections are averages of values derived for 1981 and 1982. Some of the basic parameters used to project spawning stock biomass and catches are given in Table 4.

Under the assumption that the 1983 TAC (260,000 tons) will be fully utilized, catches in 1984 and spawning stock biomass at the beginning of 1985 were projected for three levels of fishing mortality (Table 5). This range of fishing mortality is consistent with the strategy to rebuild the spawning stock biomass faster than that associated with fishing at the $F_{0.1}$ level, the target spawning stock biomass being in the range of 1.2-1.8 million tons (ICNAF Redbook, 1977, page 54).

The TAC of 237,000 tons set for 1982 was previously projected to be associated with fishing at a level of F = 0.19 (NAFO Sci. Coun. Rep., 1982, p. 81). However, it is now estimated that the actual catch of 228,000 tons corresponds to fishing at F = 0.225 and that the catch would have been 195,000 tons at F = 0.19. The discrepancy is, therefore, the difference between 195,000 and

237,000 tons. Half of this discrepancy is accounted for by the decrease in average weight-at-age values used and the remainder by the higher fishing mortality in 1982, estimated in the present assessment.

Table 4. Divisions 2J+3KL cod: parameters used for projections of catch and stock size.

Age (yr)	Millions of cod (1982) Population	Catch	Mean wt. (kg)	Partial recruitment
4	550.0	32.7	0.80	0.20
5	209.5	18.7	1.18	0.46
6	109.4	14.3	1.70	0.69
7	165.7	25.1	2.16	0.81
8	91.1	16.7	2.77	1.00
9	64.4	11.8	3.46	1.00
10	10.4	1.9	4.74	1.00
11	1.6	0.3	6.29	1.00
12	1.1	0.2	7.16	1.00
13	0.5	0.1	7.77	1.00

Table 5. Divisions 2J+3KL cod: projection of catch and spawning stock biomass (000 tons) at three levels of fishing mortality in 1984. (Spawning biomass refers to age 7+ fish at the beginning of the indicated years.)

1982			1983			1984			1985
Spawning biomass	F	Catch	Spawning biomass	F	Catch	Spawning biomass	F	Catch	Spawning Biomass
810	0.225	228	943	0.226	260	1,034	0.10	138	1,489
							0.16	216	1,414
							0.20($F_{0.1}$)	266	1,366

3. Cod in Division 3M (SCR Doc. 83/VI/20, 29, 42, 64)

a) Fishery trends

Nominal catches from this stock declined from a high of 60,000 tons in 1965 to an average level of 24,000 tons durng 1973-77. After an increase to around 30,000 tons in 1978 and 1979, catches have since declined to less than half that level. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	40	40	25	40	40	13	12.7	12.4[1]	12.4[1]
Catch (000 tons)	25	22	27	33	30	11	14	13[2]	

[1] Excludes expected catches by Spain.
[2] Provisional data including catch (4,500 tons) by Spain.

b) Status of the stock

Catch rates for the Norwegian longline fishery declined from 1979 to 1980 but increased in 1981. Length and age samples from the commercial fishery in 1982 showed that the 1977 and 1978 year-classes comprised the major portion of the overall catch. Also, significant numbers of the 1980 year-class appeared in the catches. Average weights-at-age for age-groups 4-8 from commercial sampling increased during 1978-82, due posssibly to decreased density. Average lengths-at-age from research surveys have exhibited increases between the 1949-51, 1964 and 1968 periods, corresponding on a qualitative basis to perceived changes in stock size.

Length frequencies from research surveys by Canada and USSR showed a similar pattern in 1982, with a dominant mode at 21-26 cm and a less dominant mode at 45-48 cm. Abundance estimates from Canadian research surveys in winter, having shown a decline in recent years, increased in 1983, largely due to good recruitment of the 1980 and particularly the 1981 year-classes.

Although there is evidence of good recruitment, the Committee noted that the fishable stock remains in a depleted state, and reiterates the advice given at the June 1982 Meeting (NAFO Sci. Coun. Rep., 1982, page 22) that there should be no exploitation of this stock in 1984. Too early exploitation of the 1980 and 1981 year-classes will reduce considerably their expected contribution to the fishable biomass and subsequently to the spawning stock, and the start of a fishery on these year-classes should therefore be delayed.

4. Cod in Divisions 3N and 3O (SCR Doc. 83/VI/20, 53)

a) Fishery trends

Nominal catches have declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	88	43	30	15	25	26	26	17[1]	17[1]
Catches (000 tons)	44	24	18	15	28	20	24	32[2]	

[1] Excludes expected catch by Spain.
[2] Provisional data including Spanish catch of 14,400 tons.

b) Abundance

Stratified-random surveys have been conducted in the area by Canada since 1971 but there was no coverage of Div. 3O in 1971, 1972 and 1974. The entire area occupied by the stock was not fully covered in all years, particularly the earlier years, and no trend was evident in the biomass estimates for the survey period. Age compositions of catches during the surveys in 1982 indicated that the 1978 year-class continues to be relatively strong and that the 1980 year-class appears to be a good one. From USSR research surveys over the same period, abundance, in terms of catch per hour, showed considerable fluctuation with no consistent trend.

In recent assessments, available catch and effort data for the commercial fishery have been analyzed to produce a single catch-rate index using a multiplicative model, which standardized the catch rates with respect to gear type by country, division and month. The major gear types in the cod fishery of this area are otter trawl and pair trawl, the catch-rate series of which exhibited different seasonal patterns. Because the model assumes that the different catch-rate series have similar seasonal patterns, it was considered inappropriate to combine the two series. In an attempt to obtain a catch-rate index reflective of the total fishery, the two separate series derived from the multiplicative model were combined and averaged over the 1959-75 period after scaling each to its respective mean catch-rate index for the period. The catch-rate index for 1976-82, which was also scaled to the otter trawl catch rate for 1959-75, was derived from the Canadian (Nfld) otter-trawl fleet. However, the previously-stated uncertainties about the catch-rate data for this stock continue to be a problem. These uncertainties include (i) large fluctuation in the catch rates of Spanish pair trawlers in recent years, together with fishing being limited to a much smaller area in 1981 and 1982 than in previous years; (ii) the use of catch-rate data for otter trawlers, which take a very small proportion of the total catch; and (iii) the use in recent years of catch-rate data for Canadian otter trawlers, which take cod mainly as by-catch in the fishery for flounders.

c) Assessment parameters and results

Biological sampling of Canadian otter-trawl and Portuguese gillnet fisheries were used to estimate the age composition and mean weights-at-age of the commercial catches and landings in 1982. No single age-group was dominant in the samples, but it was apparent that the 1974 and 1975 year-classes contributed substantially to the catches. The lower than anticipated abundance of the 1978 year-class may have been due to the lack of adequate sampling data for all gear components in the fishery, particularly the Spanish pair trawl. The 1974 and 1978 year-classes were reported to be dominant in catches sampled on board Spanish pair trawlers in 1982.

Partial recruitment estimates relative to the fishery in 1982 were obtained by averaging selectivity coefficients over the 1974-80 period (excluding 1976), as derived from VPA. These values and the average weight-at-age values from the 1982 commercial fishery are as follows:

Age (years)	3	4	5	6	7	8	9	10	11	12
Partial recruitment	0.08	0.51	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average weight (kg)	0.94	1.17	1.50	2.20	3.83	5.26	7.49	8.80	9.82	12.28

These data were used to update the VPA to obtain estimates of population numbers and biomass for 1982.

Estimates of fishing mortality (F) in 1982 were obtained from regressions of exploitable biomass from VPA on the catch-rate indices for the otter-trawl, the pair-trawl and the combined (otter-trawl and pair-trawl) series. From these regressions, estimates of F in 1982 ranged from 0.15 to 0.40. Additional efforts to correct for inconsistencies in the catch-rate series, as noted in (b) above, did not produce significant changes in these estimates. Estimates of F were also obtained from regressions of population numbers and biomass from VPA on corresponding numbers and biomass derived from surveys during the 1975-82 period. Depending on the input variables, best agreements were obtained with F ranging from 0.25 to 0.50 in 1982. Despite the wide range of estimates, the Committee concluded that F in 1982 was not less than 0.20 and agreed that a value of 0.25 was the best estimate for use in the projections.

Recruitment at age 3 was taken to be 25 million fish in 1983, based on recent survey results, and was assumed to be 35 million in 1984, being the geometric mean of VPA estimates for the 1972-80 period. Recruitment at age 3 in 1981 (1978 year-class) from the VPA calculations was considered to be low (17 million fish) in the light of the survey results, and a value of 35 million was assumed for the projections.

Population numbers at age from the VPA with F = 0.25, together with recruitment at age 3 and the parameters given in Table 6, were used to project mid-year biomass (age 3+) in 1984. The catch in 1983 was assumed to be 26,000 tons, and $F_{0.1}$ = 0.18 was used as the fishing mortality in 1984. The mid-year biomass (age 3+) in 1984 is projected to be approximately 198,000 tons.

Table 6. Divisions 3NO cod: parameters used for projections of catch and stock size.

Age (yr)	1982 numbers (000's) Population	Catch	Mean wt. (kg)	Partial recruitment
3	25,000	33	0.92	0.08
4	28,200	1,513	1.22	0.51
5	9,627	1,694	1.67	0.86
6	6,537	1,316	2.44	1.00
7	9,249	1,862	3.69	1.00
8	8,464	1,704	5.30	1.00
9	2,931	590	7.31	1.00
10	854	172	8.95	1.00
11	392	79	9.42	1.00
12	84	17	11.22	1.00

d) Conclusions

Recent assessments have indicated that this stock has been in a depressed condition but showed signs of improvement, and a cautious approach to exploitation was recommended to permit rebuilding. The present assessment indicates continued improvement in the condition of the stock, in terms of biomass and catch-rate levels, but uncertainties about these parameters, particularly the catch-rate information, still exist. In 1982, the Fisheries Commission decided that the TAC for this stock would not be increased until the annual mean biomass (age 3+ fish) reached 200,000 tons.

Although the level of 200,000 tons lies within the upper part of the range of biomass (age 3+) estimates from the present assessment, this level would be exceeded only with optimistic assumptions concerning recruitment. The Committee therefore concludes that there is not yet convincing evidence that the annual mean biomass (age 3+) will exceed 200,000 tons in 1984.

The projected yield at $F_{0.1}$ associated with the higher levels of estimated biomass, is approximately 26,000 tons, and, as such, no loss in yield would be expected even if this approach is considered conservative.

5. Redfish in Subarea 1 (SCS Doc. 83/VI/6)

a) Fishery trends

Nominal catches have fluctuated greatly since 1950, increasing from 150 tons in 1951 to a maximum of 61,000 tons in 1962, generally decreasing to a low level of about 3,000 tons in 1971-74, and increasing thereafter to a level of about 7,000 tons in 1980-82. There is an indication that catches in 1977, 1978 and 1979 were overestimated in the official statistics. Recent catches are as follows:

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Catch (000 tons)	3	9	14	31	8	9	8	6	8[1]

[1] Provisional data.

b) Assessment

The *Sebastes marinus* stock was assessed at the June 1979 Meeting of ICNAF's Standing Committee on Research and Statistics (ICNAF Redbook, 1979, page 74). Further assessment has not been possible due to the lack of sufficiently good fishing effort data for recent years. The 1979 assessment, based on a general production model analysis, indicated a MSY (maximum sustainable yield) level of about 10,000 tons and an equilibrium catch at 2/3 F(MSY) of about 9,000 tons. However, the correlation coefficient for the regression of catch-per-unit effort on fishing effort (r = 0.63) indicated that catch levels derived from the model have fairly large variances.

c) Biological studies

Length compositions from a French groundfish survey in June 1982, mainly in Div. 1C and 1D, indicate a distinct bimodal distribution of *S. marinus* catches. The first modal group at 8-10 cm was dominant mainly at depths greater than 200 m and corresponds with the length composition of redfish by-catches in the shrimp fishery. These by-catches have until now been thought to consist mainly of *S. mentella*. Because of the difficulty in separating the two species in samples of small redfish, further studies of this problem are required. The second mode at about 30 cm is at the lower end of the size range of marketable redfish in commercial catches.

The Joint NAFO/ICES Study Group on Biological Relationships of the West Greenland and Irminger Sea Redfish Stocks (SCS Doc. 83/VI/6) concluded that there are no direct observations of spawning redfish in the West Greenland area. The slow southward migration of young *S. mentella*, as indicated by an increase in length from north to south in the shrimp fishing area, and the presence of adult *S. mentella* in the southern divisions of Subarea 1 lead to the conclusion that adult females of this species leave the West Greenland area to release their larvae. Similar observations from the commercial fishery, together with information from tagging experiments, indicate that the same conclusion might be valid for *S. marinus*.

The question of the origin of young redfish at West Greenland cannot be answered at present from direct observations of larval and young fish drift. The species composition of the small redfish which have been observed along the West Greenland coast is not known. Because there are no known redfish spawning grounds in West Greenland waters, the interim conclusion is that *S. marinus* fry originate from spawning outside the West Greenland region, very likely in the Irminger Sea. This conclusion is supported by the current system existing in the Irminger Sea and off West Greenland. It should be noted, however, that the evidence on which these conclusions are based is of an indirect nature and, therefore, is not very strong.

6. Redfish in Division 3M (SCR Doc. 83/VI/33)

a) Fishery trends

Nominal catches increased from 700 tons in 1967 to 42,000 tons in 1972 and then declined to values between 13,000 and 20,000 tons since 1975 under quota regulations. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	16	16	16	16	20	20	20	20	20
Catch (000 tons)	16	17	20	17	20	16	14	15[1]	

[1] Provisional data.

b) Abundance

The few length frequencies available from the commercial fishery indicated that a major portion of the 1982 catch consisted of 27-32 cm fish, which represent the relatively successful year-classes of the early 1970's. Fish of these year-classes were also shown to be abundant from research surveys. Although recruitment to the stock was poor during the latter half of the 1970's, recent survey results indicate that the 1980 and 1981 year-classes are relatively strong.

c) Assessment

Because of a change in fleet composition in the early 1970's and a lack of fishing effort data for much of the 1960's, recent assessments have incorporated data only from 1972 onwards. That practice has been continued in this assessment. Standardized catch rates (from the multiplicative model) have increased since 1978, reflecting the recruitment of the successful year-classes of the early 1970's to the fishery. The time series of data is too short to carry out a general production model analysis of this stock.

The Committee recognized the difficulties in carrying out a proper assessment of this stock due to very inadequate data. Although the catch rate for 1981 was the highest of the available time series, some concern was expressed about the poor recruitment to the stock during the latter half of the 1970's. Because the apparently successful 1980 and 1981 year-classes will not recruit to the fishery until the latter half of the 1980's, the catch rate is expected to decline before then as the year-classes of the early 1970's pass through the fishery. The Committee, while noting the importance of obtaining reliable catch and effort data in the ensuing years, advises that the TAC for 1984 remain at 20,000 tons.

7. Redfish in Divisions 3L and 3N (SCR Doc. 83/VI/36; SCS Doc. 83/VI/16)

a) Fishery trends

Nominal catches fluctuated greatly prior to 1974 but have stabilized somewhat since then under quota regulations. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	20	20	16	16	18	25	25	25	25
Catch (000 tons)	18	21	17	12	14	16	24	21[1]	

[1] Provisional data.

b) Abundance

Length frequencies of commercial catches in Div. 3L show a wide range of sizes, whereas smaller fish are generally caught in Div. 3N due to the difficulty of fishing in depths greater than about 350 m on account of rough bottom. Length frequencies from a USSR research survey in 1982 indicated the dominance of fish around 30 cm in Div. 3L and 23-25 cm in Div. 3N. Small redfish (<16 cm) constituted 7% and 16% of the samples from Div. 3L and 3N respectively.

c) Assessment

Catch and effort data for 1959-82 (standardized by the multiplicative model) were examined with a view to undertaking a general production model assessment of the stock, but this was not possible because the regression of catch-per-unit-effort on fishing effort was not significant. Catch rates have increased since 1978, due partially to recruitment to the fishery of the relatively strong year-classes of the early 1970's. However, the TACs have generally not been achieved in recent years for economic reasons, and the effect that this may have had on catch rates is unknown. Taking account of inadequacies in the data base, the Committee considered that this stock is not being overexploited in view of the wide range of length-groups present in samples of commercial catches, and therefore advises that the TAC for 1984 remain at 25,000 tons.

8. Silver Hake in Divisions 4V, 4W and 4X (SCR Doc. 83/VI/10, 43, 44, 59)

a) Fishery trends

The fishery on this stock began in 1958, and nominal catches fluctuated greatly during the 1960's (1,000-123,000 tons), with the peak catch in 1963. During the early to mid-1970's, catches varied from 96,000 to 299,000 tons, with the peak catch in 1973. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	120	100	70	80	70	90	80	80	80
Catch (000 tons)	116	97	37	48	52	45	41	60[1]	

[1] Provisional data.

b) Abundance

A review of the monthly distributions of USSR catch and effort data for silver hake and other species indicated that catch rates for silver hake in 1982 were twice as large as any reported since 1970. These high catch rates were related to the prevalence on the shelf slope of lower-than-normal water temperatures which restricted the movement of silver hake and made them more available to the gear. Consequently, most countries had taken their 1982 allocations by the end of July, a month earlier than in recent years.

c) Assessment parameters

Catch composition. The age compositions of catches in 1970-80 were the same as those used in previous assessments (SCR Doc. 81/VI/74). Removals by age-group in 1981 were adjusted to the final reported nominal catch for that year.

The discrepancies noted between Canadian and USSR estimates of age composition of removals in 1981 (SCR Doc. 82/VI/13, 14, 65) were also apparent in the age compositions of removals in 1982. The recent exchange of ageing material between Canadian and USSR scientists resulted in 75% agreement for the age readings. Consequently, there remains no satisfactory explanation for the observed discrepancies in the 1981 and 1982 age compositions.

Partial recruitment. The values used in the assessment (Table 7) were derived from a catch curve based on numbers caught per unit of fishing effort for the 1977-81 period. Full recruitment occurs at age 3, which is in agreement with the assessment in 1981 (SCR Doc. 81/VI/65).

Table 7. Silver hake in Div. 4VWX: parameters used for projections of catch and stock size.

Age (yr)	1982 numbers (000's) Population	Catch	Mean wt. (kg)	Partial recruitment
1	1,797,558	10,337	0.051	0.03
2	1,015,701	50,825	0.140	0.25
3	358,299	65,866	0.202	1.00
4	354,328	65,136	0.263	1.00
5	186,056	34,202	0.322	1.00
6	47,749	8,778	0.387	1.00
7	14,927	2,744	0.522	1.00
8	5,600	1,029	0.638	1.00
9	677	124	0.844	1.00
10+	37	7	0.923	1.00

Recruitment. Reliable estimates of recruitment continue to be difficult to determine for this stock. However, data from research vessel surveys and sampling of commercial catches indicate that the 1981 year-class is a good one and will be the major support for the fishery in 1984. This year-class was estimated from VPA to be the second largest and from research surveys to be the largest of the year-classes during the 1970-82 period. Abundance indices for juvenile silver hake from USSR-Canada cooperative surveys were used to provide an indicator of the relative magnitude of the 1981 year-class. From these data, the 1981 year-class was assumed to be similar in size to the 1978 year-class. The 1981 year-class size from VPA was adjusted by the average ratio of estimated population numbers divided by the reported yearly abundance indices for the 1978 and 1979 year-classes. This adjustment decreased the estimated 1981 year-class size in VPA from 3.15 billion to 1.80 billion fish.

Recruitment of the 1982 and 1983 year-classes was assumed to be equal to the geometric mean of the VPA estimates for the 1969-80 year-classes at age 1 (i.e. 1.47 billion fish). These assumed estimates of the sizes of the 1981, 1982 and 1983 year-classes at age 1, together with the VPA estimate of the size of the 1980 year-class at age 2 (1.02 billion fish), were used to project population size and catch in 1984.

Fishing mortality in 1982. The Committee considered methods of validating the VPA results by using catch-effort data for 1970-82 (standardized by the multiplicative model). However, the commercial catch rates observed in 1982 were influenced by the abnormally-low water temperatures on the Scotian Shelf. Furthermore, the catch rates for the periods before and after 1977 are not comparable because of the regulations imposed since 1977. Therefore, it was agreed to consider the results from Canadian research surveys as a means of validating the VPA. The best relationship between age 3+ numbers from VPA and 3-year running means of age 3+ numbers from the survey data was obtained with F = 0.25 in 1982.

Mean weight-at-age data. Values used in the projections are averages of weight-at-age data for 1977-82.

d) Assessment results

The recruitment estimates noted above, together with the parameters given in Table 7, were used to project stock size and catch in 1984, under the assumption that the 1983 TAC of 80,000 tons will be fully taken. If the TAC set for 1981 is fully utilized and if fishing is conducted at the level of $F_{0.1}$ = 0.418 in 1984, the projected yield is 100,000 tons (Table 8). STACFIS therefore advises that the TAC associated with fishing at $F_{0.1}$ in 1984 is 100,000 tons.

Table 8. Silver hake in Div. 4VWX: projection of catch and stock size.

Year	Population		Catch		Fishing mortality (ages 3+)
	Number (millions)	Biomass (000 tons)	Number (millions)	Weight (000 tons)	
1982	3,781	490	239	55	0.250
1983	3,801	539	354	80	0.325
1984	3,723	542	464	100	0.418

It the actual catch in 1983 is lower than the TAC, the catch associated with fishing at $F_{0.1}$ in 1984 would obviously be somewhat higher. It is pointed out, however, that the projected catch for 1984 is subject to some uncertainty, due particularly to the input of assumed recruitment values which determine the major part of the calculated yield, and hence further adjustment in the TAC advice for 1984 is not justifiable.

The Committee, noting that work on pre-recruit surveys is ongoing, stresses the importance of this work to improvement of silver hake assessments and encourages its continuation and the presentation of detailed analyses of results as soon as possible.

9. American Plaice in Division 3M

This stock has been regulated since 1974, and nominal catches have ranged from 600 to 2,000 tons. The TAC has been set at 2,000 tons except in 1978 when it was 4,000 tons. Apparently, the reported catches are almost exclusively by-catches in the cod and redfish fisheries. Although recent research surveys indicate the possibility of good recruitment, there is, however, insufficient evidence to warrant changing the TAC. STACFIS therefore advises that the TAC remain at 2,000 tons for 1984.

10. American Plaice in Divisions 3L, 3N and 3O (SCR Doc. 83/VI/27, 58)

a) Fishery trends

Nominal catches reached a level of 94,000 tons in 1967 but have not exceeded 53,000 tons since TAC regulation was introduced in 1973. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	60	47	47	47	47	47	55	55	55
Catch (000 tons)	43	52	44	50	49	49	50	51[1]	

[1] Provisional data.

b) Abundance

Catch rates by Canadian otter trawlers fishing in Div. 3L and 3N increased from 0.41 to 0.60 tons per hour during 1977-80 and declined slightly to 0.57 and 0.56 tons per hour in 1981 and 1982 respectively. Canadian research surveys in spring and autumn of 1981 and 1982 indicated little change in population abundance.

c) Assessment parameters

Catch composition. Age composition and mean weight-at-age data for Div. 3L and 3N were derived from sampling the catches of Canadian trawlers in 1982. The age structure of catches in 1982 was similar to that derived for 1981, with both series showing reduced catches of age-groups 6-9 and significantly increased catches of age-groups 11+, relative to observations in 1979 and 1980.

Discarding of undersized (unmarketable) American plaice has been significant, the overall rates for Div. 3LNO being 20-32% during the 1978-82 period (27% in 1982). Because of the shortness of the discard data series relative to the nominal catch-at-age series, the estimates of discarded fish were not applied to the nominal catch-at-age matrix. Therefore, the catch-at-age series used in the VPA represents only the numbers of fish landed and not the actual numbers of fish caught.

Partial recruitment. The values derived in 1982 were the same as those obtained in 1981. Because of a significant reduction in the catches of fish aged 6-9 in 1981-82 relative to those in 1979-80, partial recruitment at these ages in 1982 was considerably lower than the averages for 1979-81, which were used in the projections. Both sets of values are as follows:

Age (years)	6	7	8	9	10	11	12	13+
Partial recruitment (1982)	0.008	0.037	0.123	0.231	0.515	0.750	0.800	1.000
Partial recruitment (1979-81)	0.067	0.194	0.305	0.369	0.502	0.668	0.872	1.000

Fishing mortality. A value of 0.35 was used as the fishing mortality on fully-recruited age-groups in 1982 to initiate the VPA. This value was determined to be the best estimate of terminal F, based on the following: (i) regression of mid-year biomass (ages 8+) from VPA on catch-per-unit-effort for Canadian otter trawlers (tonnage class 5) in Div. 3L and 3N; (ii) regression of fishing mortality (ages 8-18) from VPA on fishing effort; and (iii) regressions of population numbers (ages 8-18) from VPA on abundance estimates (ages 8-18) from Canadian research surveys.

Recruitment. The geometric mean of population numbers (age 6) in 1976-81 from the VPA was used as the estimate of annual recruitment to the fishery in Div. 3L and 3N during 1982-84, this value being 229 million fish.

d) Assessment results

A projection, using 1982 population numbers from VPA with F = 0.35, average weight-at-age and partial recruitment values for 1979-81, and assuming a catch of 49,000 tons in 1983, leads to a catch, equivalent to fishing at $F_{0.1}$ = 0.262 in 1984, of 47,000 tons. This represents the catch in Div. 3L and 3N only. Making allowance for fishing in Div. 3O where catches have averaged 4,200 tons since 1978, STACFIS advises a continuation of the TAC of 55,000 tons in Div. 3LNO for 1984.

11. Witch Flounder in Divisions 3N and 3O (SCR Doc. 83/VI/56)

a) Fishery trends

Nominal catches increased from 4,700 tons in 1969 to a high of 15,000 tons in 1971 and declined to a level of about 3,000 tons since 1978. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC ('000 tons)	10	10	10	10	7	7	5	5	5
Catch ('000 tons)	6	6	6	3	3	3	2	4[1]	

[1] Provisional data.

b) Abundance

Catch rates for Canadian trawlers (tonnage class 5) have increased during 1979-82, but these rates must be interpreted with caution as they are based on very low levels of catch in which witch flounder was the main species. Commercial sampling data indicate a shift in the age composition toward younger fish.

c) Assessment

A general production model analysis, presented at the June 1980 Meeting (SCR Doc. 80/VI/95), indicated an equilibrium catch at 2/3 F(MSY) of 4,000-5,000 tons. Age composition data presented at that time indicated that fishing mortality was near the $F_{0.1}$ level when catches were in the range of 5,000-6,000 tons. These analyses resulted in the advice that the TAC in 1981 should not exceed 5,000 tons. In the absence of any conclusive evidence to indicate a change in the state of the stock, STACFIS advises that the TAC of 5,000 tons, in effect since 1981, remain in effect in 1984.

12. Yellowtail Flounder in Divisions 3L, 3N and 3O (SCR Doc. 83/VI/57)

a) Fishery trends

Nominal catches peaked at 39,000 tons in 1972, declined to 8,000 tons in 1976 and increased to 18,000 tons in 1979. The TACs were not fully utilized in 1980-82, when catches averaged about 13,000 tons. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	35	9	12	15	18	18	21	23	19
Catches (000 tons)	23	8	12	16	18	12	15	12[1]	

[1] Provisional data.

b) Abundance

Catch rates for Canadian trawlers (tonnage class 5) increased steadily from 0.33 to 0.64 tons per hour during 1976-80 and then declined to 0.61 and 0.53 tons per hour in 1981 and 1982 respectively. Data from Canadian research surveys in Div. 3L and 3N have indicated a relatively stable population since 1978, except in 1981, when the apparent slight decline in abundance may be attributable to incomplete survey coverage.

c) Assessment parameters

Catch composition. Length and age compositions and mean weight-at-age data were derived from sampling the catches of Canadian trawlers in 1982. Age-groups 4 and 5 were considerably less abundant in the catches in 1982 than in 1981, whereas the abundance of older fish (age 8+) was noticeably higher in 1982.

Partial recruitment. Values for 1982 were derived from a preliminary VPA and represent the average of fishing mortality rates in 1979 and 1980, standardized to 1.0 for age 8. An adjustment was made to the partial recruitment value for age 4 so that it would give an estimate of recruitment at age 4 in 1982 approximately equal to the geometric mean of population numbers at age 4 in 1977-81 from the VPA (i.e. 110.6 million fish). The partial recruitment values used in the catch projections are as follows:

Age (years)	4	5	6	7	8	9	10
Partial recruitment (1982)	0.003	0.068	0.222	0.628	1.000	1.000	1.000

Fishing mortality. From the regression of stock biomass (ages 4+) from VPA on commercial catch rates and the regression of weighted fishing mortality (age 4+) on fishing effort, the best estimate of fishing mortality in 1982 was judged to be F = 0.40.

Recruitment. The geometric mean of population numbers at age 4 in 1977-81, determied from the VPA with F = 0.40 in 1982, was assumed to represent annual recruitment at age 4 in 1982-84, this value being 110.6 million fish.

d) Assessment results

A projection, using 1982 population numbers from VPA with F = 0.40, partial recruitment and recruitment values indicated above, mean weight-at-age values for 1982, and assuming a catch of 19,000 tons (equal to the TAC) in 1983, leads to a catch, equivalent to fishing at $F_{0.1}$ = 0.52 in 1984, of 17,000 tons. It was noted that a catch of 19,000 tons in 1983 corresponds with fishing at F = 0.56 for fully-recruited age-groups, slightly higher than the $F_{0.1}$ level. It was further noted that the projected catch in 1984 should contain significantly higher numbers of older fish (age 8+) than have been caught in recent years. STACFIS advises that a TAC of 17,000 tons in 1984 corresponds to fishing at the $F_{0.1}$ level.

13. Greenland Halibut in Subareas 0 and 1

a) Fishery trends

Nominal catches peaked at 25,000 tons in 1975 and have been less than 20,000 tons since then. Provisional data for 1982 indicate a catch of 7,000 tons, mostly taken in Subarea 1. There is some

indication that the reported catches for 1977-79 may have been overestimated (SCR Doc. 80/VI/72). Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	-	20	20	20	25	25	25	25	25
Catch (000 tons)	25	16	13	12	19	8	6	7[1]	

[1] Provisional data.

b) Assessment

No new data were available for this stock, the status of which has not been assessed since 1978. Catches have been less than the TAC in all years since it was imposed in 1976. Recent research surveys indicate a large biomass on the slope of the shelf in Div. 0B, but no information is available on the stock size in Subarea 1 where the main fishery is located. In view of the low catches in recent years and lacking adequate data for an assessment, STACFIS advises that the TAC remain at 25,000 tons for 1984.

14. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 82/IX/100, 83/VI/55)

a) Fishery trends

Nominal catches were relatively stable at 25,000-30,000 tons during 1971-76, increased to 39,000 tons in 1978 and subsequently declined to about 26,000 tons in 1982. The fishery was prosecuted in the past mainly by otter trawlers from German Democratic Republic, Poland and USSR. However, in recent years, the fishery was conducted mostly by Canadian fishermen of northeastern Newfoundland, more than half of the total catch being taken by gillnets. The fishery usually occurs in Div. 2J, 3K and 3L, but nearly one-third of the 1982 catch was taken in Div. 2H. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	40	30	30	30	30	35	55[1]	55[1]	55[1]
Catch (000 tons)	29	25	32	39	34	33	31	26[2]	

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

b) Distribution and migration

From available biological and tagging data, the major spawning stock of Greenland halibut is believed to be located in Davis Strait (about 67°N) in depths of 600-1,000 m. After spawning, the larvae drift southward to colonize the banks off Labrador and eastern Newfoundland. As these fish become older, they move into deeper water along the continental slope, and, upon approaching maturity, they migrate northward to the spawning area in Davis Strait. It is for this reason that the catch off Labrador and eastern Newfoundland consist almost entirely of immature fish. It is also believed that these fish, after moving northward to spawn, do not return to the Labrador and Newfoundland areas. The migratory pattern is particularly apparent when recent fishing patterns of the Canadian fleet are considered, involving three year-classes (1972-74) which supported the fishery. Gillnet fishermen of eastern Newfoundland took 72% and 88% of the total catches in 1978 and 1979 respectively. Having grown older and having moved deeper and northward, these year-classes in 1982 were fished by otter trawlers in Div. 2H, and the catch by gillnets decreased to only 53% of the total catch in the southern part of the area.

c) Abundance

Stratified-random trawl surveys in Div. 2J, 3K and 3L indicated a minimum trawlable biomass of about 187,000 tons in 1982, about 20,000 tons higher than the estimate from 1981 surveys. These biomass values are considered to be underestimates because of inadequate survey coverage of deeper areas of the continental slope where the larger fish are located. Surveys conducted in Div. 2G and 2H in 1978, 1979 and 1981 indicate that the stock biomass in these divisions may be nearly as large as that in Div. 2J, 3K and 3L combined.

d) Assessment parameters

Catch composition and weight-at-age. The catch-at-age matrix for 1982 was derived from samples of Canadian landings, which represented the major part of the total catch. Mean weight-at-age values

were derived by applying a length-weight relationship from the most recent data to weighted length-at-age data from the commercial catch in 1982. Age compositions of catches and mean weight-at-age values for 1975-81 were those given in SCR Doc. 82/VI/67, except that the 1981 catch-at-age vector was adjusted to reflect the final reported catch in 1981.

Partial recruitment. Values used for the catch projections were derived by comparing the age compositions of commercial catches and research survey catches in 1982.

Age (yr)	5	6	7	8	9	10	11	12	13	14	15	16	17
Mean weight (g)	547	711	923	1168	1444	1839	2445	3554	4605	5966	7669	8841	11719
Partial recruit.	0.02	0.18	0.45	0.41	0.68	1.00	0.70	0.49	0.52	0.26	0.26	0.26	0.26

The partial recruitment pattern in 1982 was found to be dome-shaped as usual, but the descending right limb was less pronounced than in previous years. This was due to increased fishing activity by Canadian trawlers in the northern part of the stock area on larger fish than were available to the gillnet fishery of eastern Newfoundland.

Fishery mortality. An estimate of recent fishing mortality was derived from the regressions of the 1972-74 cohorts in the research data from 1979-82 surveys in Div. 2J and 3K. Only strata common to all years were used in the analysis. The resultant average value of F was 0.11 for fully recruited age-groups.

e) Assessment results

The strong 1972-74 year-classes were still significant in the 1982 fishery, accounting for 52% of the total catch by number and a higher percentage of the catch by weight. Research survey data indicate that the 1975 and 1976 year-classes, which accounted for 41% of the commercial catch by number, are stronger than average.

The population sizes indicated by the VPA were considered to be very sensitive to small changes in fishing mortality, especially since the F-value used to initiate the VPA was quite small. However, from the available information, fishing mortality was judged to have been below the $F_{0.1}$ level in recent years. Also, in view of the migration and distributional patterns, the biomass values are probably underestimated. Considering the sensitivity associated with some of the assessment parameters, STACFIS advises that the TAC remain at 55,000 tons for 1984 and that this TAC apply only to Div. 2J, 3K and 3L.

STACFIS noted that Canada had implemented an additional TAC of 20,000 tons in Div. 2G and 2H for 1983, and further advises that a catch in the order of 20,000 tons from these divisions in 1984 would not adversely affect the stock, considering recent estimates of biomass and low fishing effort in these divisions.

15. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 83/VI/37)

a) Fishery trends

Nominal catches have varied between 12,000 tons in 1974 and 400 tons in 1981. Provisional data indicate a catch of only 18 tons in 1982. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	10	14	8	8	8	8	8	8	8
Catch (000 tons)	5	9	3	6	7	2	+	+	

b) Assessment

Previous assessments of this stock have consistently indicated a TAC of 8,000 tons. There has been esentially no directed fishery in recent years and the TACs were not fully utilized. In the absence of new data, STACFIS advises that the TAC for 1984 remain at 8,000 tons.

16. Roundnose Grenadier in Subareas 2 and 3 (SCR Doc. 83/VI/28, 37)

a) Fishery trends

Except for a catch of 75,000 tons in 1971, nominal catches ranged from 12,000 to 28,000 tons during 1967-78 and then decreased to 2,000 tons in 1980. Recent TACs and catches are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	32	35	35	35	35	30	27	27	11
Catch (000 tons)	27	21	15	21	8	2	7	4[1]	

[1] Provisional data.

b) By-catches of Greenland halibut

Concern was expressed by USSR scientists that the low catches of roundnose grenadier, particularly in recent years, were due to by-catch constraints at a level of 10% of Greenland halibut in the roundnose grenadier fishery. Data obtained by observers on USSR and German Democratic Republic fishing vessels and from research vessel surveys indicate that this level may be too low. The most productive depths for fishing roundnose grenadier are greater than 1,000 m, where the lowest by-catches of Greenland halibut occur, but the by-catches tend to be higher in the northern divisions. In general, a more realistic level of by-catch of Greenland halibut in the roundnose grenadier fishery would appear to be in excess of 20% with provision for increased by-catches from south to north.

c) Assessment

The low catches of roundnose grenadier relative to the TACs since 1979 have been partially due to limitations in the allowable by-catches of Greenland halibut. The limited amount of new data available indicates that catch rates declined in 1982. STACFIS therefore advises that the preliminary 1983 TAC of 11,000 tons be maintained for 1984.

17. Wolffishes in Subarea 1

a) Fishery trends

Two species of wolffishes, Atlantic wolffish (*Anarhichas lupus*) and spotted wolffish (*A. minor*) occur in the commercial catches. Total catches of both species have been generally in the range of 3,000-6,000 tons since 1957, except for 17,000 tons in 1979. There is some indication that the reported catches for 1977-79 may have been overestimated. Recent catches are as follows:

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Catch (000 tons)	5	6	6	6	6	6	17	5	4	4[1]

[1] Provisional data.

b) Catches by species

Specific statistics have not been provided for the two species separately, but, taking account of the guidelines given at the June 1981 Meeting (NAFO Sci. Coun. Rep., 1981, page 46) leads to the following breakdown of the provisional 1982 catch by species:

Species	Catch (tons)	%
Spotted wolffish	3,007	77
Atlantic wolffish	883	23

About half of the total catch is taken as by-catch in the trawl fishery for cod, and part of the remainder in a directed fishery by small vessels using longlines, mainly in inshore areas of Div. 1C.

c) Assessment

Until more biological data and detailed fishery statistics for the two species become available, it is not possible to carry out firm assessments of these stocks. However, taking into account the available statistical data and information presented earlier (NAFO Sci. Coun. Studies, No. 1, pages 35-40; NAFO Sci. Coun. Rep., 1979-80, pages 85-86), STACFIS advises that a catch in the range of 5,000-6,000 tons seems to be reasonable.

18. Capelin in Subareas 2 and 3 (SCR Doc. 83/VI/11, 46, 47, 49, 49, 50, 52)

a) Fishery trends

Nominal catches of capelin in Subareas 2 and 3 increased from 2,800 tons in 1971 to 366,000 tons in 1975 and declined to 20,000 tons in 1980. Provisional statistics indicate a total catch of 41,000 tons in 1982. No offshore fishing was allowed in Div. 3LNO during 1979-82, and only a small experimental fishery was allowed in Subarea 2 and Div. 3K in 1980-82. Recent TACs and catches are as follows:

Area		1975	1976	1977	1978	1979	1980	1981	1982
2+3K	TAC (000 tons)	160[1]	160[1]	212[1]	212	75	5	10	13
	Catch (000 tons)	199	216	152	55	11	6	12	14[3]
3LNO	TAC (000 tons)	180[2]	180[2]	200[2]	200	10	16	30	30
	Catch (000 tons)	166	144	74	30	12	14	25	27[3]

[1] Countries without allocations could each take up to 10,000 tons.
[2] Countries without allocations could each take up to 5,000 tons.
[3] Preliminary data.

b) Biological studies

A reanalysis of meristic data, using a multivariate generalized distance method which was considered more appropriate for meristic data than the original analysis, confirmed previous findings that the two stocks, the west coast of Newfoundland (Div. 4R) stock and and Southeast Shoal (Div. 3NO) stock, were separate from other stocks. The other groupings tested, the Labrador-Northeast Newfoundland (Div. 2J+3K) stock, the Grand Bank-Avalon (Div. 3L) stock and the St. Pierre-Green Bank (Div. 3P) stock, continued to be problematic. However, analysis conducted only on these three groupings indicated that the three were separate stocks.

Another study analyzed data, on mean lengths of capelin and percentages of females in capelin schools, collected by observers on commercial purse seiners during the 1982 inshore capelin fishery in Div. 3L. The average length of males in schools during June remained similar in samples from Conception and Bonavista Bays. The mean length of females declined while the percentage of females increased in Conception Bay samples during June. In contrast, the mean length of females and the percentage of females in Bonavista Bay samples did not vary throughout June. The trend in Conception Bay samples support earlier observations in this area. Sampling in Conception Bay was in a small part of the Bay while sampling in Bonavista Bay was over the entire Bay. It was suggested that the sampling in Bonavista Bay may have been too coarse to detect trends similar to those observed in Conception Bay and in earlier studies.

c) Subarea 2 and Division 3K

i) Commercial catch-effort analysis

The series of catch rates of USSR BMRT-type trawlers has been considered as a useful index of abundance (ICNAF Redbook 1979, page 34; NAFO Sci. Coun. Rep. 1979-80, page 49; NAFO Sci. Coun. Rep. 1981, page 15; NAFO Sci. Coun. Rep. 1982, page 31), although it was noted that the 1979 and 1980 estimates were for the smaller BMRT class and the previous estimates were for the more powerful BMRT-A class trawlers. Catch rates peaked in 1975 at 6.45 tons per hour fished and declined to 1.34 tons per hour in 1979. The catch rate of 4.57 tons per hour in the 1980 experimental fishery was considered to be an overestimate. The catch rate of BMRT trawlers in the 1982 experimental fishery was 3.19 tons per hour, a decline of approximately 13% from the 1981 level of 3.68 tons per hour. Catch rates for 1972-82 are as follows:

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Catch per hour (tons)	2.81	3.29	4.56	6.47	5.27	4.14	2.29	1.34	4.57	3.68	3.19

The 1982 experimental capelin fishery operated only in Div. 2J, a pattern similar to that observed in 1980 and 1981 but different from the large-scale fishery that operated in the 1970's when catches were reported from Div. 2J and 3K. The catch in 1982 was composed mainly of the 1980 and 1979 year-classes (73% and 20% respectively). The relatively high proportion of 2-year-olds in the catch was similar to the pattern in 1979-81.

As part of the logbook survey of the inshore capelin fishery in Div. 3K, catch-per-unit-effort estimates were derived for the purse-seine fleet. Purse-seine catch rates in Div. 3K were 15 tons per day and 9 tons per set in 1982. No estimates were available from 1981. Discarding of capelin was estimated at 21% of the catches reported in logbooks. No data were collected for the fixed-gear fishery in Div. 3K in 1982. The 1979 year-class accounted for more than 80% of the catch (by numbers) in the 1982 inshore fishery, with the 1978 year-class being next in importance (10%).

ii) Research vessel surveys

A Canadian acoustic survey in Div. 2J and 3K during 1-25 October 1982 did not result in a biomass estimate because of acoustic equipment problems which invalidated the data. Fishable concentrations of capelin were not encountered in most of the area surveyed in Div. 3K. Capelin were detected in Div. 2J and in northern Div. 3K. The area where capelin were encountered was divided into five blocks for the acoustic survey, and an analysis of age composition data indicated that the 1980 and 1981 year-classes comprised over 80% of the fish taken in fishing sets in four of the five blocks. In the fifth and most northerly block, the 1980 year-class predominated (about 70%) with the 1979 year-class (about 22%) next in abundance.

A USSR acoustic survey in Div. 2J and 3K during 14-25 October 1982 indicated that the main capelin concentrations were in Div. 2J. The biomass of capelin resulting from this survey was estimated at 610,000 tons. The 1979 and 1980 year-classes occurred in approximately equal proportions (49% each by number). The age composition was very different from that found during the Canadian survey, although the length compositions from both the Canadian and USSR analyses appeared similar. It was not possible to resolve these differences in age composition.

iii) Capelin recruitment and abiotic variables

An analysis relating capelin recruitment to abiotic variables examined the influence of two possible regulators of year-class strength in beach-spawning capelin: (a) frequency of onshore winds during the period immediately following hatching, and (b) water temperatures experienced subsequent to the onset of larval drift. Onshore winds were examined because of their effect on the beach residence time of larvae and on the physical condition of the larvae at the onset of larval drift, both of which have been demonstrated in published studies. Water temperatures experienced during larval drift were examined because of the known positive relationship between water temperatures and biological production which could influence the quantities of food available to the larvae during drift. Annual estimates of abundance of 2-year-old capelin were from sequential capelin abundance models. Univariate analysis showed that the sign of the correlation coefficient for the relationship between year-class strength and wind was consistently negative whereas that for year-class strength and temperature was consistently positive, both of which are consistent with the demonstrated effect of wind and assumed effect of temperature. The relationship between year-class strength and the two environmental variables was significant ($r^2 = 0.73$). Further examination of the model indicated that July and August, the month of larval capelin emergence in Newfoundland and Labrador, may be the most important months in the temperature series used (July-December). It also appears that the time interval between onshore winds becomes more critical to year-class formation when water temperatures are lower. Predictions of recruitment from the model indicated that the 1979 and 1981 year-classes are very strong and the 1980 year-class is substantially weaker. However, it was noted that the temperature value used in the prediction of the 1981 year-class was outside the range of values used in the initial relationship.

There were several criticisms of the model. The source of the intial estimates of recruitment used in the model was questioned, although the trends of year-class strength used were indicative of the trends in recruitment in the 1970's observed from other sources. It was noted that a series of regressions, each with its own sources of error, could result in substantial error in the estimate of hatching time. Since this parameter is critical to the evaluation of the wind variable, errors in this estimate could affect the model. It was also noted that the 1967 values had not been used to generate the model because the value for temperature was observed to be very high; inclusion of the 1967 data greatly reduced the variance accounted for by the model ($r^2 = 0.33$).

iv) Recruitment estimation and prognosis for 1984

Initial estimates of year-class size were derived from the total number of capelin estimated from the USSR acoustic survey in October 1982 and age composition from the Canadian survey. Equal weight was given to each survey block when calculating age composition from the total Canadian survey. The 1980 year-class was estimated to be substantially lower than that projected from last year's analysis. The size of the 1981 year-class at age 1, estimated by this method, was also very low and less than one-half the estimated size of the 1980

year-class at age 1. The relative sizes disagreed with the trends predicted from the relationship between abiotic variables and year-class strength, in which the 1981 year-class was predicted to be larger than the 1980 year-class and about the same size as the strong 1979 year-class. As a result, the 1981 year-class was set at the same level as the 1979 year-class at age 2 (in the 1981 assessment), and the 1980, 1979 and 1978 year-classes were derived from the USSR acoustic assessment, as noted above.

Estimates of spawning mortality and proportions mature-at-age were from sequential capelin abundance models and were the same as used in previous assessments. The estimated stock sizes in July 1984 (approximate spawning period) and September 1984 are given in Table 9. In these projections, the 1980 and 1981 year-classes account for most of the biomass in both the July and September periods. Evidence for the size of the 1981 year-class was conflicting. Estimates, derived from age compositions from the Canadian and USSR acoustic surveys and applied to the total numbers from the USSR survey, indicated that the 1981 year-class was not abundant. The recruitment-environment model predicted an abundant 1981 year-class. The projections in Table 9 assume the latter and therefore may be optimistic. The Committee emphasized, as it did last year, that the estimates of year-class strength and biomass provided in the projections are subject to potentially large errors. The estimates of year-class size derived from acoustic surveys exhibit large variance. In addition, the values of proportion mature-at-age and spawning mortality, both of which are critical in the projections, probably exhibit large annual variation which cannot be taken into account with the available data. Furthermore, the evidence of the stock size in Div. 2J in the autumn of 1982 is conflicting and could not be resolved. The catch-per-unit-effort data from the experimental fishery indicate a decline in abundance of only about 13%, whereas the acoustic survey results for 1982 indicate that the biomass of age 2+ fish is about half of the biomass estimated from an acoustic survey in 1981. There is no estimate available for the 1982 year-class which could contribute significantly to the catch as 2-year-olds in the autumn of 1984, and, therefore, the projected biomass in September 1984 does not include a biomass estimate of 2-year-olds. The potential errors in the projections infer that extreme caution should be used in advising a TAC for 1984. The Committee also recognized that capelin represent an important source of food for predators, especially cod. The Committee noted that a 10% exploitation level has been advised for capelin in Div. 3L for a number of years, and such a level, if applied to capelin in Div. 2J+3KL, would result in a TAC level of 100,000 tons in the autumn of 1984.

Table 9. Projections of stock size for capelin in Subarea 2 and Div. 3K.

Age (years)	Numbers of fish (millions)		
	Oct 1982	Jun 1984	Sep 1984
1	71,000	-	-
2	21,100	-	-
3	3,300	43,000	36,000
4	3,700	11,200	5,200
5	-	1,000	200
6	-	600	100
Mature biomass (tons)		568,000	
Total biomass (tons)			1,045,000

The Committee emphasizes that considerably more data will be available following the completion of research in 1983. Furthermore, for a relatively short-lived species, such as capelin, the biological advice is likely to be more accurate if it is provided as close to the fishing season as possible. Thus, a meeting in early 1984 to reassess this capelin stock would utilize all of the 1983 data and would probably increase the accuracy of the biological advice.

d) Divisions 3L, 3N and 3O

i) Commercial catch-effort analysis

There was no offshore commercial fishery in these divisions during 1979-82.

A logbook survey of the inshore capelin fishery in Div. 3L, designed to provide estimates of catch-per-unit-effort was initiated in 1981 and expanded in 1982. Data, collected by observers aboard capelin purse seiners and compared to logbook records, indicated that information from purse-seine logbooks was representative of the entire fishing fleet. The return rate of logbook records in 1982 was higher than in 1981, 68% for purse-seine fishermen and 81% for

fixed-gear fishermen. Records were also of higher quality in 1982, due to more experience in completing the logbooks and more emphasis in explaining how the records should be kept. Purse-seine catches per day were higher in 1982 than in 1981 for Conception Bay but was similar for Trinity Bay. The catch rate for traps on the southern Avalon Peninsula was much higher in 1982 than in 1981 but remained lower than the catch rates for Conception and Trinity Bays. Discarding of capelin appeared to be reduced in 1982. Although the by-catch of cod in capelin traps increased in 1982, it represented only 1.4% of the total reported logbook catch for traps. The 1979 year-class accounted for more than 80% of the catch (by numbers) in the 1982 inshore fishery and the 1978 year-class was next in abundance (11%).

ii) Research vessel surveys

A Canadian acoustic survey, conducted in Div. 3LNO during 2-21 April 1982 (SCR Doc. 82/VI/54), provided a capelin biomass estimate of 525,000 tons. Ice cover prevented complete survey coverage of fish concentrations found in the northern and northeastern extremities of the survey area. Substantial concentrations were also found in the nearshore area, but they could not be completely surveyed. The 1979 year-class (55%) and 1980 year-class (33%) dominated in the samples collected during the survey.

A Canadian acoustic survey was also conducted in Div. 3LNO during 17 June-4 July 1982. Small capelin of the 1981 year-class predominated in the southern part of Div. 3L, whereas the 1979 year-class predominated near the Newfoundland coast and in the northern part of Div. 3L. In the latter two areas, the 1980 year-class was next in abundance. The biomass estimate of 217,000 tons in Div. 3L was lower than the June 1981 estimate of 1,680,000 tons and the April 1982 estimate of 525,000 tons. However, the June 1982 survey covered a smaller area than the April 1982 and June 1981 surveys, and this may partially account for the large difference in the estimates.

The capelin biomass on the spawning grounds in Div. 3NO in 1982 was estimated at 446,000 tons, a significant increase over 185,000 tons estimated during a Canadian survey and 109,000 tons estimated during a USSR survey, both in June 1981. The 1979 year-class comprised over 90% of the spawning stock in Div. 3NO in 1982.

iii) Capelin recruitment and abiotic variables

A model using the same environmental variables and taking the same form as the model developed for capelin in Div. 2J+3K was developed for capelin in Div. 3L. The same wind variable was used, based on the assumption that pressure systems generating onshore winds are large enough to synchronously influence water-mass exchange over a large area of Newfoundland's east coast. This assumption seems to be reasonably met on the basis of examination of water temperature data for one year from five capelin spawning sites with a less than 3° latitude range. The use of the same water temperature data assumes that the source of the data (Station 27) reflects the trends in temperature of the Labrador current, the dominant hydrographic influence along the Labrador-Newfoundland coast. Estimates of abundance of capelin as 3-year-olds were from sequential capelin abundance models. The general form of the Div. 3L model was similar to that of Div. 2J+3K model, but the fit was not as good (r^2 = 0.55). The two also differed in the magnitude of the temperature effect and the fact that at no time in the Div. 3L model did temperature override wind.

Survival appeared to be lower and to decline more rapidly at lower temperature values in Div. 3L than in Div. 2J+3K. The differences between the models may have been due to the inferior quality of the Div. 3L recruitment data and the fact that the slopes of both the wind and temperature relationships in the Div. 3L model were not significantly different from zero. Predictions of recruitment for the 1979, 1980 and 1981 year-classes from the Div. 3L model yielded the same trends as the Div. 2J+3K model, but there is much less confidence in the Div. 3L predictions because of the poorer fit of the data. The criticisms of the Div. 3L model were the same as those for the Div. 2J+3K model listed previously.

iv) Recruitment estimation and prognosis for 1982 and 1983

Stock size projections for capelin in Div. 3L were made by using estimates of year-class size derived from acoustic surveys. The estimate of the 1981 year-class was derived from the June 1982 Canadian survey and the estimate of the 1980 year-class was derived from three sources: the Canadian and USSR surveys conducted in June 1981, and the Canadian survey conducted in April 1982. The size of the 1979 year-class (age 5 in 1984) was assigned on the basis of the proportions of this year-class expected in the mature portion of the stock in 1984. Five-year-olds have comprised from 2% to 17% of the mature portion of the stock in Div. 3L in recent years, and it was assumed that the 1979 year-class would comprise about 9% of the mature portion of the stock in 1984. Projections based on these estimates are given in Table 10.

Table 10. Projections of stock size for capelin in Div. 3L, 3N and 3O.

Age (years)	Numbers of fish (millions)			
	Jun 1982	Jan 1983	Jan 1984	Jun 1984
1	27,600	-	-	-
2	21,500	23,200	-	-
3	-	18,500	17,200	15,100
4	-	-	8,900	7,800
5	-	-	-	1,400
Mature biomass (tons)				384,000

The estimates of the size of the 1980 and 1981 year-classes were derived from acoustic surveys and therefore exhibit large variances. In addition, the estimates of the size of the mature portions of stock in June 1984 are dependent on the estimates of the age-specific proportion of mature capelin and the age-specific mortalities, both of which probably exhibit significant annual variation. It was also recognized that capelin represent an important source of food for predators, especially cod. In view of these factors, STACFIS advises that an exploitation rate of 10% should be maintained in 1984, resulting in a TAC of 38,000 tons for capelin in Div. 3L.

No stock projections were made for capelin in Div. 3NO in 1983 because no estimates of year-class size were available. The estimates of stock size for 1982 were 2-4 times higher than those for 1981. This increase in biomass in 1982 was due to the strong 1979 year-class which will be 5 years old in 1984 and will probably comprise a relatively small proportion of the spawning stock. Even with the presence of this strong year-class, the estimate of the stock size for 1982 was below acoustic estimates of this stock during the mid-1970's. If the 1980 and 1981 year-classes of capelin follow the pattern of other areas, some decline in this stock would be expected in 1984. Due to uncertainty about year-class strength and the fact that the biomass is still below historical levels, STACFIS advises that there should be no fishery for capelin in Div. 3N and 3O during 1984.

The Committee reiterates its concern regarding the accuracy of its advice in relation to the timing of the scientific meeting to assess the stock. Although an estimate of the size of the 1982 year-class is not important to projections of 1984 stock size in Div. 3LNO because 2-year-olds are considered to be immature, the estimates of the 1980 and 1981 year-classes are of critical importance to stock size projections in 1984. Results of research conducted in 1983, including more precise estimates of those year-classes, would be available in early 1984, and reconsideration of the status of the stock at that time would probably result in more accurate projections of stock size for 1984.

19. Squid-*Illex* in Subareas 2 to 6 (SCR Doc. 83/VI/10, 21, 25, 32, 38, 39, 40; SCS Doc. 83/VI/11, 12)

a) Fishery trends

Nominal catches of *Illex* in Subareas 2 to 4 increased rapidly from an annual average of 4,500 tons in 1970-74 to a peak of 162,000 tons in 1979 and have declined continually since then. Recent TACS and catches are as follows:

Subarea 2-4	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC (000 tons)	25[1]	25[1]	25[1]	100	120	150	150	150	...
Catch (000 tons)	18	42	83	93	162	70	30	13[2]	

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

In Subarea 3, the inshore catch at Newfoundland was only 11,100 tons in 1982, a 28% decrease from that of 1981 and 68% below that of 1980. The French inshore fishery around St. Pierre and Miquelon accounted for a catch of only 34 tons in 1982, fishing being restricted to the week of 19-25 July due to low availability of *Illex*. French offshore catches were taken only as by-catch in the cod fishery and totalled only 34 tons, the lowest catch since the offshore squid fishery began in 1977.

In Subarea 4, catches in both inshore and offshore areas declined significantly, the overall decrease from 1981 to 1982 being 88% (Table 11). This decline was attributed to lower availability

of *Illex* in 1982 and a consequent reduction in fishing effort directed toward squid. In northern Newfoundland, the decline was less pronounced than that observed in other inshore areas of Subareas 3 and 4.

In Subareas 5 and 6, the international offshore fishery began in 1972, with catches increasing to about 25,000 tons in 1976 and 1977 followed by a decline in subsequent years to an annual average of about 17,000 tons (Table 11). Offshore catches declined from about 15,000 tons in 1981 to 13,000 tons in 1982, while the inshore catch was a record 5,000 tons in 1982. The increase in the inshore catch was due in part to increased markets and joint ventures with other nations but also reflected higher availability than normal to the inshore fishery.

Table 11. Nominal catches of short-finned squid in Subareas 2, 3 and 4 and in Subareas 5+6, 1972-82.

Year	SA 2	SA 3	SA 4	Total SA 2-4	SA 5+6
1972	-	26	1,842	1,868	17,641
1973	2	620	9,255	9,877	19,155
1974	31	17	389	437	20,628
1975	-	3,751	13,993	17,744	17,926
1976	-	11,257	30,510	41,767	24,936
1977	6	32,748	50,726	83,480	24,883
1978	-	40,697	51,987	92,684	17,695
1979	1	88,832	73,259	162,092	17,522
1980	1	34,779	34,826	69,606	17,878
1981	-	15,524	14,142	29,666	15,354
1982[1]	-	11,133	1,635	12,768	18,000

[1] Provisional data.

b) Abundance indices

Minimum trawlable abundance and relative abundance estimates are available from French and USA (preliminary data) surveys in Div. 4VWX and Subareas 5 and 6 respectively. These estimates indicate a significant decline in abundance from 1981 to 1982 (Table 12). The minimum abundance estimates in September from the French surveys in Div. 4VWX showed a decline from 222 million squid in 1981 to 54 million in 1982). This decline in abundance was associated primarily with decline in abundance of small (<13 cm) and large (>18 cm) squid, whereas the abundance of intermediate sizes (13-18 cm) was the highest of the time series. USA relative abundance (mean numbers per two) for Subareas 5 and 6 in September-October declined from a record high of 54.8 in 1981 to 4.3 in 1982.

The catch rate of the French inshore fishery in Subdiv. 3Ps continued to decline sharply from 37.7 tons per dory season in 1980 to 6.3 tons in 1981 and to 0.8 tons in 1982 (Table 12). Catch

Table 12. Abundance indices for short-finned squid in Subareas 3 to 6, based on stratified-random trawl surveys and on commercial abundance indices.

Country	Area	Months	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Source
Stratified-random surveys														
Canada[1]	4VWX	Jul	14.4	14.4	25.1	52.5	337.9	80.8	30.9	152.2	26.6	...	...	SCR 81/34
France[2]	4VWX	Aug-Sep	-	-	-	-	-	-	-	-	665	222	54	SCR 83/38
USA[1]	5Z+6	Sep-Nov	3.5	1.3	0.3	12.4	28.7	15.8	28.4	32.1	17.0	54.8	4.3	SCR 81/33[6]
Commercial catch rates														
France[3]	3Ps	Jun-Oct	(inshore)		-	-	-	-	-	36.9	37.7	6.3	0.8	SCR 83/38
France[4]	3P+4VW	Aug-Oct	(offshore)		-	-	-	-	-	17.0	5.5	...	...	SCR 81/37
Japan[5]	4VWX	Sep			-	-	-	-	233	667	69	49	...	SCR 82/22
International[4]	4VWX	Jul-Sep	(tons/day)		-	-	-	14.6	9.0	17.5	11.3	15.7	2.4	SCR 83/40
			(effort, days)		-	-	-	1921	2274	1619	1703	626	88	

[1] Mean number per tow.
[2] Abundance (*millions of squid*).
[3] Tons per dory season.
[4] Tons per day fishing.
[5] *Biomass estimates (000 tons).*
[6] Updated values for 1981 and 1982.

rates in the offshore fishery in Div. 4VWX also declined sharply, the catch-per-effort index for the international fishery having decreasd from 15.7 tons per day in 1981 to 2.4 tons per day in 1982, with associated effort declining from 626 to 88 days fished. The abundance index based on the Japanese fishery in Div. 4VWX in September of 1978-81 was not calculated in 1982, because catch rates were so low that the fleet moved to Subareas 5 and 6. Catch-per-hour of *Illex* as by-catch in the silver hake fishery by USSR was about 25% of that observed in 1981.

c) Distribution

The available information on distribution of larval and juvenile *Illex* from the winter-spring surveys in early 1983 was considered by the Environmental Subcommittee (see Annex 1).

The distribution of adults exhibited an unusual northward extension around northern Newfoundland in 1982, but there was a continued decline in catches in most other areas associated with major declines in availability, especially in offshore waters.

d) Biological characteristics

In general, the size composition of *Illex* in Subareas 3 and 4 during the early part of 1982 was the same as observed in previous years. Sizes observed late in the year, however, were significantly smaller than reported in past years. Information supporting the hypothesis of more than one cohort per year was also discussed, including the appearance of a significant number of small squid in the commercial fishery in mid-August and the appearance of one or two additional modes between the small and large size-classes in Subarea 4 during October-November 1982.

Information from samples collected by observers on commercial vessels and from research surveys indicate that maturation was delayed in 1982 compared with previous years. Numbers of males and females remained approximately equal in samples taken in Subareas 3 and 4 until early November. This was unusual because mature males generally begin to move offshore in November.

No significant changes were noted in the growth rate of *Illex* in 1982 (July-October), with monthly averages of 13 mm reported from Subdiv. 3Ps compared with a range of 10-20 mm observed in most areas in previous years.

e) Special research

Efforts to validate the use of statoliths as a tool for ageing squid have led to the successful development of techniques to put a time mark on the statoliths using tetracycline and strontium. Also, there is some evidence that subjecting squid to unusually low temperatures may result in a recognizable mark being left on the statoliths. However, other variables which may have caused the noted marks, such as light period or early inducement of maturation under experimental conditions, should be investigated further to clarify these results.

The variation in abundance of *Illex* in relation to maturity stage, size and stomach fullness as biotic factors and to temperature and time (month) as abiotic factors was analyzed using path analysis. Although multiple regression accounted for a similar amount of variation in the study, path analysis provided additional information about the explanatory power of any individual variable. For example, while multiple regression indicated that temperature was an important factor affecting abundance, path analysis revealed that it was important because of its effect on mean size and maturity stage. This study should be viewed as an example of the possible use of this technique in predicting *Illex* abundance rather than as a final product in itself.

f) Management regime for Subareas 3 and 4

Because no significant new information was presented on which a forecast of *Illex* abundance in 1984 might be based, STACFIS continues to support the management regime proposed at the February 1980 Meeting (NAFO Sci. Coun. Rep. 1979-80, pages 39-40), and therefore advises that the TAC for 1984 be maintained at 150,000 tons. The Committee recognized again that this regime implies a substantial loss of yield in years of high squid abundance but that a TAC regulation at this level is intended to avoid excessive fishing mortality (i.e. >40%) in years of moderate abundance. As indicated in previous reports, in years of very low abundance, the fishery tends to be self-regulating, effort not being expended when catch rates are very low.

g) Special session on squid in September 1984

i) Title

"Biology and Ecology of Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic".

ii) Specific topics

STACFIS agreed that the following topics under the general theme warranted consideration by the conveners in developing the program for the session:

- Early life histories and their relation to oceanic processes.
- Size distribution and cohort components related to the life cycle.
- Sexual maturity and growth.
- Large-scale and micro-scale distributional characteristics in relation to environmental conditions.
- Migration from tagging experiments.
- Age validation techniques.
- Sampling methodology.
- Predator-prey relationships.
- Biological implications to management.

iii) Organization arrangements

Appointment of convener(s) was deferred to the September 1983 Annual Meeting. Deadlines for the submission of titles, abstracts and manuscripts were left to the discretion of the convener(s) in collaboration with the NAFO Secretariat. It was agreed that a poster, similar in format to that for the "Special Session on Trophic Relationships ...", should be prepared and circulated as soon as possible after the appointment of the convener(s).

20. Northern Shrimp in Subareas 0 and 1 and in Denmark Strait (ICES Area XIV)

The Committee noted the requests of Canada (SCS Doc. 83/VI/2) and the EEC (SCS Doc. 83/VI/3) for advice on management in 1984 of the shrimp stock in Subareas 0 and 1 as well as the EEC request for management options for shrimp in Denmark Strait (ICES Subarea XIV). Considering the substantial contribution of shrimp recruitment to annual yields and the current lack of ability to accurately predict recruitment, STACFIS advises that it is more appropriate to assess these shrimp stocks and to advise on management for 1984 at a mid-term meeting early in 1984, when data from the fishery and research surveys will be available.

III. ASSESSMENT OF SEAL STOCKS

1. Introduction

The *ad hoc* Working Group on Seals met during 13-17 June 1983 at the request of STACFIS, with G. H. Winters (Canada) as Convener, to consider the joint request by Canada and EEC for advice on management in 1984 and 1985 of the seal stocks in the Northwest Atlantic (SCS Doc. 83/VI/4). K. Zwanenburg (Canada) was appointed rapporteur for the session. Scientists attended from Canada (W. D. Bowen, W. G. Doubleday, K. Hay and D. E. Sergeant), EEC (J. Harwood, R. Noé, P. Reijnders and Wijnstekers), and Norway (T. Øritsland). Sv. Aa. Horsted attended the meeting when Section 3(d) below was discussed.

2. Harp Seals

a) Review of fishery trends

The latest catch information available (to 14 June 1983) is given in Table 13. It was noted that Arctic Canada catches may be more related to the price paid per pelt than to availability. Because ringed seals are much more abundant in the Arctic than harp seals, a large price differential would be required to change hunting effort from ringed seals to harp seals.

b) Research conducted in 1982 and 1983

In 1983, a total of 13,000 harp seal whitecoats were tagged by Canada, 4,000 in the Gulf of St. Lawrence and 9,000 at the Front. Double marks were applied to 1,000 pups in the Gulf and 800 pups at the Front. All tagged animals were sexed. At the Front, all marks were applied within two major concentrations. A third patch of 20,000-30,000 pups was located later but none were tagged.

The study of the relationships between pup size, growth rate and female condition continued in 1983. A similar study was conducted during 1982 in the Gulf of St. Lawrence. A sample of 119 female harp seals collected in the Gulf in 1982 were analyzed for maturity and pregnancy rates.

In April 1983, 440 age 1+ females were collected from the Front herd for studies on morphometrics, reproductive rates and feeding. In addition, a sample of 220 beaters was collected during April and May for studies on morphometrics, growth and feeding.

Table 13. Summary of harp seal catches in the Northwest Atlantic, 1977-83. (The symbol "..." indicates data not available.)

Year	West Greenland	Arctic Canada: Northwest Territories	Arctic Canada: Labrador N. of 54°	Arctic Canada: Northern Quebec	Regulated catch	Total catch
1977	9,938	1,508	254	-	155,143	166,843
1978	7,944[1]	2,129	1,263	-	161,723	173,059
1979	9,301[1]	3,620	619	87	160,541	174,168
1980	5,177[1]	6,350	3,335	109	171,929	186,900
1981	...	4,672	10,863	...	189,731	205,266[2]
1982	...	...	...	...	169,484	169,484[2]
1983	...	...	...	...	50,000[3]	50,000[2]

[1] Provisional estimates.
[2] Partial statistics.
[3] Norway did not participate in the seal hunt in 1983.

An experiment to determine the inter-reader variability in age determination of harp seals will be completed in 1983.

c) Population assessment

i) Vital rates

From an analysis by Roff and Bowen (1983)[1], it was noted that the most likely estimates of M = 0.0725 (for $M_0 = 3M_1$, where M for animals less than 1 year old equals three times M for age 1 and older animals) and M = 0.0750 (for $M_0 = M_1$) lay outside the feasible range of M (0.08-0.11) reported by the ICES *ad hoc* Working Group on Assessment of Harp and Hooded Seals in the Northwest Atlantic (ICES Coop. Res. Rep. No. 121, 1983). On the basis of similar analyses, Roff and Bowen reported a corresponding range of feasible values of M from 0.050 to 0.105. This difference in reported ranges of M for harp seals arises principally from a change in the 1967 population age distribution used by Roff and Bowen to initiate the analysis of trends in population size and pup production. Estimates of M are sensitive to the percentage of age 7+ animals in the population. Previous analyses (SCR Doc. 81/XI/166, revised), reviewed by the ICES Working Group, were based on 1967 population age structure in which the percentage of age 7+ animals in the population varied between 44% and 52%. The estimates of M by Roff and Bowen were based on an age structure in which 55% of the seals were 7+ years of age. The age structure used by Roff and Bowen was considered to be closer to the true population age structure, because it agreed with empirical estimates of the percentage of age 7+ seals in the 1967 population derived from a large sample of molting males taken in that year. It was concluded that the range of feasible values of M is 0.05-0.11.

ii) Pup production and stock size

Pup production of the Northwest Atlantic population was estimated by using a modified Petersen index corrected for tag loss and reporting rate of recovered tags for the period 1978-80, as in Bowen and Sergeant (1983)[2] but incorporating 1982 recoveries. Variance estimates were corrected for additional sources of variation due to tag loss, reporting rate and estimation of the number of seals examined for tags. The pooled estimates for each cohort is given in Table 14.

An analysis of tag returns for the 1978-80 marked cohorts (see Annex at end of this section) showed that Gulf-tagged seals were more catchable in the Gulf of St. Lawrence than at the Front (i.e. Subareas 2 and 3). A more detailed analysis of recoveries at Greenland and Newfoundland by date and area of recapture was considered necessary in order to discriminate between various possible explanations. At the Front, the relative catchabilities (q) of animals tagged in the Gulf and Front areas were not significantly different. It was noted that the difference in q between the Gulf and Front could bias the estimate of pup production from mark-recapture. In order to assess the likely direction and magnitude of this bias, pup production was calculated by using only returns from the Front. The resulting estimates (see Annex) were 10-20% higher than those based on all returns, indicating that the estimates of pup production for 1978-80 may be biased downward. Although there was no significant difference between the q-values for Gulf- and Front-tagged animals at the Front,

[1] ROFF, D. A., and W. D. BOWEN. 1983. Population dynamics and management of the Northwest Atlantic harp seal (*Phoca groenlandicus*). Can. J. Fish. Aquat. Sci., 40: 919-932.

[2] BOWEN, W. D., and D. E. SERGEANT. 1983. Mark-recapture estimates of harp seal (*Phoca groenlandicus*) pup production in the Northwest Atlantic. Can. J. Fish. Aquat. Sci., 40: 728-742.

Table 14. Estimates of harp seal pup production for 1978-80.

Year	Pup production (000)	Standard error	95% confidence limits Lower	Upper
1978	497	75	349	645
1979	478	68	346	611
1980	475	75	327	622

it was decided to examine how sensitive the estimates of pup production were to variations in this parameter. Pup productions were therefore recalculated using only Front returns, but using either the upper or the lower 95% confidence limit for the pooled estimate of q for Gulf-tagged animals. These changes affected pup production by 3-5%.

iii) Replacement and sustainable yield

Replacement yields in 1984 were calculated using the probable range of pup production for the late 1960's, (320,000-420,000) and a range of 350,000-600,000 for pup production in 1978-80 derived from mark-recapture estimates (ICES Coop. Res. Rep. No. 121, 1983). The range of replacement yield in 1984, with a catch of 80% young of the year and consistent with the above ranges of pup production, is shown in Table 15, together with the 1984 replacement yield corresponding to the maximum likelihood estimate of Roff and Bowen.

Table 15. Estimates of replacement yield in 1984 for various levels of harp seal pup production in 1967 and 1979.

Pup production (000) 1967	1979	M_o	M_{1+}	Replacement yield in 1984 (000)
355	600	0.05	0.05	>600
370	415	0.075	0.075	346
430	350	0.3	0.1	160

In view of an anticipated 1983 total catch of about 75,000 animals (including 25,000 for Arctic Canada and Greenland), the harp seal population is predicted to increase from 1983 to 1984 for all values of 1984 replacement yield quoted above. With a catch of 200,000 in 1984, the population would increase unless the replacement yield was close to the lowest quoted value. Should the 1984 replacement yield be equal to or greater than that based on the maximum likelihood estimates, the harp seal population would increase by more than 101% from 1983 to 1984 and would continue to increase rapidly if hunting continued at or below the 1983 level.

Sampling of 1983 catches indicates that the proportion of age 1+ animals in the catch is not likely to increase substantially over recent levels. Although an increase in the proportion of age 1+ seals, and especially of mature seals, in the catch implies a reduced replacement yield, there was no evidence that such an increase will occur in 1983, and therefore no calculations are presented here.

As was noted by ICES (ICES Coop. Res. Rep. No. 121, 1983), the presence of a higher proportion of immature seals in the population than in the stable age distribution with the same vital rates implies that the sustainable yield from the population, given a continuation of the current mortality schedule, exceeds the replacement yield. The reduction of catch from 1982 to 1983 resulted in the proportion of immature seals in the 1984 population being higher than in the stable age distribution, so that the ICES observation applies in the present case.

d) Future research requirements and the need for coordination with ICES

Two main issues were identified in relation to coordination with ICES. The 1982 ICES Working Group on Northwest Atlantic Harp and Hooded seals was an *ad hoc* group. Should such a permanent ICES working group be established, it would be desirable to have coordination between it and a NAFO working group. At present all research on Northwest Atlantic seals is reported to ICES through the administrative report of the Marine Mammals Committee.

Because an estimate of harp seal pup production in 1984 would aid in narrowing the feasible range of natural mortality estimates, STACFIS suggested that a mark-recapture experiment be conducted in 1984. In addition, more use should be made of catch-at-age data in estimating total population numbers and vital rates. STACFIS also recommended that the mathematical models presently employed to determine stock size and projected yields be subjected to sensitivity analyses, in order to determine the influence of parameter estimates on estimates of stock size and projected yields.

3. Hooded Seals

a) Review of the fishery in 1983

The most recent estimated catch of hooded seals at Greenland is 5,600 in 1980. No hooded seals were taken at the Front by large vessels during 1983 because of low demand for hooded seal pelts. Up to 3 June 1983, 50 pups and 64 older seals had been taken by landsmen at the Front. If the total catch of hooded seals in 1983 at Greenland is similar to that in 1980, the expected catch for the Northwest Atlantic will be less than 6,000. Estimated average catches since the early 1970's have been about 16,000 animals.

b) Research in 1983

An aerial photographic survey was carried out to estimate pup production at the Front from 17-27 March. Analysis of these data is in progress, but, since only partial coverage was achieved, only part of the total production will be estimated. A total of 825 pups were tagged at the Front and 70 pups and 10 adults in the Gulf. At the Front, 18 adult females and 35 pups were killed to obtain biological samples.

c) Population assessments

i) Vital rates

The analysis of reproductive data from a large sample of females obtained from the commercial hunt at the Front in 1979 is nearing completion, and new data on age at maturity are available. The age-specific maturation rates derived from this sample were not significantly different from earlier estimates by the same method. Therefore, the earlier estimates and a pregancy rate of 0.915 (Born, 1982)[3] were used for further calculations. The estimation of total (Z) and natural (M) mortality rates was discussed by the Working Group. Estimates of Z for females (age 6+) sampled at the Front in 1966-82 range from 0.19 to 0.28. Lower Z values at the Front and at Greenland in the late 1970's followed reduced kills of breeding females at the Front since 1977. Lower values of Z at Greenland than for the Front (for the same time period) may reflect a mixture of animals from the Front and Davis Strait whelping patches in the Greenland catches. A natural mortality above 0.15 is incompatible with a sustainable population and values below 0.05 have not been reported for any pinniped population. These considerations together with a preliminary analysis of the total and hunting mortality rates indicate a probable range of M from 0.07 to 0.13. Since it was not possible to investigrate further the feasible range of M values, STACFIS

recommends

that further detailed analyses of historical catch-at-age data for hooded seals be carried out to provide better estimates of natural mortality.

ii) Pup production and stock size

From the survival index method (Winters, 1978)[4], pup production in 1966 was estimated to be 33,000 (95% nominal confidence interval of 22,000-45,000).

Analyses of 1977-82 catch-effort data for large vessels at the Front (SCR Doc. 83/VI/51) provided Leslie estimates of pup production in hunted patches which exceeded the catch by 25%. These pup production estimates were considered to be negatively-biased due to decreasing catchability of pups as the hunt progressed. Because the lactation period is only 6-10 days, large decreases in catchability of pups occur during the hunt.

No estimate of current pup production at the Front is available, but it was agreed that pup production in 1979 was at least 15,000, given the catch of 12,000 pups. No useful upper bound can be given.

The interrelationships of hooded seals which pup at the Front to those which pup in the Davis Strait are not yet known. However, pup production in the Northwest Atlantic must have exceeded 15,000 in 1978, considering unpublished aerial survey estimates for hooded seal production in Davis Strait and known pup kills at the Front in 1977-78. A pup production of about 15,000 corresponds roughly to a total age 1+ population of 60,000.

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[3] BORN, E. W. 1982. Reproduction in the female hooded seal, *Cystophora cristata* Erxleben, at South Greenland. J. Northw. Atl. Fish. Sci., 3: 57-62.

[4] WINTERS, G. H. 1978. Production, mortality, and sustainable yield of Northwest Atlantic harp seals (*Pagophilus groenlandicus*). Can. J. Fish. Aquat. Sci., 35: 1249-1261.

iii) Replacement yield

It was agreed that pup production was at least 15,000 in 1979 and that M is probably between 0.07 and 0.13. Pending further detailed analysis of historical catch-at-age data, accurate estimates of replacement yield for 1984 cannot be provided. However, projections to 1990 were calculated for the hooded seal population at the Front for six hunting strategies: no hunting, Greenland kill of 6,000 (30% females), and four levels of catch for the Front (12,000, 9,000, 6,000 and 3,000) plus the Greenland kill. The projections were initialized by using a 1979 female population age structure calculated from the 1979 age sample of female hooded seals corrected for the proportion whelping at each age and assuming constant pup production from 1976 to 1979. The projections were carried out for three levels of pup production in 1979 (15,000, 20,000 and 25,000) and four values of M (0.07, 0.09, 0.11 and 0.13). The catch history of the population from 1979-83 was used to calculate the corresponding 1984 population. Subsequently, the six hunting strategies were used in the projections to 1990. The projections illustrated that a harvest of mature animals (as occurs in Greenland) has a greater effect on the reproductive potential of the population than a kill of an equal number of pups. The projections further showed that, for a pup production of 15,000 and values of M above 0.09, only the "no catch" or "Greenland catch only" strategies will allow the population to increase or stabilize during the period of the projections. Cohort analyses demonstrated that M = 0.13 and pup production of 15,000 in 1979 are not compatible with the nominal 95% confidence limits on the 1966 production estimate.

Replacement yields in 1984 were calculated for levels of M between 0.07 and 0.13 and pup production in 1979 equal to the minimum level of 15,000 and arbitrary higher levels of 20,000 and 25,000 (Table 16). If there is a substantial degree of interchange between the Front and Davis Strait herds, with both contributing to Greenland catches, these estimates are clearly conservative.

Table 16. Estimates of replacement yield of hooded seals in 1984 for various levels of pup production in 1979.

Pup production (1979)	Replacement yield in 1984 for a range of natural mortality (M)			
	0.07	0.09	0.11	0.13
15,000	8,300	6,300	4,700	3,500
20,000	15,700	11,900	8,900	6,500
25,000	23,000	17,600	13,100	9,500

vi) Sustainable yield

STACFIS was not able to provide useful estimates of sustainable yield for 1984 because of the uncertainty in the population parameters, particularly current pup production and estimates of M.

d) Future research

The inability of STACFIS to provide scientifically determined estimates of current pup production and replacement yield of hooded seals in the Northwest Atlantic is to a large extent related to the lack of reliable information on the size of the Front and Davis Strait herds, the extent to which these meet along the coast of Greenland, the amount of interchange between these two herds, and the possibility of interchange with the Jan Mayen herd. Such information is considered to be critical for future advice on harvest levels of hooded seals, and STACFIS strongly

recommends

that an intensive one-year corrdinated program for hooded seals be undertaken, involving:

i) simultaneous aerial surveys of the Front and Davis Strait breeding populations and the requisite ground-truthing;

ii) collection of adequate biological samples (500-750 females) for age composition analysis and reproductive rates at the Front, in Davis Strait and along the Greenland coast; and

iii) tagging of pups at the Front and in Davis Strait and at Jan Mayen.

The biological sample from the Davis Strait herd in particularly important because of the information it can provide on total mortality rate for this herd, its reproductive parameters and degree of mixing with other whelping herds. It was pointed out that the cost of carrying out any one element of this program would be almost as high as carrying out the entire program in one year.

Some concern was, however, expressed on this part of the program because it would involve killing of animals to supply the sample. It was noted that such a comprehensive research program is being prepared for consideration by the relevant parties for implementation in 1984. It was also noted that additional information on natural mortality and trends in pup production may be obtained from further analyses of the catch-at-age data from the Front and at Greenland.

e) Workshop on hooded seals

STACFIS was informed that the Hooded Seal Workshop will be held at the Institute of Marine Research, Bergen, Norway, during the week beginning 7 November 1983. In view of the importance ot this workshop to the work of the Scientific Council, STACFIS

recommends

that the Scientific Council consider publication of the proceedings of the Hooded Seal Workshop and associated papers in one of its series.

ANNEX TO SEAL SECTION

Relative Catchability of Harp Seals Tagged in 1978-80 in the Gulf and at the Front

Tag recoveries and age-specific catches of the 1978-80 marked cohorts in January-May 1979-82 by area of tagging and recapture are given in Annex Table 1. Age-specific catches were derived by prorating the total catch of seals age 1 and older from the Gulf and Front areas using age samples from the various components of the hunt collected each year during the period of tag recoveries. Tag recoveries from Gulf tagged animals listed in Annex Table 1 are adjusted by ratio of numbers tagged in the Gulf and Front area in each year.

The relative catchabilities of Gulf-tagged and Front-tagged seals were calculated by the formula $q = m_{i,t}/n_{i,t}$ for each cohort, where q = catchability, $m_{i,t}$ = the number of tags recovered from seals age i in year t, and $n_{i,t}$ = the number of seals age i examined for marks in year t. The data show that Gulf-tagged seals are on average about three time more catchable in the Gulf than at the Front (Annex Table 2). However, at the Front, the relative catchabilities of Gulf-tagged and Front-tagged seals did not differ significantly ($P>0.05$), as indicated by the following analysis.

The numbers of seals tagged in the Gulf (m_g) and at the Front (m_f) found in the catch of the appropriate age-group at the Front in a given year are assumed to follow a Poisson distribution with means:

$$E(m_g) = M_g.n.q \quad \text{and} \quad E(m_f) = M_f.n.q'$$

Annex Table 1. Tag recoveries and catches in December-May 1979-82 of harp seal cohorts marked in 1978-80, by area of tagging and recapture. Recoveries from Gulf-tagged seals are adjusted for the ratio of numbers tagged in each area.

		1979		1980		1981		1982	
Year	Location	Gulf	Front	Gulf	Front	Gulf	Front	Gulf	Front
1978	Gulf	25	82	23	53	18	12	10	12
	Front	17	107	7	35	5	5	2	6
	Catch	797	12,340	1,016	5,551	1,271	1,815	374	876
1979	Gulf			21	47	2	11	6	7
	Front			1	41	12	12	1	10
	Catch			1,665	12,323	1,025	1,833	379	1,712
1980	Gulf					9	27	5	23
	Front					3	12	0	14
	Catch					966	3,939	216	4,424

where M_g and M_f are the *effective number* of tagged seals in Gulf-tagging and Front-tagging experiments respectively, n is number of seals caught from the appropriate age-group at the Front, and q and q' are the effective relative catchability factors for seals tagged in the two areas.

For different experiments and for different years of recapture for the same experiment, the number of unadjusted recaptures at the Front are assumed to be statistically independent. Thus the total number of Gulf-tagged animals recaptured at the Front follows *a Poisson distribution* with mean $q\Sigma M_{g_i n_j}$ for experiments i and years j. Similarly, for Front-tagged animals, the Poisson parameter is $q'\Sigma M_{f_i n_j}$. The relevant data for the calculations are given in Annex Table 3. The effect of q on pup production estimates using only Front recoveries is illustrated in Annex Table 4.

Annex Table 2. Relative catchabilities (m_i/n_i) for Gulf-tagged and Front-tagged harp seals (corrected for number tagged in each area) of the 1978-80 marked cohorts and ratios of Gulf to Front returns per unit catch.

		1979			1980			1981			1982		
Year	Location	Gulf	Front	G/F	Gulf	Front	G/F	Gulf	Front	G/F	Gulf	Front	G/F
1978	Gulf	0.3140	0.0066	4.76	0.0226	0.0095	2.38	0.1470	0.0066	2.15	0.0267	0.0137	1.95
	Front	0.0213	0.0087	2.45	0.0069	0.0063	1.09	0.0039	0.0028	1.39	0.0053	0.0068	0.78
	G/F	1.47	0.76		3.28	1.51		3.64	2.36		5.04	2.01	
1979	Gulf				0.0126	0.0038	3.32	0.0020	0.0060	0.33	0.0158	0.0041	3.85
	Front				0.0006	0.0033	0.18	0.0114	0.0065	1.80	0.0026	0.0058	0.45
	G/F				21.0	1.15		0.17	0.92		6.08	0.71	
1980	Gulf							0.0093	0.0068	1.37	0.0231	0.0052	4.44
	Front							0.0031	0.0030	1.03	0.0000	0.0032	?
	G/F							3.00	2.27		?	1.63	

Annex Table 3. Numbers of seals examined for marks in 1979-82.

Year	M_g	M_f	1979	1980	1981	1982
1978	4,170	4,984	12,340	5,551	1,815	876
1979	2,574	2,365		12,323	1,833	1,712
1980	3,601	2,645			3,939	4,424

Total number of Gulf-tagged animals recaptured at the Front = 272

Total number of Front-tagged animals recovered at the Front = 242

Total $Mg.n = 156,786,335$ Total $M_f.n = 162,228,643$

$\hat{q} = 173 \times 10^{-8}$ $\hat{q}' = 149 \times 10^{-8}$

t-test for $q = q'$: $t = (\hat{q} - \hat{q}')/((10.52)^2 + (9.59)^2)^{0.5} = 1.69$

Pooled estimate of $q = q' = 161 \times 10^{-8}$, with 2 standard errors = ±9%

Annex Table 4. Effect of relative catchability of Gulf-tagged and Front-tagged harp seals recovered at the Front on pup production estimates using only Front returns.

					Pup production (000's) for q ± 2 S.E.			Difference using all recoveries and only
Year	M_t	n_f	M_g	M_f	0.91	1.00	1.09	Front recoveries
1978	9,154	20,582	133	153	521	542	560	+9%
1979	4,939	15,868	71	63	508	529	548	+11%
1980	6,246	8,363	50	26	560	591	618	+25%

IV. FLEMISH CAP PROJECT

1. Introduction

The *ad hoc* Working Group on the Flemish Cap Project was convened by J. T. Anderson (Canada) at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, on 10 June 1983, to review recent studies on Flemish Cap, including comparative ichthyoplankton sampling and a comparison of results from fixed station and stratified random trawling, and to formulate future cooperative research plans. Scientists participated from Canada, EEC (Denmark and Federal Republic of Germany), Spain and USSR. G. R. Lilly (Canada) was rapporteur.

2. Review of Recent Studies (SCR Doc. 83/VI/20, 26, 29, 33, 34, 35, 41, 42, 65; SCS Doc. 83/VI/16)

a) Oceanography

It has been postulated that year-class strength of cod depends primarily on the dynamic state of the anticyclonic water circulation on Flemish Cap, with good year-classes occurring when the gyre is intensified and weak year-classes occurring when the gyre is weakened. It is expected that eggs and early larvae, assumed to be passive drifters, may be swept from the bank when flow is predominantly across the bank.

Variability in the direction of water movement was determined empirically from geostrophic calculations on the data from 27 USSR hydrographic surveys from December 1977 to April 1982. The analyses confirmed that an anticyclonic gyre was the prevailing form of water circulation on Flemish Cap (67% of observations), but the transient flow across the bank occurred occasionally (7% of observations) and only in winter. A mixed circulation involving both the gyre and transient flow across the bank occurred fairly frequently (26% of observations) and at any time of year. The breakdown of the gyre was associated with the passage of storms.

Determination of the relationship between year-class strength and changing circulation patterns might require oceanographic surveys at intervals of 1.5-2.0 weeks each year during the period when eggs and larvae are essentially passive drifters. However, it was also noted that if the relationship between wind speed and circulation could be firmly established, it may be possible to provide a partial test of the transport-mortality hypothesis more simply by comparing recruitment and wind speed over Flemish Cap. A relationship between wind direction and frequency and cod year-class strength has previously been reported.

b) Ichthyoplankton

The abundance, distribution and growth of larval redfish collected during Canadian surveys in 1979-81 were summarized. Redfish began releasing larvae during March, with the peak occurring in late April. A second less abundant release began during June. Peak larval abundance estimated for the study area was 9.2×10^{12} larvae. Mortality exceeded 99% in the May-July period. Redfish larvae first appeared on the southwest corner of Flemish Cap and soon were found throughout the area over depths >200 m. By July, the survivors were concentrated mostly over the central area. Growth of larvae from both release periods was exponential. Larval size was positively correlated with surface water temperature, except that unusually high temperature appeared to reduce larval growth. This reduced growth during warm years appeared to be related to increased mortality. Hence, it was suggested that growth of larval redfish is controlled by the seasonal heating cycle and that the critical period for larval growth and survival occurs in June when surface water temperature is increasing rapidly.

A Canadian survey of 20 grid stations was conducted over central Flemish Cap during 1-3 August 1982. Only one cod larva was captured. The length frequency for redfish larvae indicated three distinct modes at 6-7, 10-11 and 16-28 cm, with the majority of the larvae being in the largest modal group. This group of large larvae was from the April-May release period. Redfish occurred at all but three stations and were less concentrated in the central part of the bank relative to the pattern in some previous years. The abundance of larvae from the April-May release period surviving to early August was estimated for the years 1978-82. Abundance in 1978, 1980 and 1982 was an order of magnitude greater than in 1981. There appeared to be no survivors in 1979.

c) Juvenile redfish

Canadian bottom-trawl surveys in January-February of 1982 and 1983 revealed the presence of two very strong redfish year-classes, which are thought to be those of 1980 and 1981. These year-classes were also abundant in cod stomachs. The 1982 year-class was not well represented in trawl catches but was abundant in cod stomachs. This is similar to observations in 1979, when the 1978 year-class was abundant in cod stomachs and only moderately abundant in trawl catches. The 1978 year-class was not abundant in 1980 or later, indicating that juvenile mortality can be high. The 1979 year-class has been shown previously to be very weak, even as 1-year-olds. Estimates of relative year-class strength at the juvenile stage do not correspond well with estimates of larval abundance in early August, as indicated in the following table:

	Approximate relative abundance	
Year	Larvae (August)	Juveniles (January)
1978	+ + + +	+ +
1979	(nil)	+
1980	+ + + +	+ + + +
1981	+ +	+ + + +
1982	+ + + +	+ +

Comparisons of estimates for two years (1979 and 1980) are in agreement. However, abundances of larvae in 1978 and 1982 were high whereas those of juveniles were low, perhaps indicating increased mortality between August and the following January. Unexplained was a low estimate of larval abundance in 1981 contrasted to a high estimate of juveniles in the following January.

d) Juvenile cod

The 1981 year-class of cod was weak at age 1 in the USSR bottom-trawl survey, but it appeared quite strong at ages 1 and 2 in Canadian surveys and was estimated to be at least as strong as the 1973 year-class. The 1982 year-class also appeared to be strong at age 1 in the Canadian survey. Both age-groups 1 and 2 cod were found in the stomachs of larger cod in 1983.

e) Adult cod

Age compositions for cod caught during Canadian bottom-trawl surveys in January-February 1977-82 and during special sampling in November 1978 were considered. In 1977 and 1978, the 1973 and 1974 year-classes predominated. In 1980 and 1981, the 1977 year-class was dominant. In 1982, cod of age-groups 1, 2, 4 and 5 were predominant, whereas 3-year-olds (1979 year-class) were scarce. Cod of age-groups 4 and 5 dominated in samples from the Spanish commercial fishery in 1982.

From Canadian survey data for 1977-1983, it was estimated that only about one-third of cod survive from one year to the next. Average length-at-age for cod has increased considerably in recent years. There was an increase in length-at-age from the 1949-51 period to the 1964-68 period, and a further increase in the 1980-82 period. The 1982 length-at-age values are higher than those for 1980-82 combined. High length-at-age values for age 7 and younger fish were also found in samples from the Spanish commercial fishery in May 1982. It was noted that, on a qualitative basis, the changes observed in average length-at-age correspond to the perceived reduction in stock size. The stomach fullness index for cod <60 cm long was considerably greater in 1983 than in 1978. This is attributable to increased availability of small redfish and increased consumption of shrimp (*Pandalus borealis*). The relationship between increased food consumption and a decrease in stock size is not known, but it deserves careful investigation.

3. Research in 1982 and Early 1983

As proposed in 1982 (NAFO Sci. Coun. Rep. 1982, page 41), Canada conducted a 3-week research bottom-trawl survey in February and collected additional samples of cod in March for studies of maturity and fecundity. An ichthyoplankton and oceanographic survey for cod eggs and larvae was conducted in March. The USSR conducted trawl surveys using stratified-random and fixed-station procedures in the spring of 1983. Ichthyoplankton surveys were carried out at the same time.

4. Comparative Ichthyoplankton Sampling

No data from the comparative ichthyoplankton sampling were presented. Noting the importance of using both USSR and Canadian data to calculate changes in abundance of eggs and larvae, STACFIS

recommends

that the results of intercalibration of USSR and Canadian ichthyoplankton sampling gear be presented at the earliest opportunity.

5. Analysis of Fixed-station and Stratified-random Trawling Data

The design and sampling techniques employed in Canadian stratified-random bottom-trawl surveys were described. Catch per tow in individual strata varied considerably from year to year during 1977-83 but was always low in those strata in the 300-400 fath (549-732 m) depth zone. Catch per tow in both numbers and weight was higher in 1983 than in 1982, primarily because of good catches of the 1981 year-class. The research trawl does not adequately sample cod of ages 1 and 2 and may not adequately

sample cod of age 3. No information on fixed station trawl surveys was presented. Noting the value of using Canadian and USSR surveys to examine seasonal changes in distribution and abundance, STACFIS

recommends

that a comparison of fixed-station and stratified-random bottom trawl surveys be made during the June 1984 Meeting of the Scientific Council.

6. Cod Recruitment and Environmental Variability

No new analysis of cod recruitment and environmental variability was presented. However, as discussed in Section 2(a), there was important progress in understanding the variability in the strength and direction of surface water flow on Flemish Cap.

7. Future Cooperative Research Plans

Canada intends to conduct a stratified-random bottom-trawl survey for 2 weeks in February 1984 but has no plans to conduct ichthyoplankton surveys in 1984. It was noted that the numbers of cod eggs and larvae collected in the Canadian surveys to date are too small to permit the calculation of accurate mortality curves, and the frequency of sampling is much too low to determine the timing of critical changes in mortality. USSR scientists intend to carry out trawl and ichthyoplankton surveys on Flemish Cap in March-June 1984.

8. Other Matters

In the absence of any plans for future cooperative reasearch on the Flemish Cap Project, the continuing role of the Flemish Cap Working Group was discussed. The status of the project, in light of the low stock biomass and past ichthyoplankton results, had been discussed previously (NAFO Sci. Coun. Rep. 1982, page 40). While a substantial amount of the material collected as part of the Flemish Cap Project has been presented and discussed, a significant portion of the data has yet to be made available. Significant events have been observed during the past five years, including high larval mortality of redfish in 1979 and absence of both cod and redfish from this year-class in research trawl surveys during subsequent years. In contrast, 1981 appeared to be a year of high survival of both cod and redfish, with predictions of potentially high recruitment to the fishery in ensuing years. Thus, years in which survival has been both very high and low have been observed. Although some hypotheses have been proposed to explain these observations, it was agreed that data exist to further explore the validity of the proposed relationships. In particular, certain aspects of oceanography affecting larval survival can be addressed, such as temperature and salinity conditions relative to larval growth, and the retention of larvae through stronger or weaker circulation over the bank. In addition, data collected during February-May 1983 in a planned cooperative research program by Canada and USSR have not yet been analyzed and presented. STACFIS therefore

recommends

that analysis and interpretation of all outstanding data relevant to the aims of the Flemish Cap Project be presented to STACFIS as soon as it is available, including data on physical oceanography, plankton, juveniles, adults and food and feeding of cod and redfish.

It was noted that previous recommendations for analysis and presentation of data had only partly been carried out. Given the importance of this information in assessment and interpretation of events relevant to the objectives of the Flemish Cap Project and any future research proposals, STACFIS

recommends

that the next meeting of the Flemish Cap Working Group be held, after consultation with all participants, only when there is reasonable assurance that sufficient information is available upon which evaluation of objectives of the project for the future can be made.

STACFIS noted the importance of interim monitoring of stock and recruitment relationships for cod and redfish on Flemish Cap, especially as related to egg, larval and juvenile fish data collected during 1978-83, and, considering the current hiatus in assessing the cod stock in Div. 3M based on commercial data, STACFIS

recommends

that research trawl surveys be continued on Flemish Cap to extend the series of estimates of numbers at age available to the research trawls to ensure comparative measurements of stock size and, in particular, recruitment in relation to the terms and objectives of the Flemish Cap Project.

It was noted that several years of data for cod have been collected only under conditions of low and decreasing cod stock biomass, and it would be particularly desirable to obtain data under conditions of higher stock abundance.

V. ENVIRONMENTAL RESEARCH

1. Introduction

The second meeting of the Subcommittee on Environmental Research was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, on 8-9 June 1983, with Dr. R. W. Trites (Canada) as Chairman. Its detailed report is at Annex 1.

2. General Considerations

Although the Subcommittee's agenda was broadened to include environmentally-linked aspects of squid research, the number of papers available at the time of the meeting was much less than at the June 1982 Meeting. Reports on the late 1982 and early 1983 surveys were very incomplete, and no conclusions could be drawn on the objectives of the survey program.

As a follow up to the discussions at the June 1982 Meeting regarding ways to improve the accuracy and usefulness of the review of environmental conditions experienced durng the preceding year, a "pilot" project was undertaken (SCR Doc. 83/VI/23) in order to provide the Committee with an opportunity to assess its value and whether it should be continued, altered or expanded. Although the report demonstrated that a range of useful time-series of data sets could be analyzed and assembled in time for the June meeting, the Committee concluded that further examination of the existing documentation was needed before specific recommendations on future efforts to assemble and document environmental conditions could be made.

The Chairman of the Subcommittee expressed the view that participation by oceanographers was below the "critical" level for ensuring a sustained and vibrant Subcommittee. He noted that, if STACFIS assigned selected specific tasks, the Subcommmittee might operate with a sharper focus on problems.

3. Base Periods

After reconsideration of previous recommendations (ICNAF Redbook 1976, page 136; SCR Doc. 83/VI/23), the Committee adopted the recommendation of the Subcommittee on base periods (see Annex 1).

4. Future Considerations

STACFIS noted the very small participation of scientists (particularly oceanographers) at the meeting of the Environmental Subcommittee and the small amount of documentation presented. The future of the Subcommittee was discussed relative to its primary function. The apparent lack of interest led to a suggestion that the Subcommittee might be discontinued and environmental matters considered directly within STACFIS. However, further discussion on the future of the Subcommittee was not possible at this time, because participants wished to contact other scientists in their laboratories. It was agreed that the matter would be considered further at the September 1983 Meeting of STACFIS.

VI. GEAR AND SELECTIVITY

1. No new information on this matter was reported. However, USSR scientists indicated that studies on the selectivity of cod, redfish, American plaice, witch flounder, Greenland halibut and roundnose grenadier have been recently carried out in the Newfoundland area. They also indicated that the results of these studies will be presented at the September 1983 Meeting.

VII. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Redfish Age Determination

Following a recommendation at the June 1980 Meeting of STACFIS (NAFO Sci. Coun. Rep. 1979-80, page 65), a comparative study on ageing redfish was initiated by Canadian and Federal Republic of Germany scientists, involving the exchange of otoliths and scales in an attempt to resolve existing differences in age interpretation. Although the problems associated with ageing redfish were identified and discussed at the ICES/ICNAF Redfish Symposium in 1959 (ICNAF Spec. Publ., No. 3), it is evident that much work still remains to be done before a reliable method of ageing can be recommended. The Committee noted that work on ageing redfish by scales and otoliths was continuing and that the problems associated with age determination were discussed by experts at the ICES Meeting in October 1982 (ICES C. M. 1983/G:2). Otoliths tend to yield higher ages than scales, particularly in

the older redfish, and are believed by some experts to provide more realistic estimates of age. However, agreement among experienced readers tends to be higher for scales than for otoliths. Validation studies are needed, involving the examination of both scales and otoliths from redfish of known ages, such as the progression of a dominant year-class over several years. The Committee welcomed the progress in attempting to resolve the redfish ageing problems and urged that the studies be pursued and documented as work progresses.

2. Roundnose Grenadier Age Determination

The Scientific Council at its meeting in June 1980, recommended that an exchange of ageing material for roundnose grenadier be initiated between scientists of Federal Republic of Germany and German Decocratic Republic in an attempt to resolve discrepancies in age interpretation. The Committee was informed that the results from the examination of a small sample were inconclusive and that a more representative sample (otoliths and scales) was expected to be examined later this year. Like redfish, the zones in scales tend to be relatively distinct, whereas the zones in otoliths are more complex. This difficulties are similar to those encountered in ageing redfish. The Committee welcomed the progress being made and urged that the study be pursued.

3. Canada-USSR Cod Otolith Exchange for Division 3M

The Committee was informed that there was some disagreement in age interpretation of otolith samples exchanged between Canada and USSR scientists. Further exchange was not considered feasible until there was an opportunity for the scientists from both countries to view the otoliths and discuss their interpretations of age. Such a study is planned to take place at the September 1983 Meeting in Leningrad. A series of length and age compositions from Canadian surveys in Div. 3M was briefly discussed. The Committee agreed that a similar series of USSR data for 1974-82 would be extremely useful in analyzing discrepancies between Canadian and USSR age composition data at the September 1983 Meeting.

4. Review of Discrepancies in Ageing Silver Hake

A sample of 49 silver hake otoliths, collected by the USSR in April 1980 from Div. 4W, was aged by Canadian and USSR readers. Whole glycerin-stored otoliths were used, and the readers had knowledge of the length and sex of each specimen at the time of ageing. The sample consisted of 13 males and 36 females. The range of fish size was 12-47 cm, with a mean length of 31.3 cm. Ages, as determined by both sets of readings, ranged from 1 to 7 years, with a mean age of 3.76 years from the USSR analysis and 3.80 years from the Canadian analysis. The otoliths were aged by two Canadian readers with 88% agreement. Overall agreement between Canadian and USSR readings was 76%. This level of agreement and the apparent lack of bias indicates that estimates of age by Canadian and USSR readers should be comparable.

5. Other Studies

The Committee was informed that the Report of the Shrimp Ageing Workshop which was recommended for publication at the June 1982 Meeting, will be published in the next volume of NAFO Scientific Council Studies (No. 6) to be issued in the autumn of 1983.

VIII. REVIEW OF SCIENTIFIC PAPERS

1. Regressions of Weight on Length of Greenland Halibut and Witch Flounder (SCR Doc. 83/VI/18, 19)

Least squares regression equations were calculated for both round and gutted weight on length from samples of Greenland halibut and witch flounder collected on Canadian research vessel surveys in Div. 2G, 2H, 2J, 3K, 3P and 4R for Greenland halibut and Div. 2J, 3K and 3L for witch flounder. The equations, derived from the base 10 logarithmic transformation, were calculated for both species for each division separately and combined. It was felt that these weight-length relationships would be necessary and important parameters in performing analytical assessments on these two species.

2. Distribution and Biology of Roughhead Grenadier in Subarea 3 (SCR Doc. 83/VI/45)

Surveys of roughhead grenadier distribution and biology were carried out in the Grand Bank area during May-July 1982. Data on length and age composition, growth, sexual maturity, feeding and fatness were obtained. The surveys indicate that the species is appropriate for a longline fishery.

3. Distribution of Groundfish and Short-finned Squid on the Scotian Shelf in 1982 (SCR Doc. 83/VI/10)

From the data collected by USSR observers, the major part of the 1982 fishing season (April-June) was characterized by anomalous distribution of silver hake and squid on the slopes of the Scotian Shelf. Although dense concentrations of silver hake were observed, squid were found in insignificant numbers. As in previous years, by-catches of haddock, cod and redfish were also insignificant.

4. Distribution of Squid in Relation to Environmental Conditions (SCR Doc. 83/VI/61, 62)

The Committee welcomed the inclusion of these papers in the Research Document series but noted that they were received too late for consideration. In view of the significance of the information in these two papers, detailed consideration was deferred to the June 1984 Meeting of the Committee.

IX. OTHER MATTERS

1. Review of Report of the *Ad hoc* Working Group on Herring Tagging (see Annex 2)

a) Introduction

STACFIS noted that the original terms of reference set for the Working Group could not be met by the studies conducted, but two of the objectives were addressed: (i) definition of feeding, spawning and overwintering areas; and (ii) definition of recruitment migrations from juvenile fisheries. The various studies conducted between 1973 and 1981 have resulted in over 600,000 herring being tagged. Due to collapse of the Georges Bank stock, there can be no consideration given to interaction between that stock and the more coastal populations in the Gulf of Maine and on the Scotian Shelf.

b) Movement of juveniles

Juvenile herring tend to remain in the area of tagging for prolonged periods, but regular seasonal movements are also exhibited. Juveniles tagged in the Gulf of Maine area move towards the Bay of Fundy in summer and autumn but this eastward movement is limited to the New Brunswick side of the Bay. This movement is followed by a westward movement towards Cape Cod during the winter period. Juveniles tagged on the New Brunswick side of the Bay of Fundy tend to stay there during the following year but a proportion also exhibit overwintering movement. The majority of the juveniles which leave the Bay of Fundy move to the western Gulf of Maine and Cape Cod areas but a smaller group moves eastward to overwinter off eastern Nova Scotia. Juveniles tagged off southwest and southern Nova Scotia also tend to move towards the Bay of Fundy in summer.

c) Movement of adults

Adult herring tagged in the Cape Cod and Gulf of Maine areas exhibit a strong eastward movement in summer resulting in concentrations, in late summer, off western Maine and on the New Brunswick side at the entrance to the Bay of Fundy. A reverse movement subsequently occurs, resulting in a winter distribution in the areas of western Gulf of Maine, Cape Cod, and further south. Adults tagged in Div. 4W exhibit strong movement towards the Bay of Fundy during April-September, resulting in a summer distribution concentrated off southwest Nova Scotia and the upper reaches of the Bay of Fundy. Subsequent movement appears to be eastward again with overwintering concentrations occurring off eastern Nova Scotia. Adults tagged in Subdiv. 4Vn exhibit a strong directed movement into the Gulf of St. Lawrence in summer, with a lesser but significant movement towards the Bay of Fundy. No recoveries from the Subdiv. 4Vn studies were made on the New Brunswick side of the Bay of Fundy or farther west. During winter, these fish are again concentrated off eastern Nova Scotia.

d) Persistence of migratory patterns

The results from tagging spawning fish off southwest Nova Scotia show a strong tendency for herring to follow a distinct annual migratory pattern. Tag recoveries from these studies indicate that, in subequent summers, between 85% and 100% returned to the Bay of Fundy, and 44-100% returned to the actual area of release within the Bay. Winter recoveries from these same experiments indicate a consistent yearly movement to eastern Nova Scotia with between 68-86% of the recoveries being made there. Furthermore, recoveries of fish tagged off Chedabucto Bay (Div. 4W) during winter indicate that over 93% of the subsequent winter recoveries were made off eastern Nova Scotia and over 85% of summer recoveries came from the southwest Nova Scotia area.

e) Conclusions and proposals for future work

It appears that, for the major spawning groups, there are persistent annual migratory patterns, and strayng is not a major feature of these migratory patterns. The Bay of Fundy area appears to be a congregating area during summer for juveniles and adults both from the Gulf of Maine and Scotian Shelf areas. Herring from the Cape Cod and western Gulf of Maine areas do not appear to move eastward much farther than the New Brunswick side of the Bay of Fundy, while herring from eastern and southwest Nova Scotia do not appear to move westward much farther than the eastern Gulf of Maine area. Subdiv. 4Vn appears to be an overwintering area for Scotian Shelf and Gulf of St. Lawrence herring stocks.

The Committee concurred with the proposals of the Working Group that further analyses of the data were warranted to consider the effect of fishing effort levels on the interpretation of the recovery information and to consider local movements during the various phases of the annual cycle. For future tagging work, priority should be given to tagging spawning fish and to stocks in the western Gulf of Maine and Cape Cod areas. If the Georges Bank stock recovers, considerable priority should be given to elucidating the migratory pattern of that spawning group.

f) General observations

STACFIS welcomed the completion and presentation of this comprehensive report, noted that much work had gone into analysis of the data, and agreed to refer the matter of publication to STACPUB for consideration. [A subsequent decision resulted in the inclusion of the report of the Working Group as Annex 2 to this STACFIS Report.]

2. Task Force on Larval Herring

The Committee was informed by the Task Force Convener (M. D. Grosslein) that sorting of the 1978 larval herring patch study samples is virtually complete. Only 76 samples from the Georges Bank northeast grid study remain to be sorted at the Polish Sorting Center, and completion of these samples is expected by June 1983. Sorted data from the larval herring patch study off Cape Cod is being quality-controlled and standardized, which includes 61-cm Bongo 0.333-mm mesh herring and zooplankton, 20-cm Bongo 0.165-mm mesh zooplankton, and MOCNESS 1-m 0.333-mm mesh larval herring and zooplankton. Processing of available data from the northeast grid study (61-cm Bongo 0.333-mm mesh) is progressing. It is planned to have standardized tables and plots of data ready for analysis by October 1983 and the presentation of a final report in June 1984.

3. Progress Report on Contributions to Special Session at the September 1983 Annual Meeting

The Committee noted that the conveners (Dr. V. A. Rikhter and Dr. G. R. Lilly) of the Special Session have made all necessary organizational arrangements for the meeting at Leningrad, USSR, during 14-16 September 1983 and that approximately 30 papers are expected to be presented on trophic relationships in marine fishes of the Northwest Atlantic.

4. Proposed Theme for 1985 Special Session

The Committee noted that the theme agreed for the 1984 Annual Meeting is "Biology and Ecology of the Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic", and

recommends

that the Scientific Council consider "Design and Evaluation of Biological Surveys in Relation to Stock Assessments" as a possible theme for the September 1985 Annual Meeting.

5. Proposed Change in the Presentation of the STACFIS Reports

The Committee, in discussing the actual presentation of its report, noted that it has been difficult to reconstruct the stock assessments from the information given in the reports. The basic data used are very often contained in several research documents and working papers. The initial assessments are modified as a result of the discussion by STACFIS and/or in view of new information forthcoming during the meeting. These changes are not fully documented and are only partly contained in the final STACFIS Report. This situation creates the above-mentioned difficulties and is also not in agreement with the basic principal that assessments should be presented in a way that the calculations can be checked and repeated.

To eliminate this problem, the Committee proposes that an annex be added to the STACFIS report which contains the details of the calculations together with all basic data used and all assumptions made. It would be preferable if this could be done in a standard format. It was noted that this would create additional work for the designated experts. Nevertheless, STACFIS

recommends

that a small ad hoc working group of assessment experts, together with the Assistant Executive Secretary, meet at the September 1983 Meeting of the Scientific Council to (i) examine the technical feasibility to produce such an annex, and (ii) to develop a standard format for the presentation of the required information.

X. ACKNOWLEDGEMENTS

There being no further business, the Chairman of STACFIS expressed his thanks to all participants for their keen interest and cooperation during the course of this meeting. He also acknowledged the support

provided by those scientists responible for carrying out the work assigned to the Environmental Subcommittee (R. W. Trites) and the two *ad hoc* Working Groups (G. H. Winters and J. T. Anderson) and other scientists who assisted by preparing the initial draft reports on the various matters under consideration. The Chairman also acknowledged the Secretariat for their usual efficient work both in preparing for and during this meeting.

ANNEX 1. REPORT OF SUBCOMMITTEE ON ENVIRONMENTAL RESEARCH

Chairman: R. W. Trites Rapporteur: J. Gagnon

The Subcommittee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, on 8-9 June 1983, to consider and report on the various matters referred to it by STACFIS. Scientists attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany and France), Japan, Portugal, USSR and USA.

The Subcommittee reviewed the following documents: SCR 83/VI/12, 13, 14, 15, 16, 17, 22, 23, 24, 30; SCS Doc. 83/VI/11. Some undocumented observations were also noted during the discussion. Documents not available at the time of the meeting, but containing relevant environmental information, include SCR Doc. 83/VI/39, 41, 43; SCS Doc. 83/VI/14, 15, 16.

1. MEDS Report for 1982/83 (SCR Doc. 83/VI/24)

The Subcommittee reviewed the report of the Marine Environmental Data Service (MEDS) in its capacity as the regional center for the acquisition and processing of oceanographic data for the NAFO Area. Significant highlights of the report are outlined below.

a) Inventory of data collections in 1982

It was noted that observations from about 7,500 hydrographic stations were made within the NAFO Area in 1982 compared with an estimated 4,700 in 1981. It was reported (SCR Doc. 83/VI/24, tables 1 and 2) that roughly 50% of the observed data was submitted to MEDS, the majority of which was from Canada, with the only other contributions coming from the USSR. Other information, not available to MEDS in time for the meeting, was reported in SCS Doc. 83/VI/11. The *NAFO-MEDS Inventory Form* was completed by only Denmark and France. Despite this poor recovery, the form was considered very useful in identifying data collections by subareas and standard sections, and thus all countries are strongly encouraged to continue to complete and return these inventories in future years.

b) Historical data acquisition

Reference was made to the comprehensive inventory (SCR Doc. 82/VI/44) of historical oceanographic data collected by NAFO member countries but still not submitted to MEDS. Some progress was made with respect to the Subarea 1 data which were submitted to MEDS by Denmark and which concurrently supplemented the NAFO standard section databank. The majority of the data is, however, still outstanding and MEDS will continue its attempt to acquire these through the designated national representatives.

2. Review of Environmental Studies for 1982

a) Subareas 0 to 3

With the exception of SCS Doc. 83/VI/11 and SCR Doc. 83/VI/24, no written reports were available outlining environmental studies undertaken in 1982. It was reported that the hydrographic research carried out by the Greenland Fisheries Investigations in Subarea 1 in 1982 followed the standard program with two major cruises off West Greenland and in the Disko Bay area in July and November, supplemented with five small cruises covering the Fylla Bank section throughout the year. The most notable environmental feature was the salinity of the surface layer which, in 1982, was the lowest observed over the last 5-10 years. It is thought that this may be due to the large number of icebergs present. Salinity in the deeper layers was also below normal values.

Federal Republic of Germany scientists reported that oceanographic observations were taken on the Labrador Shelf (including the Seal Island section) in October-November and some of the standard sections off West Greenland were occupied in November-December.

b) Subareas 4 to 6

Ongoing studies undertaken by the United States were reported in a series of papers (SCR Doc. 83/VI/12, 13, 14, 15, 16 and 17). The locations of the Shelf-Slope front in Subareas 5 and 6 were described as being mostly offshore of its 1973-77 mean position. Although all of the factors influencing the position of the front are not known, Gulf Stream rings were observed to produce major excursions during their presence offshore from the shelf edge. Gulf Stream ring 81-G, which had a life span of 290 days, remained relatively stationary southeast of Georges Bank in the May-August period. The extent of its influence on Georges Bank conditions has not as yet been established. The number of rings found in the area west of 60°W longitude during 1982 equalled the record number (11) for the past 8 years. Variability in thermal structure on the continental shelf in the southern New England and Mid-Atlantic Bight areas can often be correlated with the passage of the warm-core rings. The average position of the cold-pool water (<10°C) shifted

slightly shoreward in 1982. Sea-surface temperature data, as reported in radio weather messages mainly from merchant vessels, indicate a broad negative anomaly in early 1982 but mixed conditions prevailed for the remainder of the year.

It was reported that hydrographic data were acquired on the Scotian Shelf in the August-September period in conjunction with a squid survey by the French research vessel, but no details were available.

3. Overview of Environmental Conditions in 1982

The Environmental Subcommittee annually faces the task of assessing environmental conditions of the previous calendar year. In preparing a report, the Subcommittee relies almost exclusively on the data contained in available research documents and national research reports. While this in itself has been viewed as a worthwhile exercise, it clearly falls short of general expectations for several reasons. It is often difficult to combine data from an array of documents, because environmental changes are generally expressed as anomalies from a "normal" or base period which differs from report to report. Moreover, much of the data collected during the previous year are often not processed to the point where they are available for analysis at the time of the June Meeting. Of even greater concern is how to deal with the aliasing problem, since often there may be one cruise in a particular area during a season or even a year. Under these circumstances, it may be meaningless or even grossly erroneous to use such limited data to make interannual comparison, because the week-to-week changes within a year may often exceed the true between-year variability.

There are a number of environmental data sets, rarely utilized in preparing the environmental overview, that would greatly enhance the usefulness and reliability of the assessment. Included in these data sets are such things as: daily sea-surface temperatures from coastal stations (e.g., Halifax, St. Andrews, Boothbay Harbor), and from offshore areas (e.g. radio-teletype, ships messages, and satellite infrared imagery); subsurface temperature and salinity data from fixed stations (e.g. Station 27 off St. John's, Prince 5 in Bay of Fundy); mean sea level from tide gauges; wave and swell from ships of opportunity; and a range of meteorological parameters, including air temperatures, measured wind speeds and directions, and geostrophic winds.

At the 1982 Meeting of the Environmental Subcommittee, it was agreed that an attempt should be made to analyze some of these data sets prior to the 1983 Annual Meeting. Accordingly SCR Doc. 83/VI/23 was produced as a "pilot" project in order to give committee members an opportunity to assess its value and whether it should be continued. Some of the highlights from this report are summarized as follows:

a) Coastal sea-surface temperatures from a number of stations in Subareas 4 and 5, compared to a base period of observation from 1951 to 1980, showed near normal-mean annual temperatures in 1982, continuing the pattern of the 1970's.

b) Offshore sea-surface temperatures from real-time reports of ships-of-opportunity during 1982 were averaged monthly for 14 areas within Subareas 3, 4, 5 and 6 and compared to a historical base period of these data collected during 1972 to 1980. Anomalies in the annual mean temperature showed a large spatial coherence, indicating that broad ocean areas could be lumped together and summarized. Sea-surface temperatures in Div. 3L, 3P, 4ST and 4V were generally warmer while those in Div. 4X, 5Y, 5Z and Subarea 6 were lower than normal in 1982, continuing a trend established in about 1976.

c) Hydrographic time-series data for Station 27 off St. John's, Newfoundland (Div. 3L), were analyzed with respect to a 1946-77 base period. Relatively high or low anomalies in the base-period data were identified as persistent with time. Generally higher temperatures were observed throughout the water column in January 1982, whereas lower temperatures prevailed from February to September 1982. Salinity anomalies were positive for the January to July 1982 period.

d) Wave statistics, derived from METOC wave charts for the 1970-82 period, were reported for Subareas 2, 3 and 4. Usng the 1970-80 peirod as a base, the significant wave heights for 1981 and 1982 were shown to be more severe than those for the base period for all areas, with the January-May 1982 period in Div. 3L having the most severe conditions ever recorded.

e) Coastal sea-level observations from one station in Div. 3L and one in Div. 4X were analyzed relative to their 1957-1980 and 1953-1980 base periods respectively. Generally, decreasing sea levels until April 1982 were shown with a positive trend in the autumn of 1982.

f) Sea-ice and iceberg conditions for the NAFO Area were summarized for 1982. No marked trends in sea-ice conditions were noted for the area as a whole. For Subareas 1 and 2, ice generally was later than normal (relative to 1964-73 period) in disappearing. There was no sea-ice reported in Div. 3M, 3N or 3O during 1982, which is normally the case. Iceberg conditions, as reflected by the numbers of bergs crossing 48°N latitude, were two-thirds of the 1945-72 period. However, early 1983 reports indicate that a record occurrence of icebergs south of 48°N may be in progress.

g) Observations on air temperatures, representative of a wide area of the coastal region of eastern Canada and the United States, were presented. Decreasing air-temperature anomalies for the entire east coast were observed in January 1982 with a warming trend at the end of 1982, except for Hopedale, Labrador, where a decrease exceeding 3°C was observed. A 1951-82 base period was used for these intercomparisons.

h) Wind statistics for 1981 and 1982, derived both from direct measurements and atmospheric pressure differences, were compared to monthly averages for a base period of 1955-80. Analysis from large-scale pressure differences showed no large deviations in 1981 and 1982 from the long-term annual mean.

4. Remote-Sensing Activities

Instrumental development of the fluorescence line imager in Canada shows considerable promise as another tool for remote sensing of chlorophyll measurements.

5. Synoptic Sea-Surface Temperature (SST) Maps

The most comprehensive SST data base is that acquired from ship-of-opportunity and transmitted directly to shore by radio or subsequently extracted from ships' logbooks. These data are received in real time at FNOC, Monteray, and compiled by 1° quadrangles of latitude and longitude by the Pacific Environmental Group (NMFS). The data are also archived by the National Climatic Center, North Carolina. SCR Doc. 83/VI/16 and 23 domonstrate the types of analyses which are possible with these data.

6. Environmental Data Products Available Aboard Ship

Oceanographic information for the Northwest Atlantic can be received by ships operating in the area (e.g. METOC sea-surface temperature maps). At present time, one of the most useful sea-surface temperature maps covering a large portion of the southern NAFO Area (Newfoundland to Cape Hatteras) is produced 3 times a week by the National Earth Satellite Service of the U.S. National Weather Service. The latest satellite imagery along with data from ships-of-opportunity are incorporated. Unfortunately, these maps are not put out by radio broadcast. The Committee agreed that the appropriate agencies should be encouraged to include these maps in their radio broadcast schedules.

7. National Representatives for Data Exchange

The Subcommittee was informed of changes in national representatives responsible for submitting oceanographic data to MEDS. The present list comprises: Canada (R. Keeley), Cuba (R. J. Dominguez), Denmark (J. Smed), France (M. Melguen), Federal Republic of Germany (D. Kohnke), German Democratic Republic (B. Schreiber), Japan (S. Kawahara), Norway (R. Leinebo), Poland (S. Grimm), USSR (G. I. Luka), United Kingdom (P. Edwards) and USA (E. Ridley).

8. Base Periods

After reconsideration of Recommendation 12 (ICNAF Redbook 1976, p. 136) and SCR Doc. 83/VI/23, the Subcommittee

recommends

that the following base periods be used with respect to environmental variables:

i) base periods for environmental data for the NAFO area should conform with those of the World Meteorological Organization convention of a 30-year mean, using the previous 3 decades, the current base period being 1951-80;

ii) where the data are of shorter duration, 20-year (1961 to 1980) or the 10-year (1971 to 1980) base periods should be used; and

iii) variability of anomaly conditions relative to the above base periods should be indicated by calculating the standard deviation about the mean for each anomaly published.

9. Distribution of *Illex* and Environmental Results

a) Larvae and juveniles

Survey work in recent years have indicated a close interrelationship between water masses in Subareas 4-6 and the winter-spring distribution of squid larvae and juveniles. Work continues to be focussed on the Gulf Stream-Slope Water frontal zone, but no physical oceanographic results were available at the time of this meeting.

Preliminary reports of surveys in early 1983 by the Canadian research vessel *A. Needler* operating from Florida to Cape Hatteras and the USSR research vessel *Gizhiga* in the area south of the Grand Bank and southeast of the Scotian Shelf were presented. On the first phase of the *A. Needler* survey, a Diamond-9 midwater trawl was successful in sampling *Illex* and other cephalepods. However, preliminary results indicate that the Bongo and Neuston nets were largely unsuccessful in capturing *Illex* larvae and juveniles, presumably due to low density or to net avoidance.

b) Adults

Preliminary results from France-Canada cooperative surveys on the Scotian Shelf in August-September indicate that surface and bottom temperatures were lower in 1982 than in the two preceding years. Best catch rates for squid were noted to coincide with bottom temperatures ranging from 5° to 10°C.

10. Other Matters

There being no further business, the Chairman thanked the rapporteur and participating scientists for their cooperation and interest during the course of the meeting.

ANNEX 2. REPORT OF *AD HOC* WORKING GROUP ON HERRING TAGGING

Convener: W. T. Stobo Rapporteur: C. Walton

The Working Group was established by the Standing Committee on Fisheries Science (STACFIS) in September 1981 and was requested to meet in early 1982 to coordinate the analysis of the large volume of tagging data preparatory to further consideration by the Committee. The Group met at Quebec City, Quebec, Canada, during 12-14 January 1982, with the following scientists in attendance: L. Clearly, J. Gagné, H. Powles and W. T. Stobo (for Canada); and V. Anthony, T. Creaser, M. Fogarty, M. Hunter, D. Libby, M. Sissenwine, C. Walton and G. Waring (for USA).

1. Preamble

It was noted that almost all of the herring tagging data being considered by the Working Group were unpublished and, in some cases, preliminary in nature, and it was emphasized that responsibility for full analysis of the data and publication of the results lie with the laboratories involved. It was further noted that attempts for simultaneous publication by the laboratories involved would be advantageous.

2. History of Herring Tagging in Subareas 4, 5 and 6

Tagging of herring in the NAFO Area was successfully attempted in the winter of 1970 in southwestern Newfoundland (Div. 3P) and in the spring of that year in the southern Gulf of St. Lawrence (Div. 4T), using internal magnetic tags. Attempts to elucidate herring movements and stock relationships in the Scotian Shelf, Gulf of Maine and Georges Bank areas first began in November 1973, using a T-bar anchor tag.

The work in late 1973 and several additional experiments in 1974 were concentrated on herring populations in the Bay of Fundy which were being exploited by Canadian purse-seine and fixed-gear fisheries. In 1975, based on tagging information, the Standing Committee on Research and Statistics of ICNAF (International Commission for the Northwest Atlantic Fisheries) recommended, and the Commission agreed, that the herring management structure of Subarea 4 be changed. The changes involved treating Div. 4V and 4WX as discrete management areas instead of Div. 4VWa and 4XWb as previously.

In 1976, largely due to the proven feasibility of tagging herring from the 1973-74 experiments, the Working Group on International Herring Tagging was established by ICNAF to develop an international tagging program to elucidate stock relationships in Subareas 4, 5 and 6. The primary objective was to describe the seasonal migration and intermixture of adult and juvenile stages of the herring stocks. Specific objects were (a) to define the feeding, spawning and overwintering areas; (b) to define recruitment migrations from the juvenile fisheries; (c) to define quantitatively the proportions of intermixing of stocks present in feeding and overwintering areas; and (d) to provide estimates of mortality rates.

The efforts of the ICNAF Working Group resulted in the development of several international and national tagging programs such that, during 1973-81, more than 500,000 herring were tagged in Subareas 4, 5 and 6 (Attachment 1). With the demise of ICNAF in 1979, there was no established forum to further coordinate herring tagging projects and to jointly analyze results. In 1981, this NAFO Working Group was established to review the results and assess the success of the tagging studies.

In discussion, the Working Group felt that specific objectives (a) and (b) were attainable and that the current information provided much of what was required to address these issues. Due to the collapse of the Georges Bank herring stock after 1976, an important omission will be information on the movements of Georges Bank fish and their contribution to other fisheries on adults and juveniles. Quantitative estimates of intermixing proportions were considered difficult to obtain from the present data, largely due to the difficulty of standardizing catch rates of the various gears and fisheries. Yet, standardization is an important consideration in trying to determine the relative significance of total tag recoveries from two or more disparate geographical areas and fisheries in terms of proportional contributions to areas of stock intermixing. Regarding objective (d), it was considered that mortality rates wuld be almost impossible to obtain from the current data, because (i) a very small proportion of the estimated population numbers in the NAFO Area were tagged (i.e. 500,000 tagged fish in populations numbering several billion), (ii) and populations are not closed and hence immigration and emigration would confound results, and (iii) the exploitation rates of the various fisheries are different and difficult to standardize, again confounding mortality estimates.

The Working Group noted that there is a major basic assumption in interpretation of the results of tagging studies. Information on the movement of tagged fish comes largely from tags recovered in the commercial fisheries, which are seasonal in nature. Thus, it must be assumed that exploitation

of the Northwest Atlantic herring stocks has developed to the extent that all major seasonal herring concentrations are being exploited by a fishery (except in northern areas such as the Gulf of St. Lawrence where ice formation may prevent fishing in winter). The corollary to this assumption is that if there is no fishery in a particular season and area, it is because there are no fish there to be exploited. A short description of the nature and seasonality of the herring fisheries in Subareas 4, 5 and 6 is given in Attachment 4.

3. Logistics of Tagging Studies

Although several different types of tags have been used for tagging herring, the external anchor tag is now used almost exclusively in the Northwest Atlantic. The popularity of this tag is due to its rapid application with a tagging gun, which enables the marking of large numbers of herring in short periods of time. The method of tagging, the potential effect of the tag on the fish, and the techniques used to capture live fish were described by W. T. Stobo in 1976 (ICNAF Res. Doc., No. 76/101, Ser. 3924). Because herring descale easily, a capture technique which involves severe crowding results in substantial loss of scales and consequent increase in tagging mortality.

4. Discussion of Tagging Results

Tagging experiments were conducted during various phases of the annual cycle on juveniles, adults and mixed groups of herring (Fig. 1). The Working Group decided that some categorization was necessary in order to associate biological meaning to the observed tag recovery information. Each tagging experiment was therefore assigned to one of the following categories and the observed movements interpreted accordingly: (i) overwintering, (ii) spring migration, (iii) summer feeding, (iv) spawning, and (v) autumn migration. It was agreed that only category (iv) herring could provide information on stock discreteness and that 90-95% of the fish must be at maturity stage 6 (ripe and running) to attain reliable information on stock movement (i.e. stock identification). The results of tagging experiments have shown that, if the proportion of sexually non-mature fish is higher than 5-10%, the concentration may be a mixture of more than one stock, and the admixture of stocks will persist until commencement of spawning. The remaining four categories provide insights into movements and mixtures of herring concentrations during other phases of their life history.

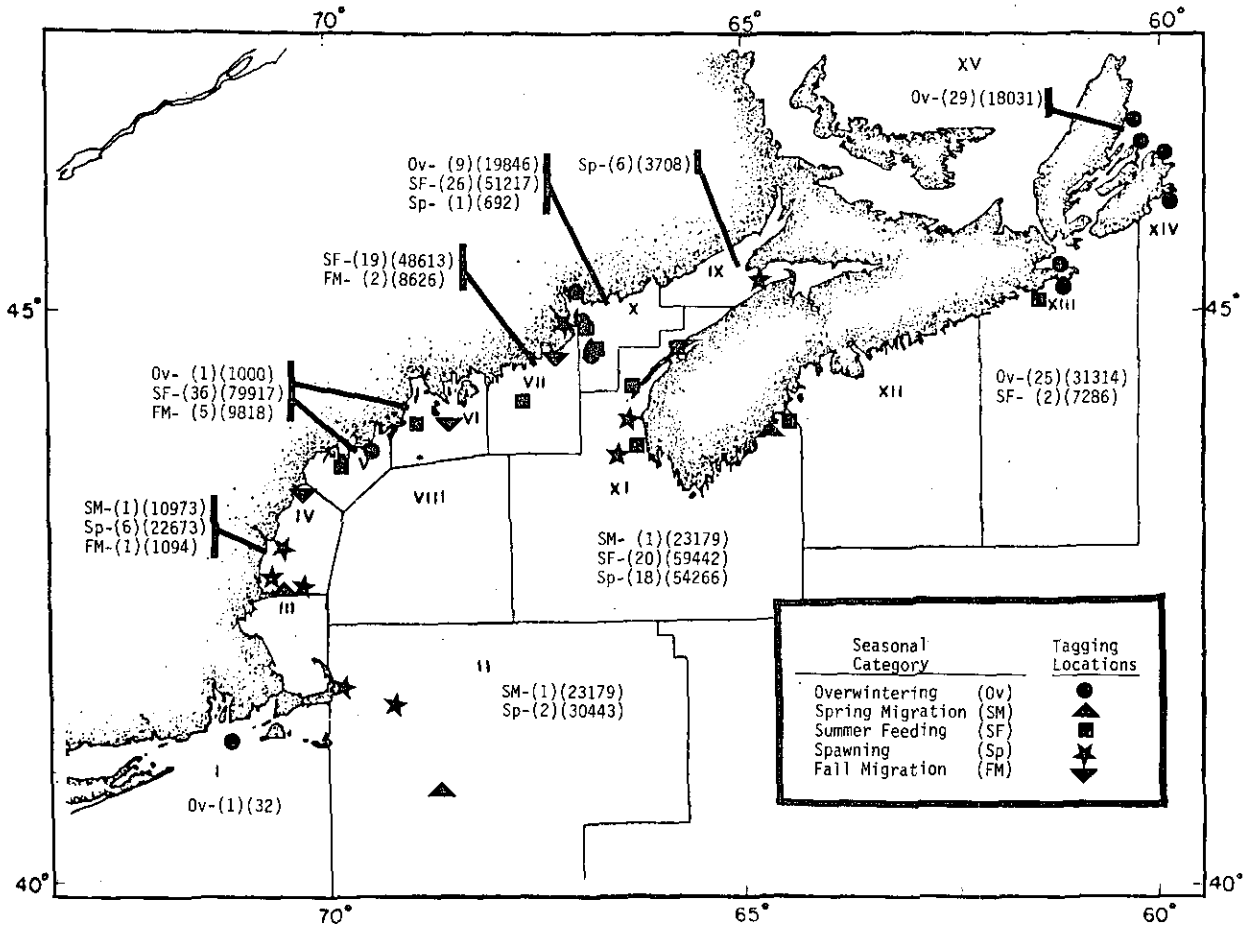


Fig. 1. Regions I-XIV established for analysis of tagging data in Subareas 4 and 5, and the numbers of release sites and of herring tagged in each region by seasonal category.

To facilitate analysis of the data, Subareas 4-6 were divided into 15 geographical regions (Attachments 2 and 3), which were used in summarizing the tag release and recovery data for each of the five seasonal phases of the annual cycle and the three categories of herring tagged (juveniles, adults and mixed groups) (Table 1). The data include the numbers of release sites (separate tagging experiments), numbers of fish tagged, numbers of recoveries from the date of tagging, and numbers of *longer-term recoveries* (excluding those recovered within 2 weeks of tagging). The overall recovery rate (long-term recoveries) varied from 0% or near 0% in some cases to about 5% for summer-feeding fish in regions 7-10, indicating that one must accept a low recovery rate in herring tagging experiments. Consideration of the total recoveries in calculating recovery rates is inappropriate because many of the recovered tags were from fish caught very shortly after release. In fact, from all tagging experiments, the majority of recoveries were made during the first year after release. Consequently, experiments which concentrated on fish during the relatively non-mobile summer-feeding phase yielded considerably less valuable information on movements and migrations, because most of the recoveries were made *in the general area of release*. The recovery rate for summer-feeding juveniles in regions 7-10 was 5.4%, and a similar rate (5.0%) pertained to summer-feeding adults in regions 5-6. Experiments on spawning fish consistently yielded recovery rates less than 2%. It may be that the stress experienced by tagging, together with the stress from spawning, substantially increases mortality. However, equally low recovery rates resulted from experiments on non-spawning fish. Thus, any conclusions pertaining to the association of greater mortality with experiments during any particular seasonal phase or life history stage are merely speculative.

Table 1. Release and recovery information for herring tagging operations during 1973-81. For each seasonal phase of the annual cycle, data are grouped by regions (Fig. 1) and life cycle stage (J = juveniles, A = adults, M = mixed juveniles and adults).

	No. release sites				Total numbers tagged				Total recoveries				Long-term recoveries[2]			
Region[1]	J	A	M	Total	J	A	M	Total	J	A	M	Total	J	A	M	Total
Overwintering																
1	-	1	-	1	-	32	-	32	-	0	-	0	-	0	-	0
5	1	-	-	1	1000	-	-	1000	15	-	-	15	15	-	-	15
10	8	-	1	9	19056	-	790	19846	475	-	2	477	392	-	2	394
13	-	-	25	25	-	-	31314	31314	-	-	1024	1024	-	-	396	396
14	-	29	-	29	-	18031	-	18031	-	1219	-	1219	-	748	-	748
Spring migration																
2	-	1	-	1	-	23179	-	23179	-	262	-	262	-	262	-	262
3-4	-	1	-	1	-	10973	-	10973	-	490	-	490	-	490	-	490
11-12	4	-	1	5	20316	-	3639	23955	95	-	13	108	81	-	11	92
Summer feeding																
5-6	26	5	5	36	65907	6273	7737	79917	3290	611	717	4618	2333	310	122	2765
7-10	29	7	9	45	61025	20485	18320	99830	5147	897	1529	7573	3309	742	985	5036
11	-	-	20	20	-	-	59442	59442	-	-	1479	1479	-	-	633	633
13	-	2	-	2	-	7286	-	7286	-	115	-	115	-	94	-	94
Spawning																
2	-	2	-	2	-	30443	-	30443	-	14	-	14	-	14	-	14
4	-	6	-	6	-	22673	-	22673	-	305	-	305	-	302	-	302
10	-	1	-	1	-	692	-	692	-	25	-	25	-	21	-	21
9	-	6	-	6	-	3708	-	3708	-	404	-	404	-	45	-	45
11	-	18	-	18	-	54266	-	54266	-	1487	-	1487	-	750	-	750
Autumn migration																
4	-	-	1	1	-	-	1094	1094	-	-	183	183	-	-	30	30
5-6	2	-	3	5	3097	-	6721	9818	301	-	349	650	121	-	178	299
7	-	1	1	2	-	4998	3628	8626	-	56	38	94	-	25	38	63

[1] Regions where no tagging was done during a particular phase of the annual cycle are excluded; regions are grouped in cases where tagging operations applied to more than one area.

[2] To discriminate between immediate recoveries and those showing migration, all recoveries occurring within 2 weeks of tagging were excluded from the "*long-term recoveries*".

a) Overwintering

Tagging experiments were conducted on overwintering fish in four regions (5, 10, 13 and 14) (Fig. 1). Overwintering herring concentrations are known to exist in the Long Island-Rhode Island area (region 1), Massachussetts Bay (region 3) and the New Brunswick side of the Bay of Fundy (region 9). The last region poses special difficulties because the size of the overwintering herring are quite small (10-15 cm, total length). The recovery information is presented in Fig. 2-4.

The movements of juveniles (Fig. 2) appear to be restricted. In both tagging regions, the majority of the recoveries were from the region of release in the same or subsequent years. Region 10 fish exhibited considerable movement throughout the Bay of Fundy and around southwestern Nova Scotia, with some tendency to expand their distribution during spring and summer (April-September) and to contract their distribution during autumn and winter (October-March). The experiment in region 5 was small and very limited movement occurred. More tagging experiments during the overwintering phase in western Maine might improve the information from that area, although a better strategy might be to tag fish further to the southwest. Most of the fish tagged in the Gulf of Maine (region 5) and some of those tagged in the Bay of Fundy (region 10) were quite small (approximately 12 cm, total length).

The experiments in region 13 were conducted on a mixture of adults and juveniles (Fig. 3), and the results indicate wide dispersion. The majority of the fish seem to move into the southwest Nova Scotia and Bay of Fundy areas (regions 9-11) in summer and return to Chedabucto Bay (region 13) in winter. There appears to be limited movement of fish from Chedabucto Bay to the Gulf of Maine and the Gulf of St. Lawrence.

The tagging experiments in Sydney Bight (region 14) were conducted on adult herring (Fig. 4) and the results again show wide dispersion. The summer distribution, although concentrated in regions 14 and 15, appears to extend into the Bay of Fundy. In winter, the distribution is concentrated in the northern regions (13-15). No recoveries from the region 14 experiments were reported in the Gulf of Maine.

Data from the overwintering experiments in regions 1 and 10 are not discussed, because there were no recoveries from the region 1 experiment and all recoveries from the region 10 experiment were made in regions 10 and 11. A similar situation exists for the region 5 experiments.

b) Spring migration

Tagging experiments were conducted on spring migrating fish in five regions (2, 3, 4, 11 and 12) (Fig. 1). The results of the experiments in regions 3 and 4 were combined due to similarity in movements. The recovery information is presented in Fig. 5-8.

The experiments in region 2 were conducted in the Great South Channel area (Fig. 5). The results indicate that fish are concentrated in the southern regions during January-March and then move eastward, distributing themselves primarily along the western Maine coast but also to the entrance of the Bay of Fundy during the remainder of the year.

The results from experiments in regions 3 and 4, also conducted on adult herring (Fig. 6), exhibit a similar pattern of movement to those of region 2, except that spring migration appears to commence earlier and the fish move farther eastward (as far as region 13). It seems that a larger proportion of these fish, than those from region 2, are found at the entrance to the Bay of Fundy in summer and autumn.

The results from experiments conducted on spring migrants in regions 11 and 12 are shown separately because the experiments in region 12 were conducted on mixed fish (Fig. 7) and those in region 11 on juveniles (Fig. 8). The results from the mixed group (Fig. 7) indicate that these fish are located off southwest Nova Scotia in summer and autumn and move eastward to regions 13 and 15 in winter, but the number of recoveries from this experiment were small. The juveniles (Fig. 8) exhibit a similar pattern, except that the eastward movement in winter is much less pronounced.

The data from all tagging experiments involving spring-migrating herring indicate that the entrance to the Bay of Fundy is an area of convergence at least for a portion of the herring populations in the Gulf of Maine and southern Nova Scotia areas.

c) Summer feeding

Tagging experiments were conducted during the summer-feeding phase in six regions (5, 6, 7, 10, 11 and 13) (Fig. 1). Experiments were extensive during this period, when herring were more accessible, and were conducted on groups of juveniles, adults and mixed fish (Fig. 9-16).

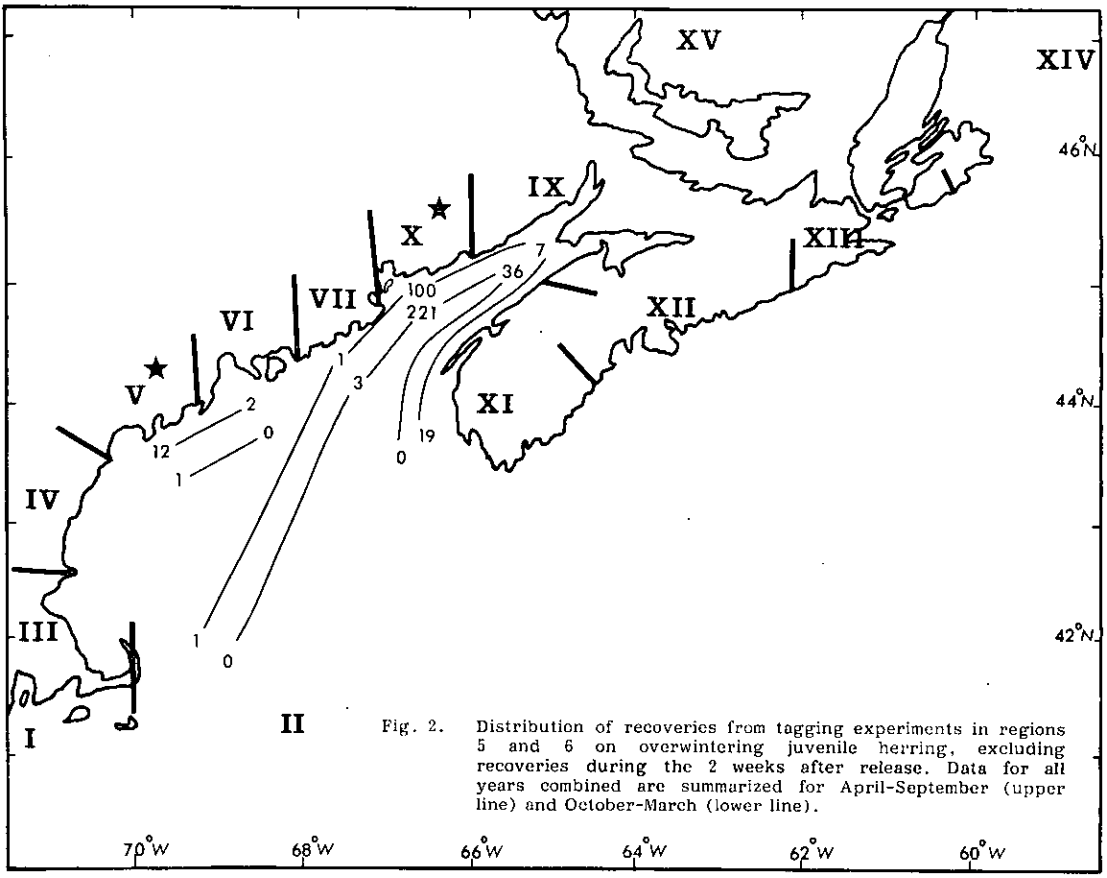


Fig. 2. Distribution of recoveries from tagging experiments in regions 5 and 6 on overwintering juvenile herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line) and October-March (lower line).

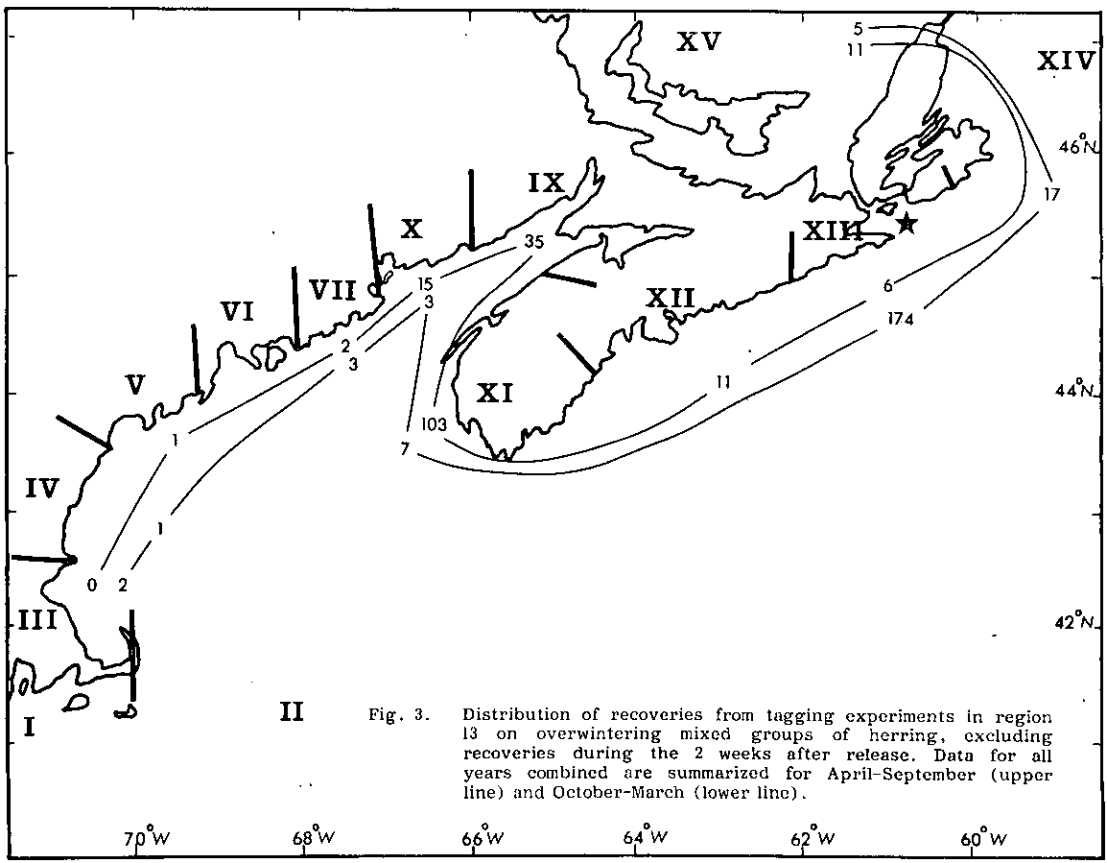


Fig. 3. Distribution of recoveries from tagging experiments in region 13 on overwintering mixed groups of herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line) and October-March (lower line).

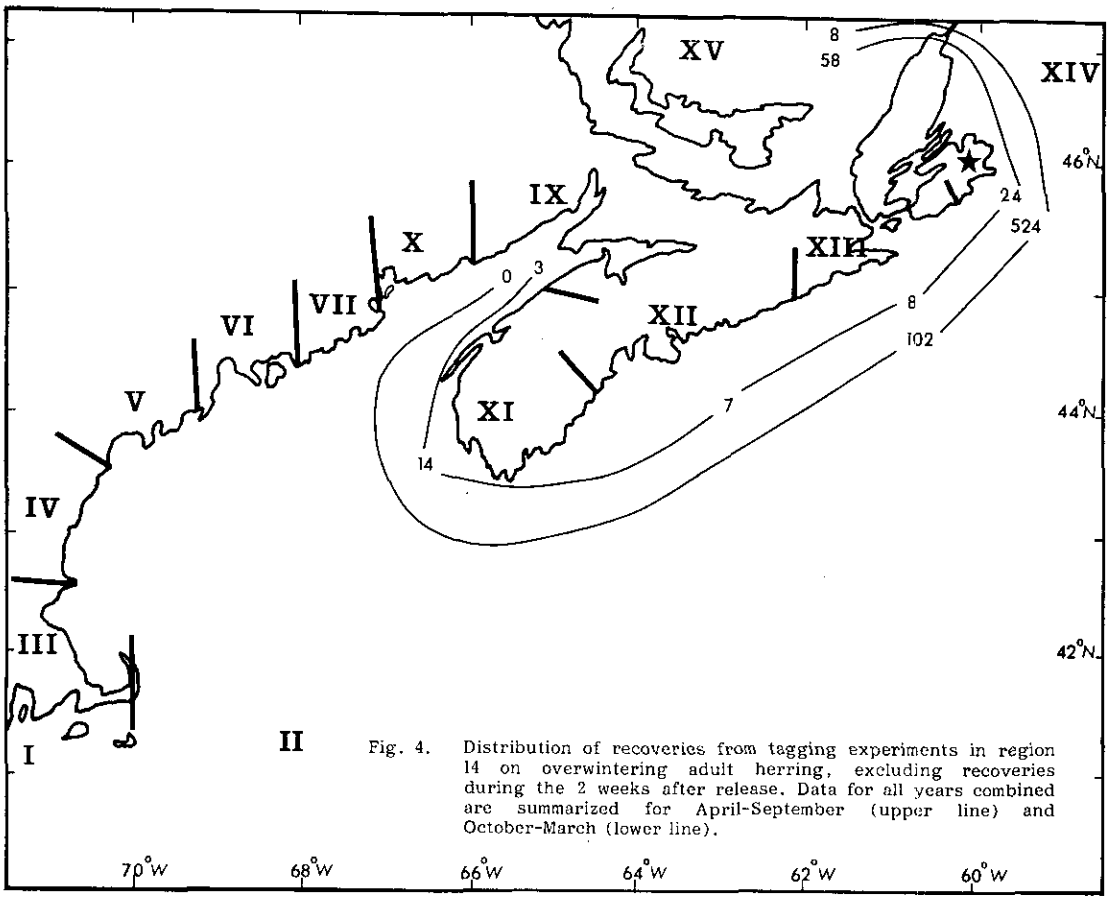


Fig. 4. Distribution of recoveries from tagging experiments in region 14 on overwintering adult herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line) and October-March (lower line).

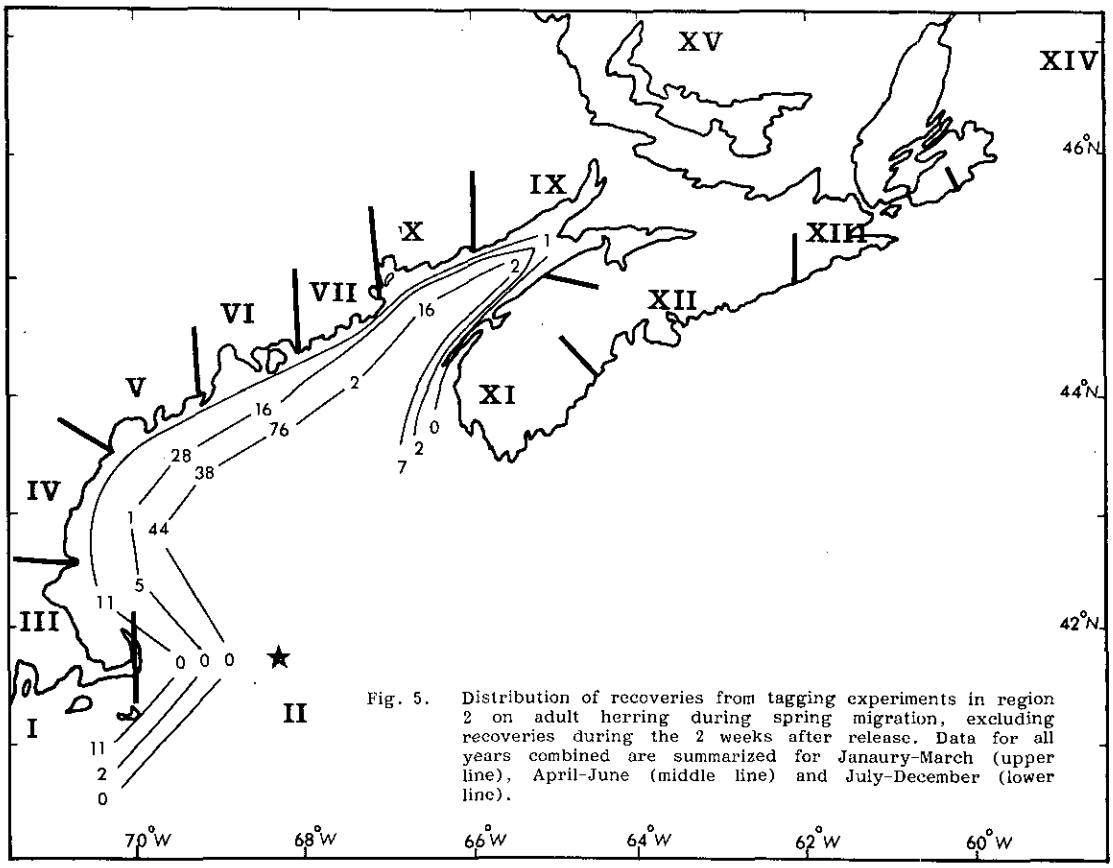


Fig. 5. Distribution of recoveries from tagging experiments in region 2 on adult herring during spring migration, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for Janaury-March (upper line), April-June (middle line) and July-December (lower line).

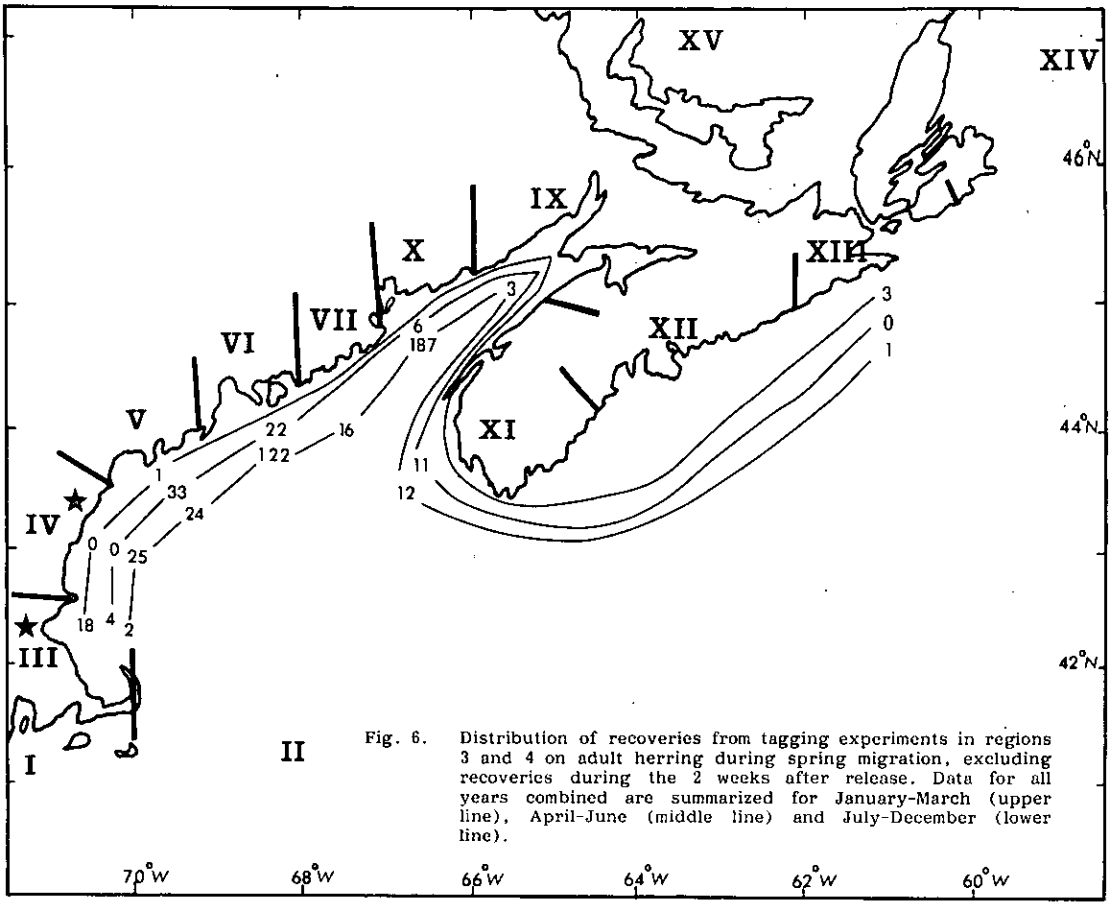


Fig. 6. Distribution of recoveries from tagging experiments in regions 3 and 4 on adult herring during spring migration, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for January-March (upper line), April-June (middle line) and July-December (lower line).

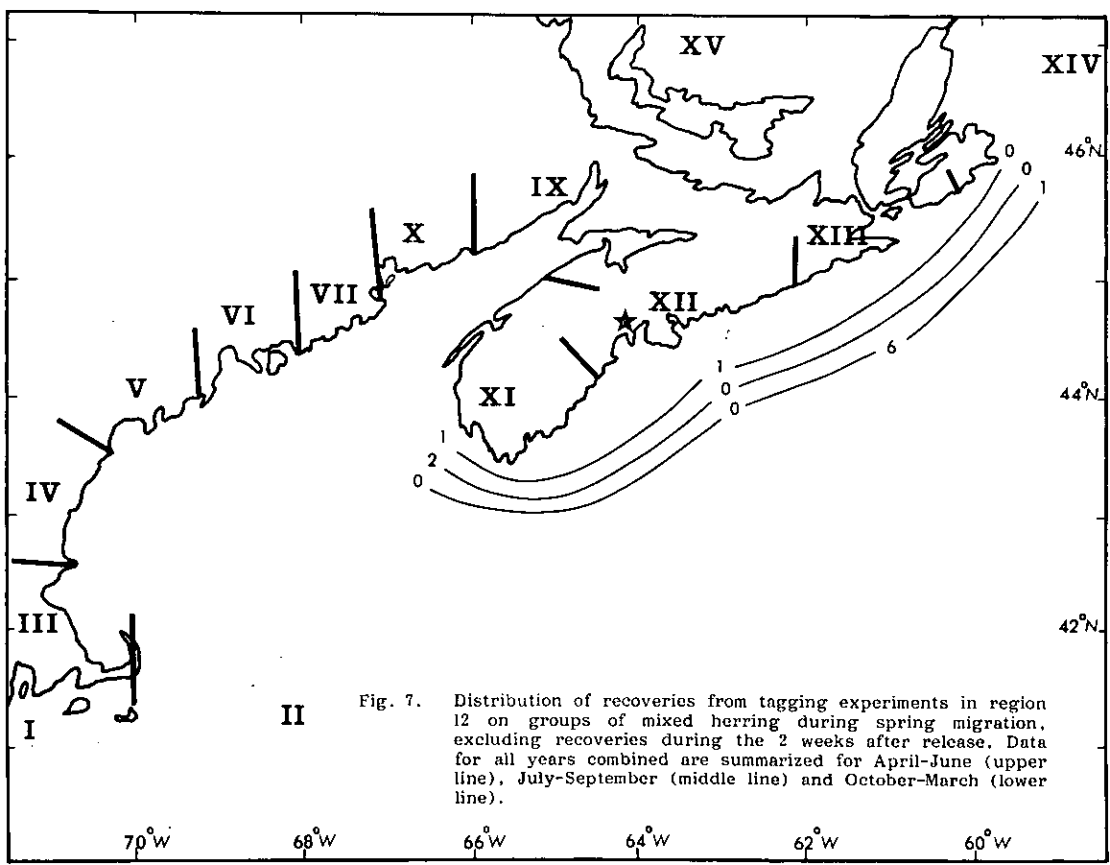


Fig. 7. Distribution of recoveries from tagging experiments in region 12 on groups of mixed herring during spring migration, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-June (upper line), July-September (middle line) and October-March (lower line).

Juveniles, adults and mixed groups, tagged in regions 5 and 6 during the summer-feeding period, appear to undergo similar subsequent movements (Fig. 9-11). They appear to remain highly concentrated in these regions from April to December, with some indication of movement eastward to the Bay of Fundy entrance in summer-autumn and subsequently southwestward in winter.

Adult herring tagged in region 7 during the summer-feeding period appear to disperse rather widely in regions 5-11 during April-December (Fig. 12), although only one tag was recovered in the inner part of the Bay of Fundy. During April-December, the fish remain concentrated in the area of release but they also concentrate in region 10. During January-March, they appear predominantly in the southern areas (regions 1-4), indicating an overwintering movement southwestward. Mixed groups of fish tagged in regions 7 and 10 during the summer (Fig. 13) also become distributed widely in regions 5-11 during April-December but show a greater tendency to move into the inner part of the Bay of Fundy. Recoveries during January-March were few for this group and thus may be of limited value, but overwintering movements eastward to region 14 and southwestward to region 4 are indicated. Movement to regions 1-3 was not demonstrated by this mixed-group.

Juveniles tagged in regions 7 and 10 during the summer-feeding period (Fig. 14) exhibited movements similar to those of the mixed group except that recoveries were made near both extremes of the distributional area (regions 1 and 14) in most seasons. There seems to be a tendency for juveniles to concentrate at the entrance to the Bay of Fundy throughout the year, but primarily during April-December. There appears to be three areas of concentration during January-March: a large one at the entrance to the Bay of Fundy, a major group spread through regions 1, 3 and 4, and a smaller concentration in region 13.

The overall results from the tagging experiments in region 7 and 10 indicate that the entrance to the Bay of Fundy is a summer-feeding area for a mixture of juveniles and adults which remain there for most of the summer-autumn period. The majority of adults tagged in these regions appear to move southwestward to overwinter in the Cape Cod area, whereas many of the juveniles remain in the Bay of Fundy with some moving southwest toward Cape Cod and a smaller number moving northeast toward Cape Breton.

Mixed groups of herring tagged in region 11 during the summer-feeding period (Fig. 15) appear to remain primarily in and at the entrance to the Bay of Fundy during April-December, although a small portion disperses as far south as region 2 and as far north as region 15. Most of these fish appear to leave the Bay of Fundy area in autumn, the majority moving northeast towards Cape Breton and a smaller number to the Cape Cod area to overwinter.

Adults tagged in region 13 during the summer-feeding period did not move farther south than region 10 (Fig. 16). Generally, they remained in the area of release during the summer, although there was some movement toward southwest Nova Scotia. In October-December, a substantial proportion appears to have moved to the Bay of Fundy area but many were still found in region 13. These observations indicate that one component of the herring population found in region 13 in summer is resident in the area whereas another component moves to the Bay of Fundy area.

d) Spawning

Tagging experiment on spawning grounds in summer or autumn were conducted in six regions (2, 3, 4, 9, 10 and 11) (Fig. 1). The results are presented in Fig. 17-20.

The spawning herring tagged on Cultivator's Shoals (region 2) exhibited very little movement on the basis of only 14 recoveries from more than 30,000 fish tagged (Fig. 17). Few conclusions can be drawn from this experiment other than the movement of some fish into the western Gulf of Maine during the first half of the year. Less than 700 tags were applied to fish on the Cutler-Grand Manan spawning grounds (region 7), but the recoveries (Fig. 17) indicate that these fish stay primarily on the Maine-New Brunswick side at the entrance to the Bay of Fundy during the latter half of the year, with some movement southwestward in winter.

Results from tagging the Jeffreys Ledge-Nantucket Shoals spawning group (regions 3 and 4) (Fig. 18) indicate rather limited movement outside the areas of tagging. There appears to be a movement eastward toward the Bay of Fundy in the latter half of the year, but this movement must occur during July-September because these fish spawn in the Jeffreys Ledge and Nantucket Shoals areas in September-October. From the limited number of recoveries, it is tenuous to suggest that these fish move southward to overwinter in regions 1 and 2.

It is interesting to note that these tagging experiments in the Gulf of Maine (Fig. 17 and 18) yielded no recoveries in the inner part of the Bay of Fundy, off southwest Nova Scotia, or farther eastward.

The tagging experiment in Scott's Bay (region 9) was on a summer-spawning population (Fig. 19). These fish appear to disperse throughout the Bay of Fundy and its approaches during

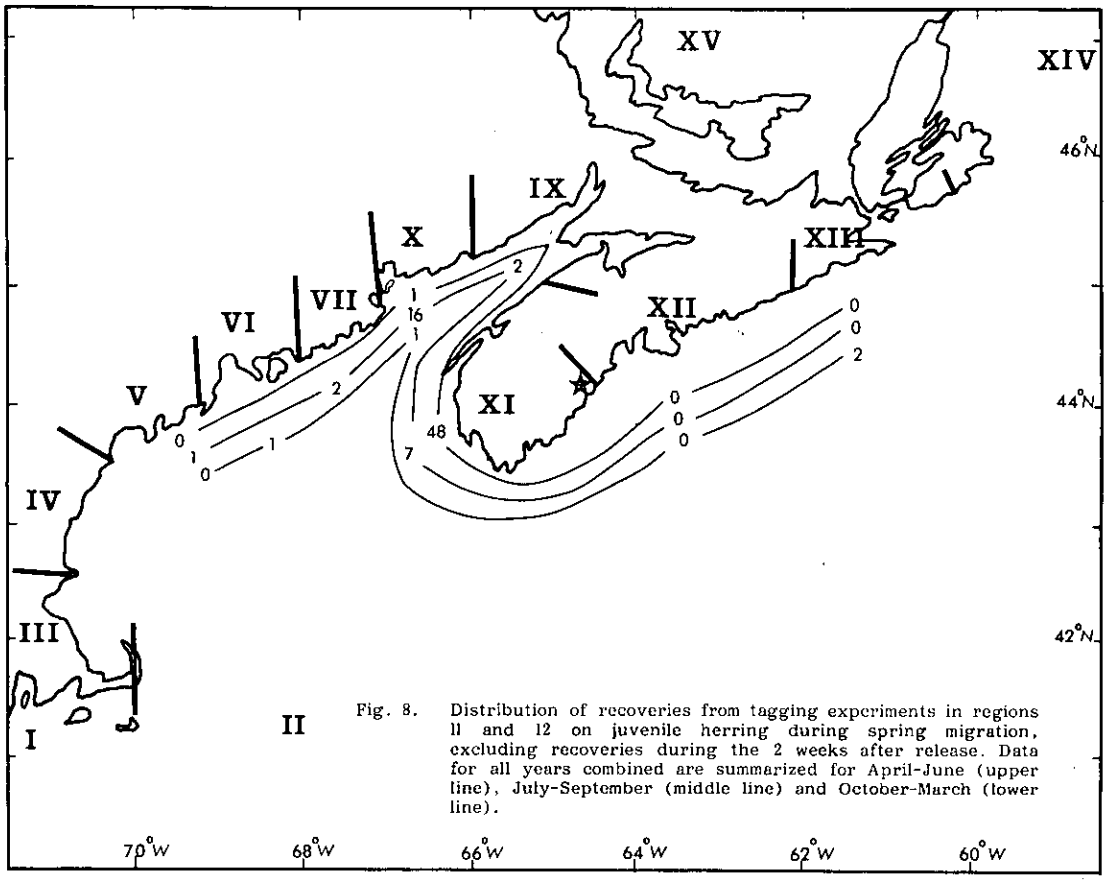


Fig. 8. Distribution of recoveries from tagging experiments in regions 11 and 12 on juvenile herring during spring migration, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-June (upper line), July-September (middle line) and October-March (lower line).

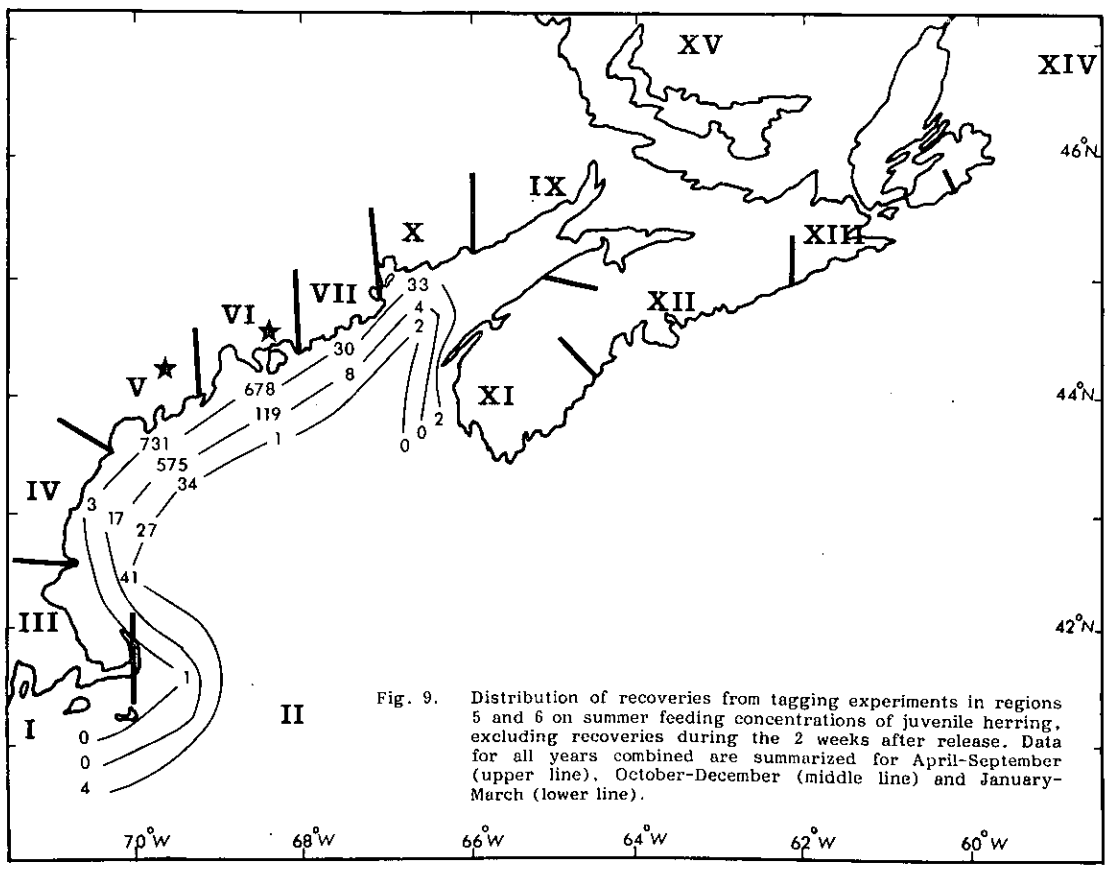


Fig. 9. Distribution of recoveries from tagging experiments in regions 5 and 6 on summer feeding concentrations of juvenile herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

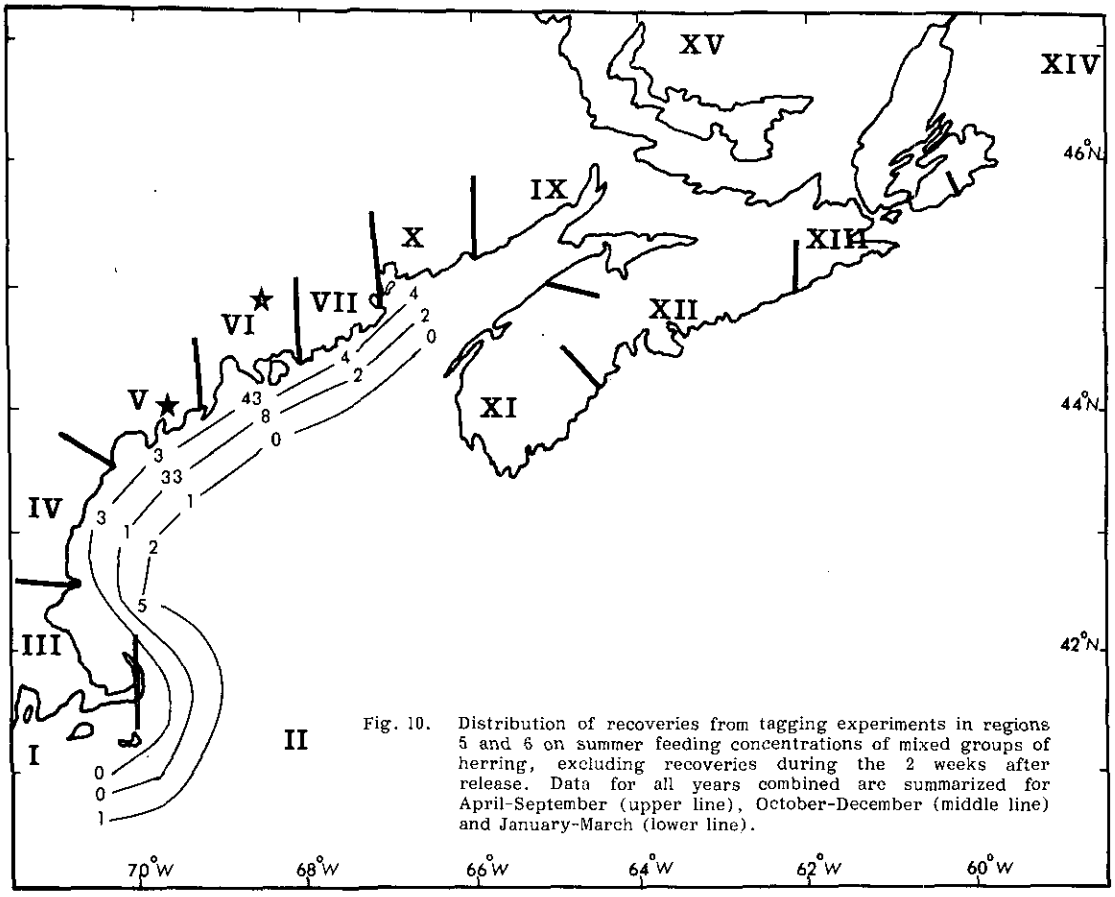


Fig. 10. Distribution of recoveries from tagging experiments in regions 5 and 6 on summer feeding concentrations of mixed groups of herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

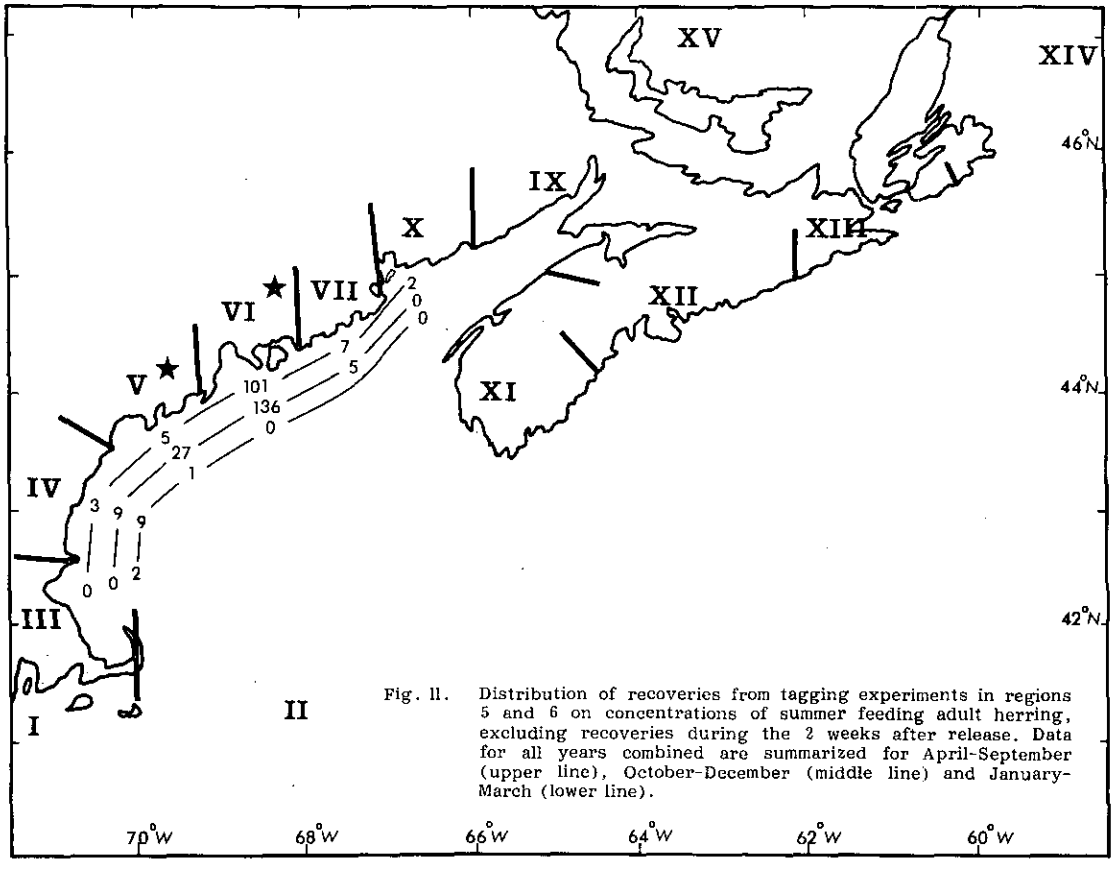


Fig. 11. Distribution of recoveries from tagging experiments in regions 5 and 6 on concentrations of summer feeding adult herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

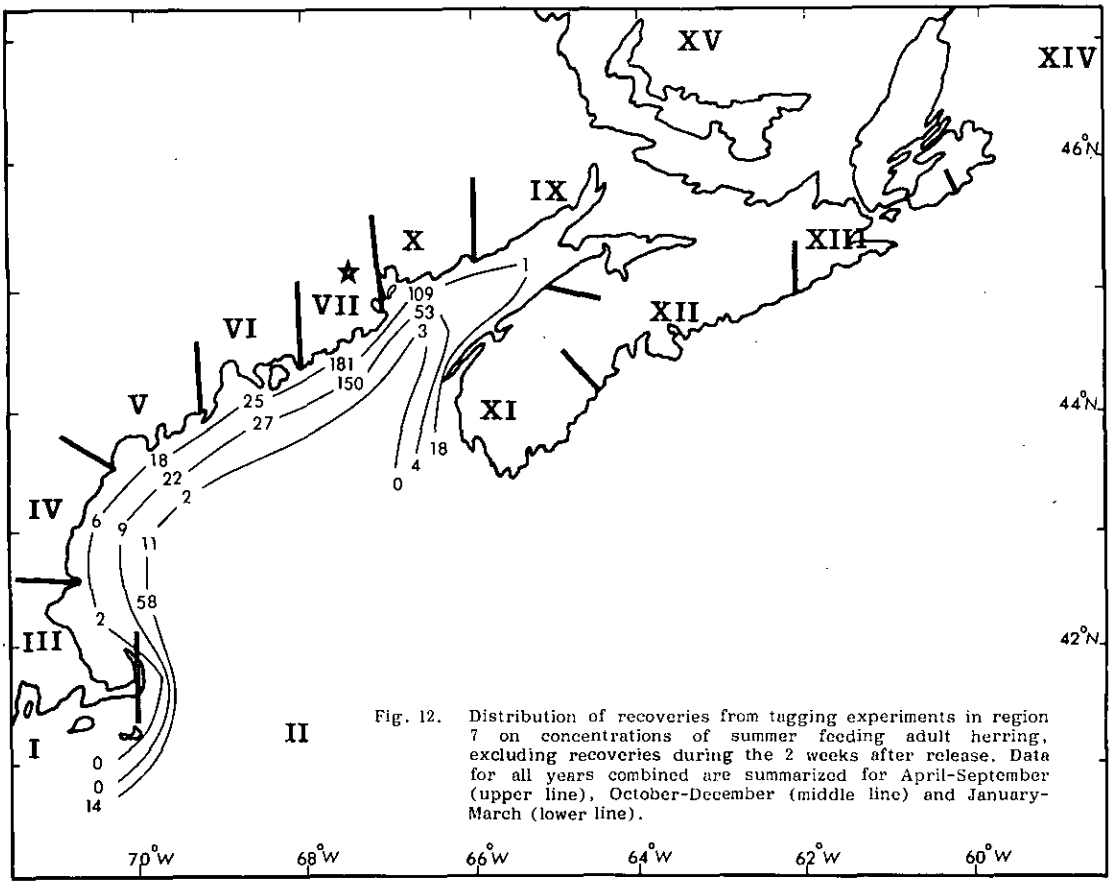


Fig. 12. Distribution of recoveries from tagging experiments in region 7 on concentrations of summer feeding adult herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

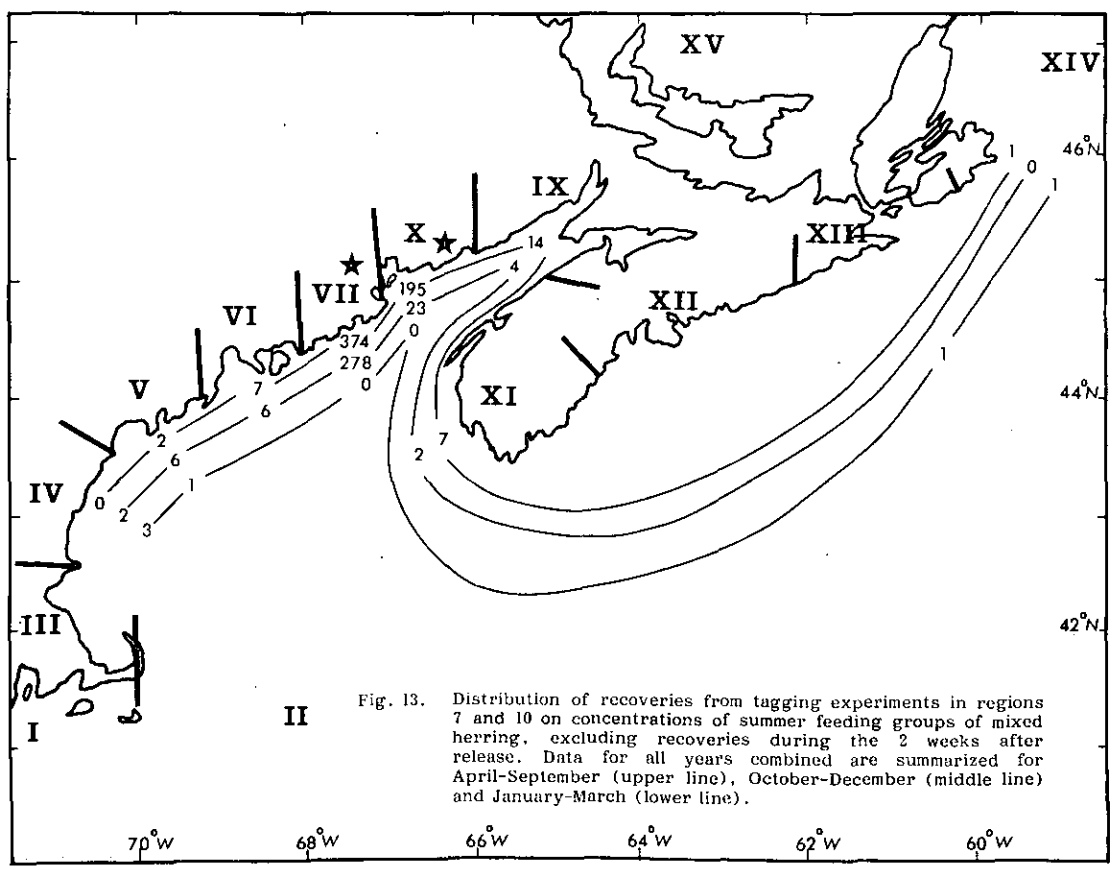


Fig. 13. Distribution of recoveries from tagging experiments in regions 7 and 10 on concentrations of summer feeding groups of mixed herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

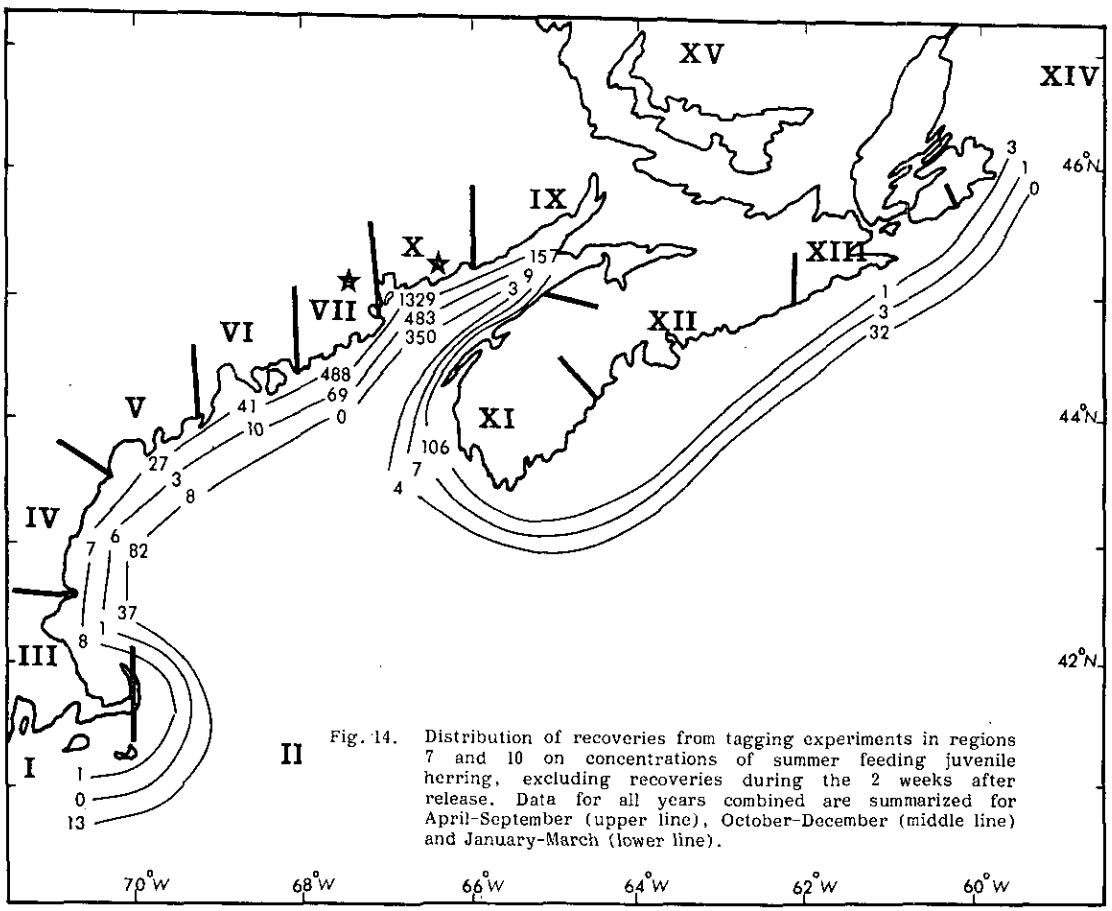


Fig. 14. Distribution of recoveries from tagging experiments in regions 7 and 10 on concentrations of summer feeding juvenile herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

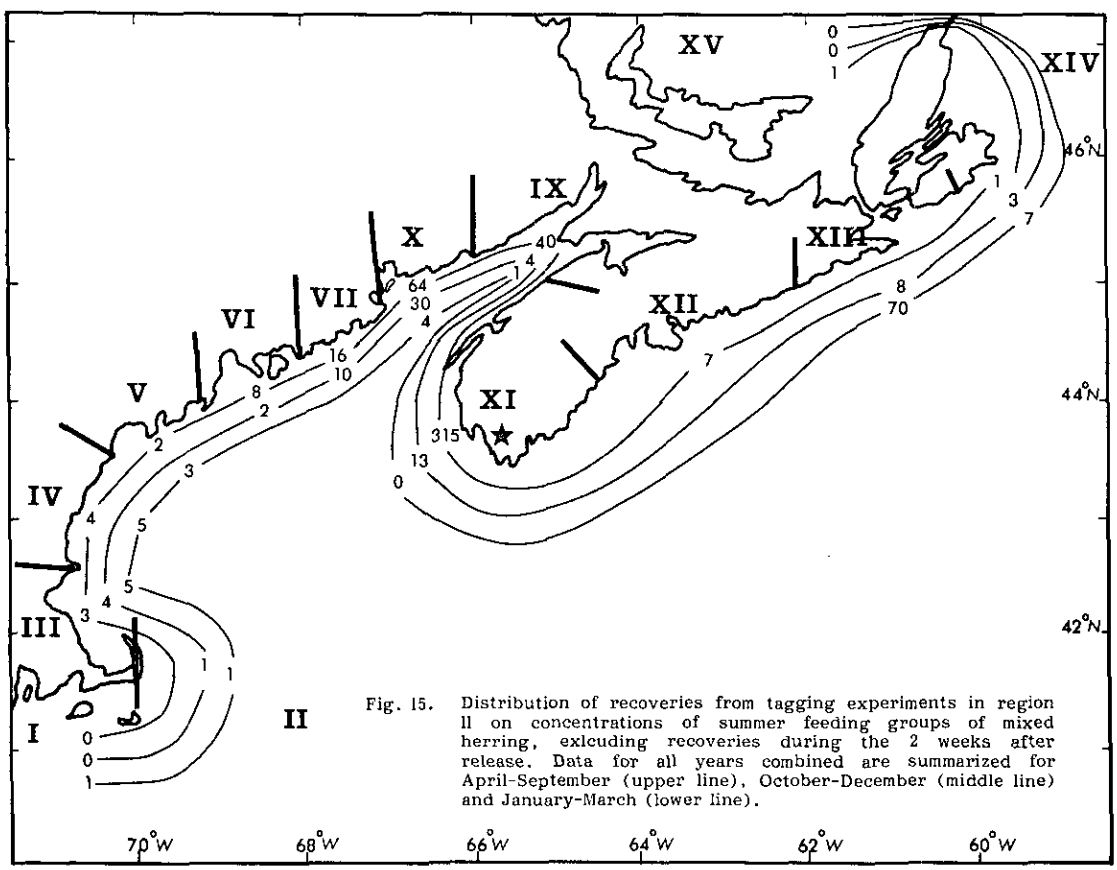


Fig. 15. Distribution of recoveries from tagging experiments in region II on concentrations of summer feeding groups of mixed herring, exlcuding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-September (upper line), October-December (middle line) and January-March (lower line).

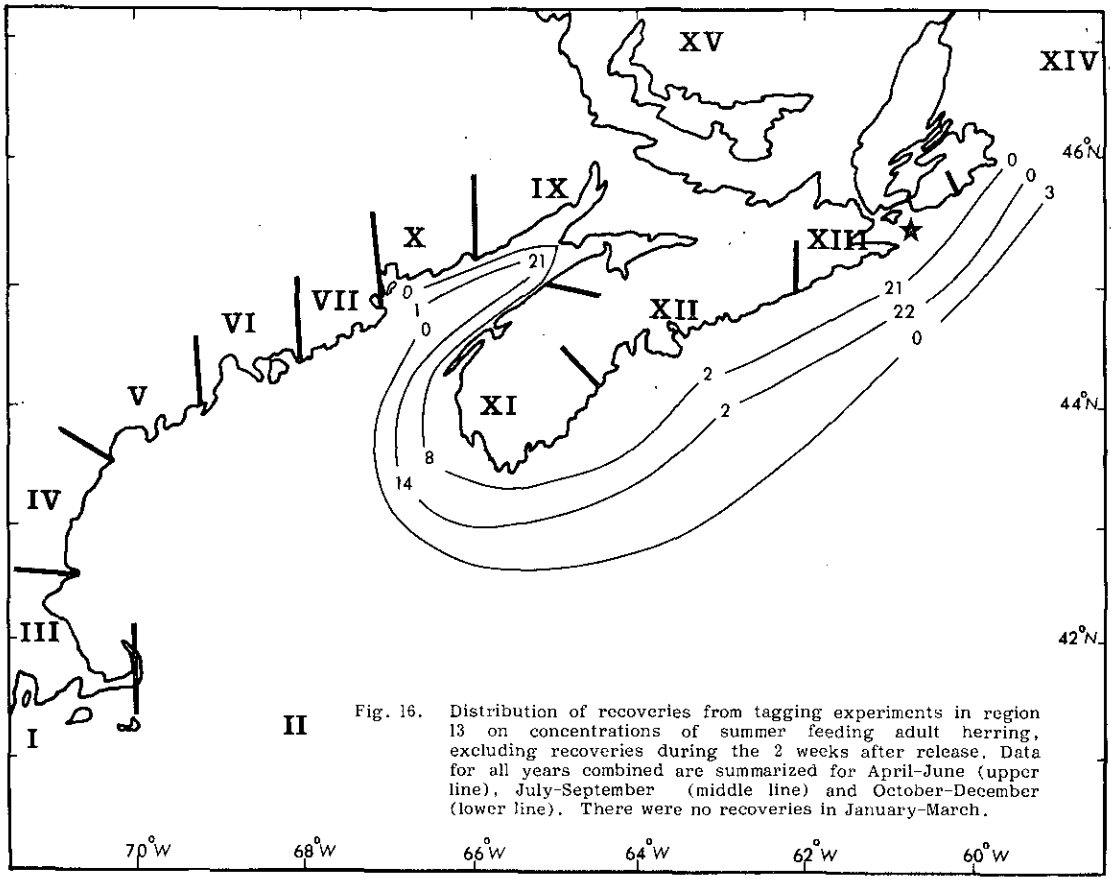


Fig. 16. Distribution of recoveries from tagging experiments in region 13 on concentrations of summer feeding adult herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for April-June (upper line), July-September (middle line) and October-December (lower line). There were no recoveries in January-March.

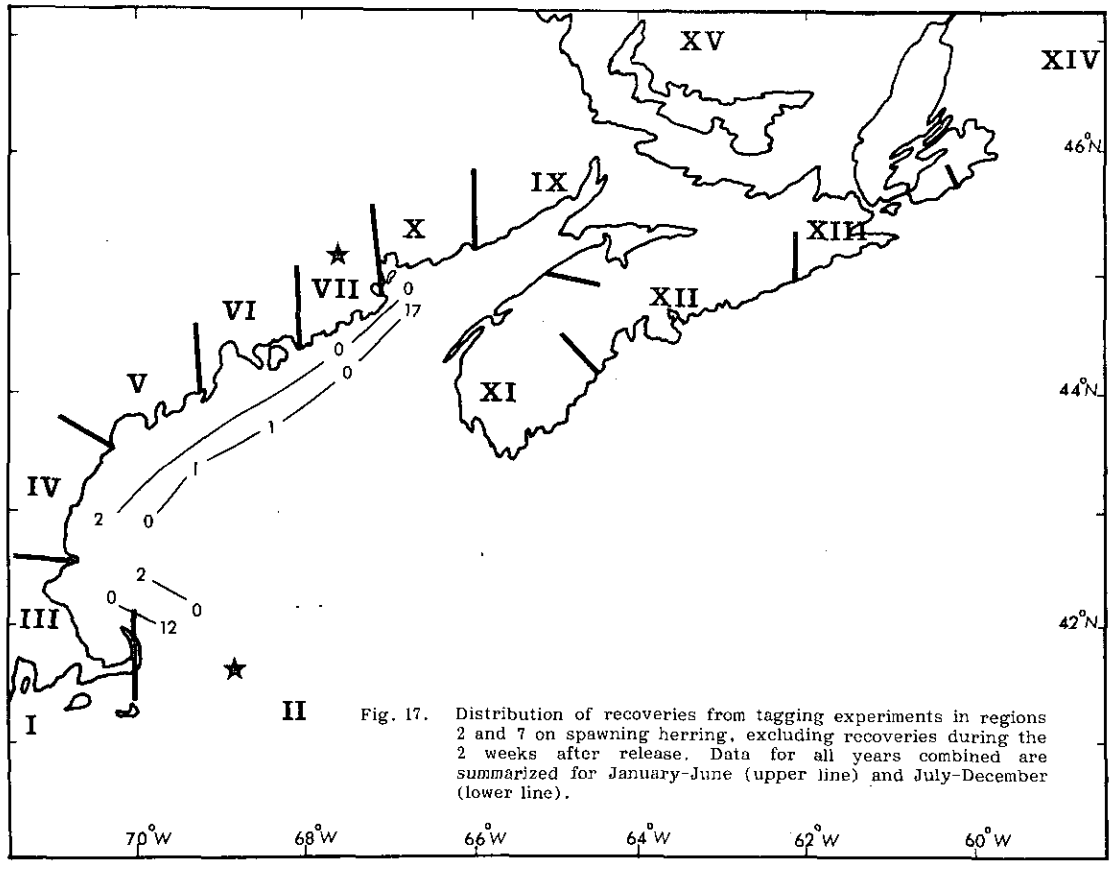


Fig. 17. Distribution of recoveries from tagging experiments in regions 2 and 7 on spawning herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for January-June (upper line) and July-December (lower line).

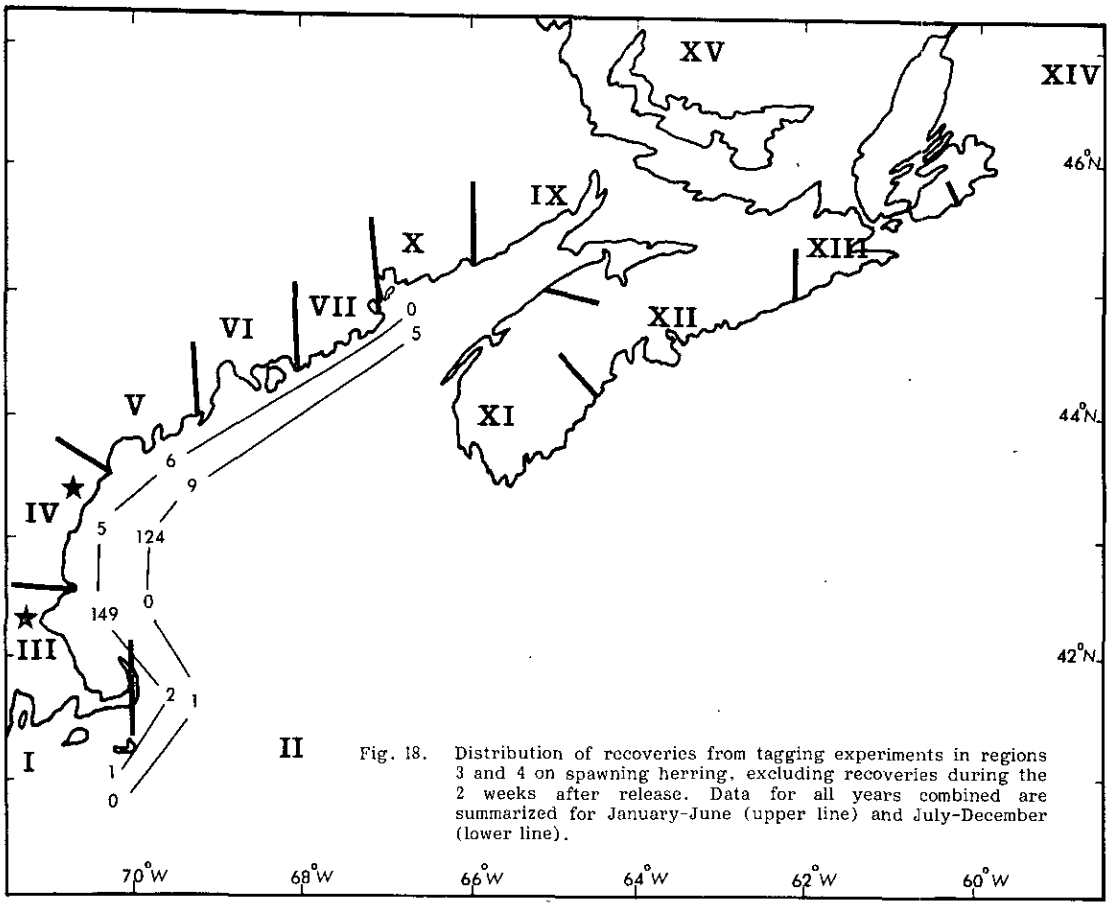


Fig. 18. Distribution of recoveries from tagging experiments in regions 3 and 4 on spawning herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for January-June (upper line) and July-December (lower line).

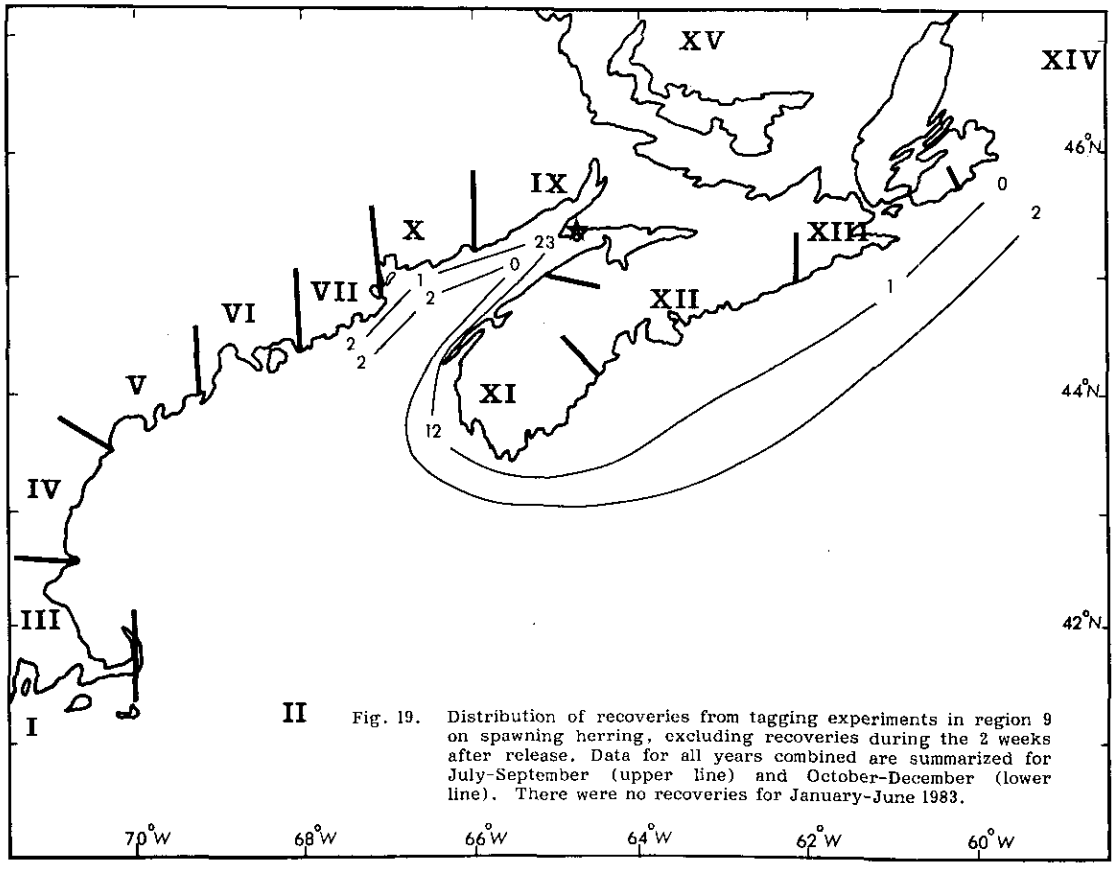


Fig. 19. Distribution of recoveries from tagging experiments in region 9 on spawning herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for July-September (upper line) and October-December (lower line). There were no recoveries for January-June 1983.

August-October with dominant distribution near the Nova Scotia side of the Bay. They appear to leave the Bay of Fundy by November with some tendency toward an eastward movement and no indication of movement to the western Gulf of Maine.

Spawning fish tagged in region 11 (Fig. 20) seemed to disperse more than any other group. During April-December, they appear to be heavily concentrated within the Bay of Fundy and off southwest Nova Scotia (regions 9, 10 and 11), although a few recoveries were made as far south as Cape Cod and north in the Gulf of St. Lawrence. During January-March, although a few recaptures were made in the Bay of Fundy, the majority of the fish moved northeast to overwinter in region 13 and a smaller component overwintered in the western Gulf of Maine.

e) Autumn migration

Tagging experiments during the autumn-migration period were conducted in four regions (4, 5, 6 and 7), involving juveniles, adults and mixed groups of herring (Fig. 1). Because the resultant recoveries exhibited very similar patterns of movement, the results of all experiments have been combined in one illustration (Fig. 21). The herring tagged in regions 4-7 appear to concentrate in the western part of the Gulf of Maine (mainly region 4) during January-March. In April-June, there is a northeastward movement extending to the entrance of the Bay of Fundy, but the majority appear to stay in the western Gulf of Maine area. The movement toward the Bay of Fundy continues in July-September, but the major concentrations remain in the Gulf of Maine and exhibit a southwestward movement during October-December.

5. Summary of Movements

a) Juveniles

Herring tagged as juveniles exhibited a tendency to remain concentrated in the area of tagging. Results from experiments in regions 5, 6 and 7 show a net movement eastward toward the entrance of the Bay of Fundy in April-September followed by a westward movement towards Cape Cod during October-March. They appear to have moved no farther eastward than southwest Nova Scotia and very few recaptures occurred in the inner part of the Bay of Fundy. Their movement southwestward is more pronounced, with a substantial number of recoveries south of Cape Cod. Results from experiments in region 10 during all seasons exhibit greater dispersal, with recoveries south of Cape Cod (region 1) and in eastern Nova Scotia (regions 13 and 14). However, these fish remain heavily concentrated in the area of release on the New Brunswick side of the Bay of Fundy during the whole year. In April-September, they are distributed extensively within and at the entrance of the Bay of Fundy as well as exhibiting some movement to the coastal area of central Maine (regions 5 and 6). During October-March, although the majority of these fish remain on the New Brunswick side of the Bay of Fundy, a substantial component moves to the western Gulf of Maine and Cape Cod to overwinter and a smaller, but still significant, component moves eastward to overwinter in the Chedabucto Bay area (region 13). Results from experiments in regions 11 and 12 exhibit a directed movement to the Bay of Fundy area during April-September, further demonstrating that the Bay of Fundy area is a summer gathering place for juvenile herring found both eastward and westward during other times of their annual migratory cycle.

It should be noted that the recovery data are grouped for all years following release. Consequently some of the movement indicated could result from juveniles moving into the adult phase of their life history prior to recapture. However, since the majority of recoveries are made within the first year of release, the change in life history phase should not seriously affect the conclusions.

b) Adults

Herring tagged as adults exhibit more directed movement in groups than do juveniles. Adults tagged near Cape Cod and in the Gulf of Maine show strong movement eastward, resulting in distribution in the area from central Gulf of Maine to southwest Nova Scotia during April-September. The greatest concentrations appear to be in central and western Maine regions (6 and 7), but substantial concentrations also appear at the entrance to the Bay of Fundy (regions 10-11), although relatively few recoveries were made in the inner part of the Bay. This eastward movement appears to concentrate the adults in eastern Maine and the New Brunswick side of the Bay of Fundy (regons 7 and 10) in late summer, followed by a westward movement which results in concentrations in the western Gulf of Maine, around Cape Cod, and in areas farther south during January-March.

Adults tagged in eastern Nova Scotia (regions 13-14) appear to move in a direction opposite to that for Gulf of Maine herring, although their movements from these two eastern Nova Scotia regions are somewhat different. Those tagged near Chedabucto Bay (region 13) exhibit a distinct movement toward the Bay of Fundy during April-September such that, in late summer and early autumn, most of these herring are off southwest Nova Scotia and in the inner part of the Bay of Fundy. Only one recovery was made on the New Brunswick side of the Bay of Fundy, indicating very limited movement to that region from Chedabucto Bay. Subsequent movement, based on very limited number of recoveries, appears to be eastward along eastern

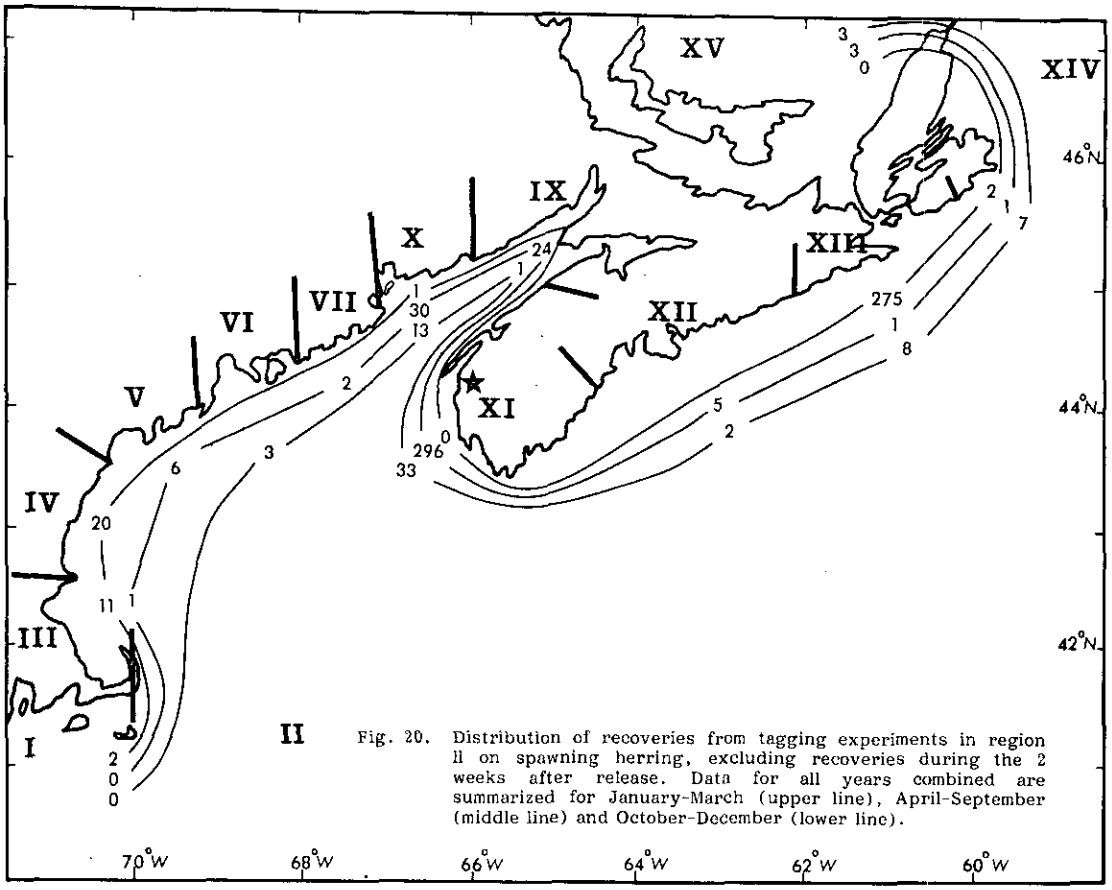


Fig. 20. Distribution of recoveries from tagging experiments in region II on spawning herring, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for January-March (upper line), April-September (middle line) and October-December (lower line).

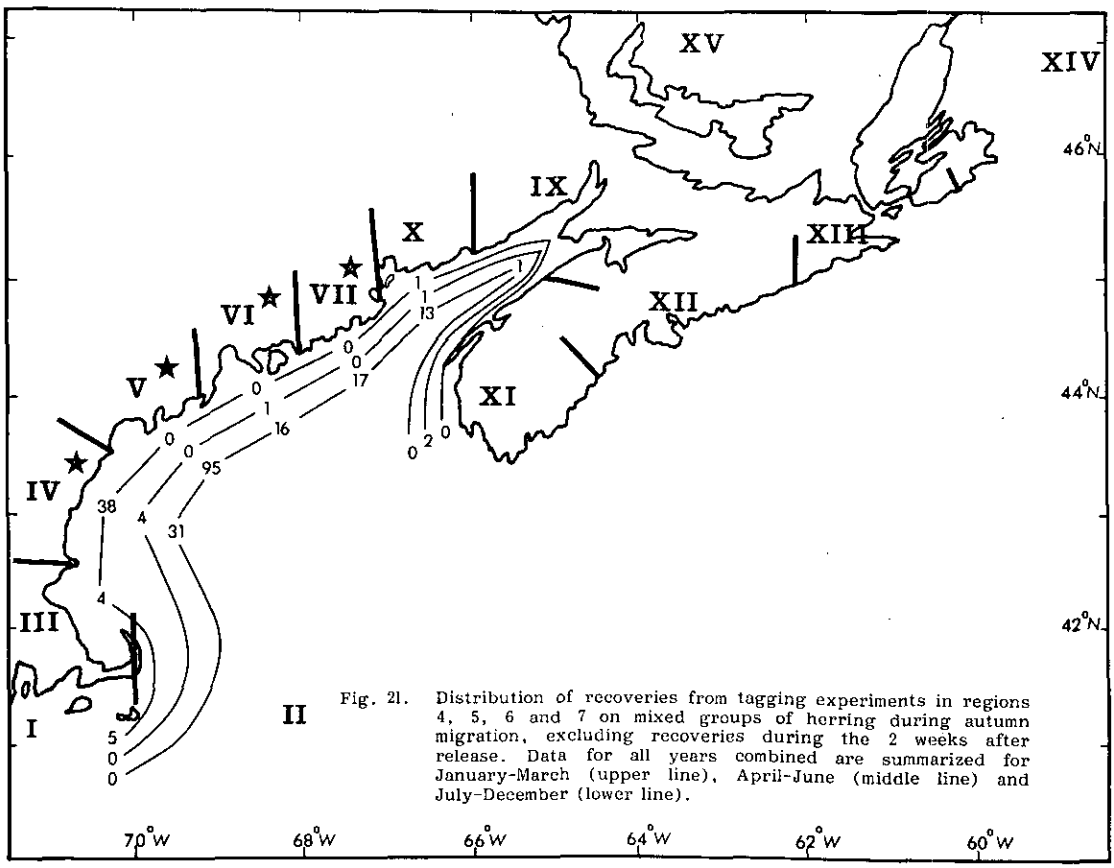


Fig. 21. Distribution of recoveries from tagging experiments in regions 4, 5, 6 and 7 on mixed groups of herring during autumn migration, excluding recoveries during the 2 weeks after release. Data for all years combined are summarized for January-March (upper line), April-June (middle line) and July-December (lower line).

Nova Scotia. Adults tagged in region 14 exhibited somewhat different movements to summer-feeding areas. Although there is a directed movement toward the Bay of Fundy during April-September, an even greater movement is observed into the Gulf of St. Lawrence (region 15). Again, there were no recoveries on the New Brunswick side of the Bay of Fundy or farther westward. The reverse movement from the Gulf of St. Lawrence and Bay of Fundy occurs in October-March, resulting in overwintering concentrations in the eastern Nova Scotia regions.

c) Mixed groups

The results from tagging of mixed groups of herring are comparable to those observed for juveniles and adults when combined. Mixed groups tagged in the western Gulf of Maine exhibit a tendency to move eastward toward the Bay of Fundy in summer and westward toward the Cape Cod area in winter, reaching the most westerly point of their migration in January-March and their most easterly point in August-October. Mixed groups tagged in eastern Gulf of Maine and in New Brunswick waters near the entrance to the Bay of Fundy exhibit somewhat similar movement. The movement is modified, however, in that more move to the inner part of the Bay of Fundy and a significant proportion overwinter off eastern Nova Scotia. Mixed groups tagged off southwest Nova Scotia are concentrated in and around the Bay of Fundy area during summer, and, although some fish move westward to overwinter, a considerably greater number moves eastward. Results from tagging mixed groups in eastern Nova Scotia waters indicate similar movements to the adults, with a dominant summer movement toward the Bay of Fundy but also significant movement into the Gulf of St. Lawrence. Relatively few recoveries were made in the Gulf of Maine. These fish are concentrated off eastern Nova Scotia in winter.

6. Persistence of Migratory Movements

The results of the tagging experiments strongly indicate that herring in Subareas 4 and 5 exhibited a strong persistence in annual migratory pattern. To illustrate this persistence, the results of tagging experiments on spawning fish off southwest Nova Scotia and overwintering fish in the Chedabucto Bay area are presented to indicate yearly recovery patterns in Fig. 22-25. The recoveries made during the season of tagging are excluded. From the distribution of summer recoveries from the southwest Nova Scotia experiments (Fig. 22), the majority of recoveries in successive summers after release are in and around the Bay of Fundy, which is the feeding and prespawning area for the southwest Nova Scotia spawning population. In the first summer after release, 95% of the recoveries were made in the Bay of Fundy environs and 77% in the area of release off southwest Nova Scotia. In subsequent summers, 83- 100% of the recoveries were made in the Bay of Fundy environs, with 44-100% in the area of release off southwest Nova Scotia.

The winter recoveries from the southwest Nova Scotia taggings (Fig. 23) show a consistent pattern of movement year after year, with the greatest proportion (67-86%) being made in the Chedabucto Bay area. Considering the earlier tagging results which showed that the Bay of Fundy area in summer and the Chedabucto Bay area in winter are the areas of mixing, the tendency for the tagged fish to return to the summer feeding area and to the overwintering area appears to be quite strong.

The recoveries from fish tagged off Chedabucto Bay during the winter fishery in 1977 and 1978 (Fig. 24 and 25) again indicate the tendency for herring to maintain a consistent migration pattern from year to year. During the first and second winters after tagging, over 93% of the recoveries were made off eastern Nova Scotia, with 58% being made in the area of release. The summer distributions indicate a consistent major movement (over 85% of all recoveries) to the Bay of Fundy area during two successive summers, with only very limited movement westward into the Gulf of Maine.

These data indicate that 77-100% of the fish tagged off southwest Nova Scotia return there in successive summers and that 67-86% of the fish overwinter in the Chedabucto Bay area. The results from Chedabucto Bay taggings indicate that 85-90% of these fish use the Bay of Fundy area as a feeding and pre-spawning area. The results indicate that herring do maintain a consistent migratory pattern.

7. Conclusions

a) It was generally agreed that the available data did provide a reasonably reliable picture of herring movement in Subareas 4, 5 and 6 as well as insight into aspects of "migratory" behavior in herring.

b) For the major spawning groups for which there are significant returns (Jeffrey's Ledge) and southwest Nova Scotia), straying does not seem to be a major feature of herring behavior.

c) Persistence in migratory patterns is apparently a major feature associated with southwest Nova Scotia, and possibly Jeffrey's Ledge, herring populations.

d) Herring tagged in the Cape Cod and western Gulf of Maine areas appear to distribute themselves along the Maine coast and at the entrance of the Bay of Fundy (mainly on the New Brunswick side) in summer and autumn and overwinter in the western part of Subarea 5. The farther eastward the tagging experiment is conducted during any phase of the annual cycle (e.g. region

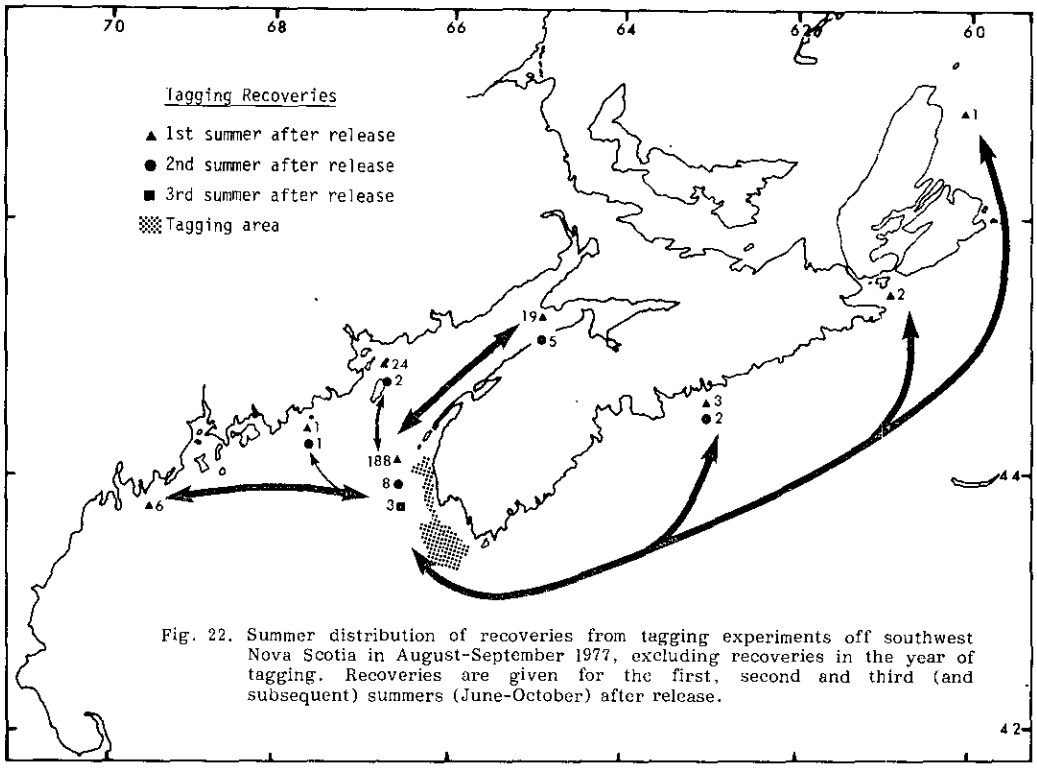


Fig. 22. Summer distribution of recoveries from tagging experiments off southwest Nova Scotia in August-September 1977, excluding recoveries in the year of tagging. Recoveries are given for the first, second and third (and subsequent) summers (June-October) after release.

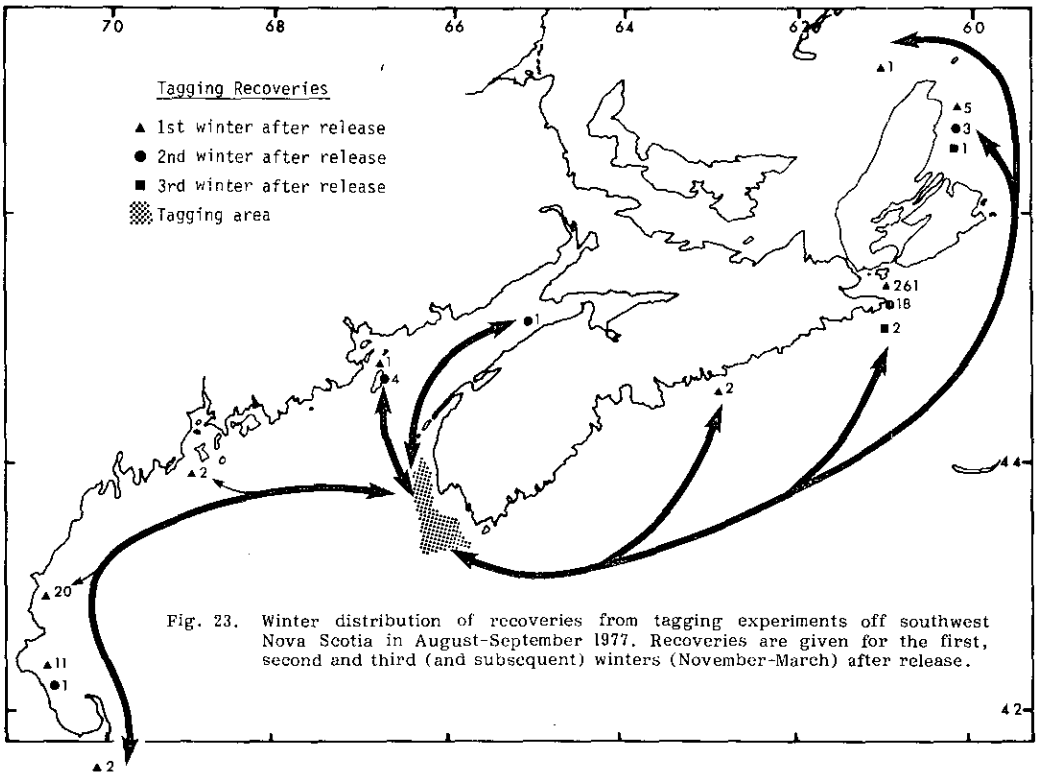


Fig. 23. Winter distribution of recoveries from tagging experiments off southwest Nova Scotia in August-September 1977. Recoveries are given for the first, second and third (and subsequent) winters (November-March) after release.

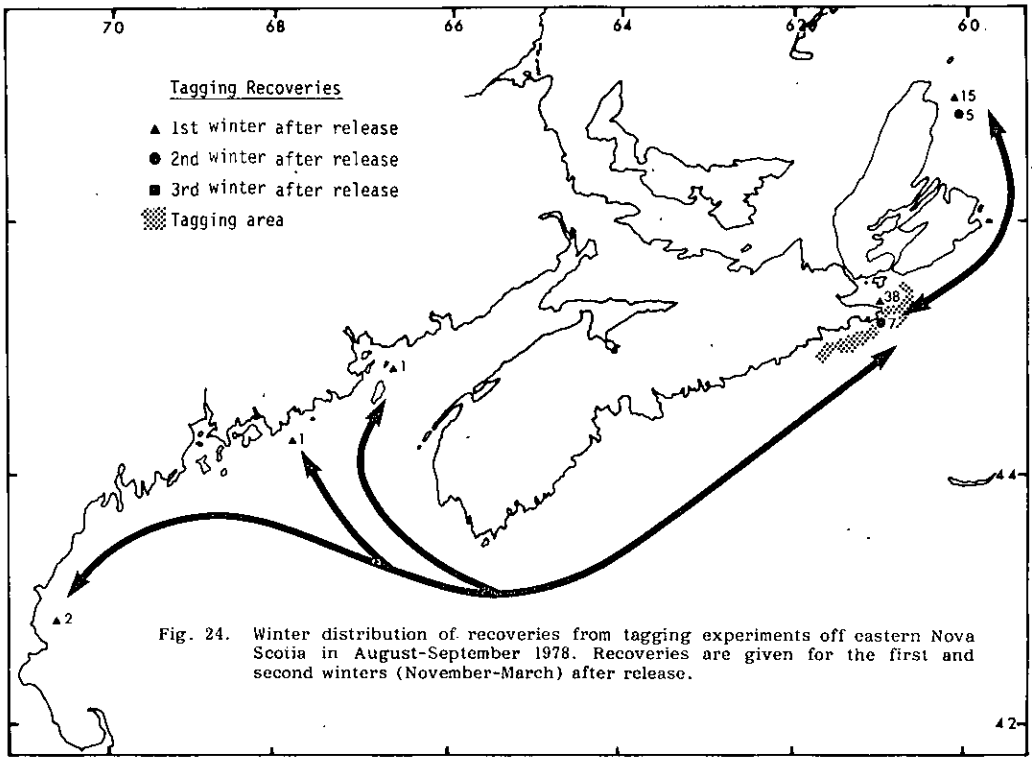


Fig. 24. Winter distribution of recoveries from tagging experiments off eastern Nova Scotia in August-September 1978. Recoveries are given for the first and second winters (November-March) after release.

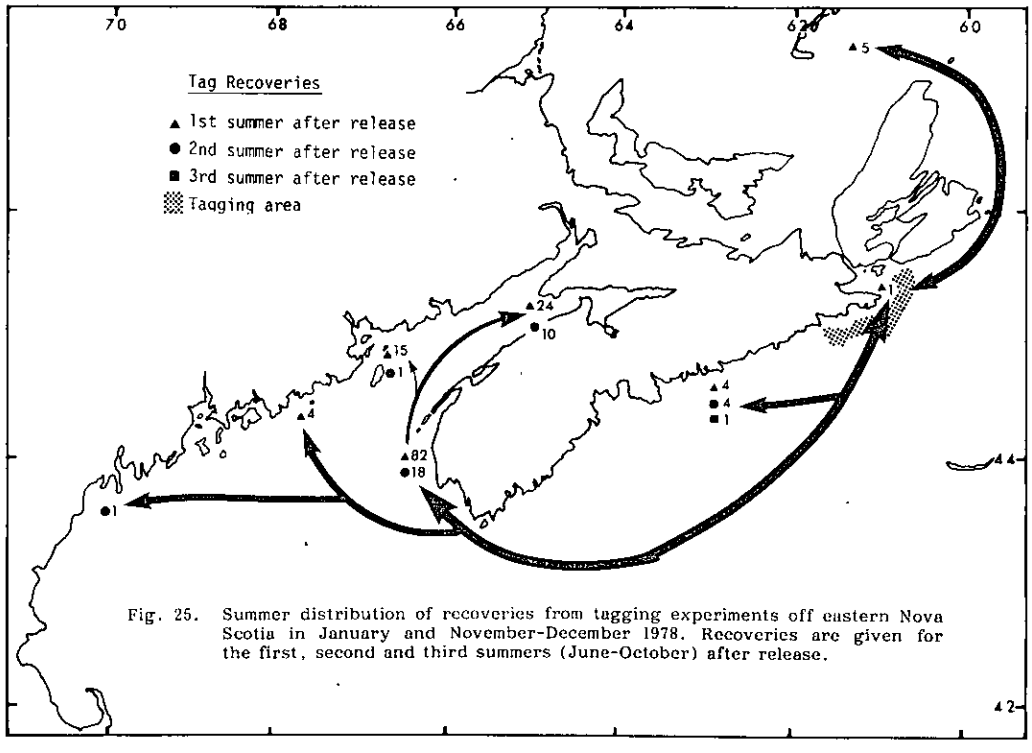


Fig. 25. Summer distribution of recoveries from tagging experiments off eastern Nova Scotia in January and November-December 1978. Recoveries are given for the first, second and third summers (June-October) after release.

6 versus region 3), the farther eastward the group reaches during the summer-autumn movement.

e) The Bay of Fundy area appears to support concentrations of herring in summer from the Gulf of Maine, southwest Nova Scotia and eastern Nova Scotia.

f) Herring tagged between Chedabucto Bay and the Bay of Fundy move westward to the Bay of Fundy (mainly on the Nova Scotia side) in summer and overwinter off eastern Nova Scotia. It appears that the Chedabucto Bay area is the overwintering area for many fish residing off southwest Nova Scotia in summer, and possibly is the overwintering area for the southwest Nova Scotia spawning stock.

g) Herring tagged in the Sydney Bight area of eastern Nova Scotia appear to undertake a major summer movement into the Gulf of St. Lawrence and a somewhat lesser one towards the Bay of Fundy. These diverging summer movements indicate that the Sydney Bight area is an overwintering area for the southern Gulf of St. Lawrence and Nova Scotia populations, with the majority of the herring overwintering in the northern portion of the Sydney Bight area moving into the Gulf in summer, while the majority in the southern part move to eastern and southern Nova Scotia and the Bay of Fundy.

h) Summer concentrations of juveniles along the coast of eastern Maine and southwestern New Brunswick are a mixture of Gulf of Maine and Nova Scotia populations.

i) The results of the various tagging experiments pertain primarily to the stock relationships with the exclusion of the Georges Bank stock (due to its collapse). The extent of intermixing of that stock with the coastal populations cannot be assessed at this time.

8. Recommendations

a) Additional analysis of short-term movements, particularly from tagging experiments on summer feeding grouns may provide further insights into the population relationships during periods of high mixing and non-directed movement.

b) Due to the mixing inherent in summer distributions, dispersion of tagged fish could be expected to indicate chaotic dispersion, and thus such tagging experiments should be interpreted cautiously.

c) Summer distributions frequently have an admixture of many size groups. Since migratory patterns may be size-associated, recovery information from experiments on mixed groups may be difficult to interpret. Thus, tagging experiments, if conducted on such groups, should be organized so that only adults or juveniles are tagged (i.e. cull out the undesired size groups).

d) Future tagging experiments should be priorized with regard to the five phases of the annual cycle: (i) spawning groups (ripe and running), (ii) overwintering, (iii) fall migration, (iv) spring migration, and (v) summer feeding. The Working Group concluded that highest priority should be given to tagging spawning fish, with care being exercised to ensure that most of these fish are at stage 6 of the maturity cycle. The tagging of spawning fish is essential for stock discrimination studies, because these are the only tagging experiments from which recovery information can be interpreted as showing stock movement. At other times in the annual cycle, stock components are, to varying degrees, intermixed, and hence the results of such experiments describe herring movements but not necessarily discrete stock movements. Tagging of summer feeding herring was accorded the lowest priority, because the stocks appear to be highly mixed during this phase of the annual cycle and the fish tend to remain in the region of tagging for the remainder of the summer, resulting in the recovery of many tags which provide limited information on stock movements (relative to the cost in terms of reward payments). The life-history categories were priorized in the following order: adults, juveniles, and mixed groups (with culling for large versus small fish). Tagging adults was emphasized for stock differentiation, because juveniles do not generally migrate as far as adults and their numbers will decrease faster due to natural mortality before they are observed on the spawning grounds.

e) The Working Group agreed that future taggings, to augment current results, should be directed at the following phases of the annual cycle in the various regions (in order of priority): (i) spawning (regions 2, 4, 7, 10); (ii) overwintering (1, 3, 4); (iii) fall migration (none); (iv) spring migration (1, 2, 3, 4); and (v) summer feeding (2, 4). Tagging in region 2 is contingent on recovery of the Georges Bank stock.

f) It was acknowledged that some consideration must be given to the fishing effort associated with the recoveries from the various geographic areas. Although appropriate weighting of the significance of tags by areas would be difficult due to lack of fisheries information, it was suggested that future analysis should attempt such considerations.

g) Because migratory patterns exhibited by herring in Subareas 4 and 5 may be influenced by hydrographic conditions, review of pertinent oceanographic data could provide insights into underlying mechanisms influencing these movements.

ATTACHMENT 1. LIST OF HERRING TAGGING ACTIVITIES IN SUBAREAS 4, 5 AND 6 DURING 1973-81.

Year	Tagging dates	Location	Number tagged	Agency[1]
1973	Nov 21-Dec 5	Grand Manan	10,868	DFO, St. Andrews
1976	Jan 29-30	45°21'N 61°16'W	3,000	DFO, St. Andrews
	Feb 8	45°21'N 61°16'W	2,150	" " "
	Feb 8-9	45°22'N 61°15'W	3,843	" " "
	Feb 10	45°22'N 61°10'W	3,199	" " "
	Feb 12	45°22'N 61°10'W	3,625	" " "
	Feb 13	45°22'N 61°10'W	6,650	" " "
	Apr 29	St. George's Bay	(6,400)	DFO, St. John's
	May 2	47°41'N 60°36'W	(1,900)	" " "
	May 11	47°41'N 60°36'W	(1,900)	" " "
	May 12	47°23'N 61°47'W	(2,000)	DFO, St. Andrews
	May 12	47°22'N 61°51'W	(1,652)	" " "
	May 14	47°23'N 61°47'W	(500)	" " "
	May 15	47°23'N 61°47'W	(3,374)	" " "
	May 17	47°23'N 61°47'W	(2,350)	" " "
	Jul 11-12	43°51'N 68°53'W	4,200	DMR, Maine
	Jul 18	44°03'N 68°37'W	1,800	" "
	Aug 4-5	44°24'N 68°12'W	3,159	" "
	Aug 23	44°18'N 68°17'W	838	" "
	Aug 31	43°43'N 70°07'W	2,000	" "
	Aug. 26-Sep 6	W Gulf St. Lawrence	(27,975)	DFO, St. Andrews
	Sep 2	44°30'N 67°38'W	1,000	DMR, Maine
	Sep 2	44°26'N 67°52'W	2,000	" "
	Sep 14-15	44°38'N 67°15'W	4,997	" "
	Sep 16	41°45'N 68°58'W	4,800	NMFS, Woods Hole
	Sep 17	41°43'N 68°56'W	5,132	" " "
	Sep 18	41°35'N 68°55'W	3,524	" " "
	Sep 19	41°44'N 68°49'W	5,443	" " "
	Sep 23	41°38'N 68°51'W	5,993	" " "
	Sep 27	41°35'N 68°57'W	4,511	" " "
	Oct 3	43°51'N 69°40'W	1,000	DMR, Maine
	Oct 8	42°39'N 70°30'W	3,466	NMFS, Woods Hole
	Oct 9	42°50'N 70°19'W	3,661	" " "
	Oct 11	42°39'N 70°30'W	3,566	" " "
	Nov 10	41°29'N 71°14'W	32	" " "
	Nov 17	43°52'N 69°40'W	1,900	DMR, Maine
1977	Jan 16-17	45°20'N 60°34'W	1,025	DFO, St. Andrews
	Mar 8	43°45'N 69°41'W	1,000	DMR, Maine
	May 1	42°41'N 70°29'W	10,973	NMFS, Woods Hole
	May 7	40°31'N 69°12'W	6,430	" " "
	May 11	40°28'N 69°09'W	2,507	" " "
	May 13	40°33'N 69°20'W	3,805	" " "
	May 15	40°27'N 69°20'W	10,437	" " "
	May 22-23	43°50'N 69°37'W	2,000	DMR, Maine
	Jun 20	43°59'N 69°26'W	1,000	" "
	Jun 27	43°52'N 69°42'W	1,500	" "
	Jun 28	3 mi SW Trinity	95	DFO, St. Andrews
	Jun 28	12 mi S Lurcher	141	" " "
	Jul 6	43°46'N 69°57'W	2,500	DMR, Maine
	Jul 6-7	Mill Cove, Campobello	3,418	DFO, St. Andrews
	Jul 12	44°26'N 67°52'W	2,000	DMR, Maine
	Jul 15-18	Mill Cove, Campobello	1,872	DFO, St. Andrews
	Jul 19	Hear Harbour I.	1,254	" " "
	Jul 27	44°37'N 67°23'W	1,000	DMR, Maine
	Jul 28	44°45'N 67°04'W	2,796	" "
	Aug 8	Bliss I. Light	2,846	DFO, St. Andrews
	Aug 10	Man of War I.	200	" " "
	Aug 10	SW Crow I.	1,600	" " "
	Aug 11	SW Whitehead	1,175	" " "
	Aug 12	Off Eagle I.	2,096	" " "
	Aug 16	St. Andrews Pt.	4,874	" " "
	Aug 18	St. Andrews Pt.	3,100	" " "
	Aug 29	2 mi NW Seal I.	3,997	" " "
	Aug 30	2 mi W West Head	6,491	" " "
	Aug 30	1 mi ESE Trinity Buoy	2,999	" " "
	Aug 31	1 mi SE Trinity Buoy	2,347	" " "
	Aug 31	2 mi W of Seal I.	5,492	" " "
	Aug 31	NW Cape St. Mary	2,828	" " "
	Sep 1	2 mi of West Head	4,500	" " "
	Sep 1	1 mi ESE Trinity Buoy	4,650	" " "
	Sep 5	1 mi N Seal I.	3,996	" " "
	Sep 6	2 mi SE Gannet Rk.	2,000	" " "
	Sep 6	2 mi E Green I.	1,125	" " "
	Sep 7	1 mi S Green I.	1,050	" " "
	Sep 7	3 mi SSE Seal I.	3,825	" " "
	Sep 7	1 mi NE Gannet Rk.	3,494	" " "
	Sep 8	2 mi SE Gannet Rk.	3,375	" " "
	Sep 9	Trinity Buoy	2,500	" " "
	Sep 23	41°38'N 69°41'W	645	NMFS, Woods Hole
	Sep 25	41°38'N 69°41'W	298	" " "
	Oct 11	43°53'N 69°07'W	800	DMR, Maine
	Oct 27	43°49'N 69°39'W	1,196	" "
	Nov 3	44°52'N 67°01'W	2,200	" "
	Nov 28	4 mi off Low Pt.	588	DFO, St. Andrews
	Dec 4	2 mi Little Lorraine	715	" " "
	Dec 5	2 mi S Cape Morien	435	" " "
	Dec 5	1 mi off Glace Bay	694	" " "
	Dec 14-15	Glace Bay Buoy	650	" " "

Year	Tagging dates	Location	Number tagged	Agency[1]
1978	Jan 13	Cape Canso, NS	542	DFO, St. Andrews
	Jan 13	15 mi E Cape Canso, NS	1,127	" " "
	Jan 17	8-15 mi E Cape Canso, NS	1,230	" " "
	Jan 23	6 mi SE White Hd., NS	670	" " "
	Jan 29	2 mi NE C.A. Buoys	829	" " "
	Feb 3	Perry Shore	50	" " "
	Feb 21	Passamaquoddy Bay	1,500	DMR, Maine
	Mar 24	NW Lettite Passage, NB	3,950	DFO, St. Andrews
	Apr 17-19	Liverpool Bay, NS	10,000	" " "
	May 11-Jun 9	Isle-Verte, Que.	(29,217)	DFO, Quebec City
	Jul 7	44°45'N 65°50'W	4,000	DFO, St. Andrews
	Jul 20	44°40'N 65°50'W	2,225	" " "
	Jul 21-26	44°39'N 65°45'W	2,880	" " "
	Jul 28-29	44°39'N 65°45'W	5,992	" " "
	Aug 7-9	43°58'N 69°12'W	2,000	DMR, Maine
	Aug 21	43°47'N 69°34'W	537	" "
	Aug 28	44°37'N 66°55'W	375	DFO, St. Andrews
	Aug 31	44°46'N 67°01'W	513	DMR, Maine
	Sep 7	43°51'N 69°41'W	2,450	" "
	Sep 18-23	43°54'N 69°07'W	4,800	" "
	Sep 26	43°56'N 69°23'W	5,200	" "
	Oct 16	2 mi ESE Thackers I.	1,500	NMFS, Woods Hole
	Oct 18	46°20'N 62°15'W	(2,500)	DFO, St. Andrews
	Oct 25	46°20'N 62°15'W	(5,500)	" " "
	Nov 1	42°53'N 70°12'W	500	NMFS, Woods Hole
	Nov 2	42°50'N 70°12'W	2,000	" " "
	Nov 3	42°50'N 70°15'W	2,000	" " "
	Nov 9	42°52'N 70°15'W	4,000	" " "
	Nov 6	46°28'N 60°15'W	233	DFO, St. Andrews
	Nov 9	46°24'N 60°14'W	186	" " "
	Nov 11	45°10'N 61°06'W	364	" " "
	Nov 17-18	46°23'N 60°06'W	344	" " "
	Nov 19-22	46°22'N 59°58'W	1,762	" " "
	Nov 30	46°28'N 60°22'W	653	" " "
	Dec 2	46°32'N 60°23'W	816	" " "
	Dec 4	45°04'N 61°34'W	646	" " "
	Dec 6-7	45°10'N 61°04'W	676	" " "
	Dec 7	45°04'N 61°34'W	538	" " "
	Dec 7-8	45°10'N 61°25'W	332	" " "
	Dec 7-8	45°10'N 61°04'W	219	" " "
	Dec 9	45°03'N 61°20'W	224	" " "
	Dec 9	46°04'N 61°34'W	48	" " "
	Dec 13	45°21'N 60°45'W	356	" " "
	Dec 13	45°22'N 60°48'W	325	" " "
1979	Mar 28-29	Liverpool Hr., NS	10,353	DFO, St. Andrews
	May 11-24	Carlton, Que.	(549)	DFO, Quebec City
	Jun 1-6	St. Marys Bay, NS	9,087	DFO, St. Andrews
	Aug 11	Blanc Sablon, Que.	(5)	DFO, Quebec City
	Sep 13	Liverpool Hr., NS	(2,651)	NSDF, Halifax
	Sep 24	Shag Rock, Grand Manan	1,475	DFO, Quebec City
	Sep 25	Seal Cove, Grand Manan	1,425	" " "
	Oct 1	Seal Cove, Grand Manan	2,025	" " "
	Dec 10	Cape Dauphin, NS	346	" " "
	Dec 11	Off Ingonish, NS	1,650	" " "
	Dec 11-13	S of Ingonish, NS	2,321	" " "
	Dec 11-12	NE Cape Smokey, NS	222	" " "
	Dec 15	Little Lorraine, NS	250	" " "
1980	Jan 3	Off Wreck Cove, NS	431	DFO, St. Andrews
	Jan 3	Cape Smokey, NS	202	" " "
	Jan 3-5	N Ingonish Bay, NS	2,512	" " "
	Jan 5	S Ingonish Bay, NS	294	" " "
	Jan 6-7	N Ingonish Bay, NS	2,803	" " "
	Feb 14-15	44°29'N 63°30'W	518	" " "
	Apr 16	St. Margarets Bay, NS	3,639	" " "
	Apr 26	Bras d'Or Lake, NS	(600)	NSDF, Halifax
	May 12-13	45°21'N 61°11'W	7,286	DFO, St. Andrews
	Jun 19-24	Iles Verte, Quebec	(9,996)	DFO, Quebec City
	Jun 22	43°40'N 65°04'W	10,036	DFO, St. Andrews
	Jul 10	43°50'N 69°36'W	903	DMR, Maine
	Jul 20-23	45°14'N 65°01'W	2,757	DFO, St. Andrews
	Jul 21-22	45°19'N 64°57'W	550	" " "
	Jul 22	43°58'N 69°12'W	1,423	DMR, Maine
	Jul 24	45°04'N 65°04'W	399	DFO, St. Andrews
	Jul 24	45°10'N 64°57'W	9,515	" " "
	Jul 27	44°55'N 65°20'W	1,025	" " "
	Aug 1	43°58'N 69°12'W	1,797	DMR, Maine
	Aug 5	43°07'N 68°50'W	1,543	" "
	Aug 7	44°48'N 66°58'W	2,344	" "
	Aug 8	43°58'N 69°11'W	1,940	" "
	Aug 13	44°31'N 67°50'W	2,236	" "
	Aug 21	44°18'N 68°17'W	3,996	" "
	Sep 4	44°38'N 67°15'W	6,980	" "
	Sep 11	43°51'N 69°40'W	4,947	" "
	Sep 15-16	45°11'N 67°09'W	9,290	DFO, St. Andrews
	Sep 16	44°06'N 68°54'W	2,800	DMR, Maine
	Sep 23	44°37'N 67°23'W	971	" "
	Sep 24	42°53'N 70°45'W	240	" "
	Sep 24	45°01'N 67°04'W	692	" "

ATTACHMENT 1. (CONTINUED)

Year	Tagging dates	Location		Number tagged	Agency[1]
1980	Oct 1	42°48'N	70°42'W	750	" "
	Oct 1	43°51'N	69°33'W	2,932	" "
	Oct 8	44°38'N	67°15'W	8,626	" "
	Oct 21	43°43'N	70°01'W	2,989	" "
	Oct 31	43°33'N	70°12'W	1,094	" "
1981	Jun 2	44°24'N	68°00'W	2,698	DMR, Maine
	Jun 17	44°22'N	68°05'W	3,298	" "
	Jun 23	43°43'N	70°00'W	1,000	" "
	Jun 25	44°30'N	67°43'W	1,782	" "
	Jul 6	44°05'N	69°03'W	2,698	" "
	Jul 8	43°58'N	69°10'W	3,295	" "
	Jul 20	43°43'N	70°01'W	3,999	" "
1981	Jul 22	45°01'N	67°04'W	4,949	" "
	Jul 27	44°04'N	69°04'W	3,398	" "
	Aug 5	44°46'N	67°01'W	4,698	" "
	Aug 11	44°07'N	68°50'W	3,900	" "
	Aug 19	44°26'N	67°52'W	3,999	" "
	Aug 25	43°51'N	69°33'W	3,996	" "
	Sep 15	44°39'N	67°11'W	3,650	" "
	Oct 29-31	46°21'N	62°16'W	(10,298)	DFO, St. Andrews
	Oct 27	48°00'N	65°15'W	(7,000)	DFO, Quebec City
	Oct 28	48°24'N	64°26'W	(2,013)	" " "
	Oct 29	47°53'N	65°27'W	(3,275)	" " "
	Oct 30	48°48'N	64°12'W	(3,100)	" " "
	Nov 1	48°49'N	64°11'W	(1,650)	" " "

[1] Names of agencies involved:

DFO - Department of Fisheries and Oceans, research centers at St. Andrews, NB, St. John's, Nfld, and Quebec City, Que., Canada.
NSDF - Nova Scotia Department of Fisheries, Halifax, NS, Canada.
NMFS - National Marine Fisheries Service, research laboratory at Woods Hole, Mass., USA.
DMR - Department of Marine Resources, research laboratory at Boothbay Harbor,Maine, USA.

ATTACHMENT 2. COORDINATES FOR 15 REGIONS ESTABLISHED TO FACILITATE ANALYSES OF HERRING TAGGING DATA

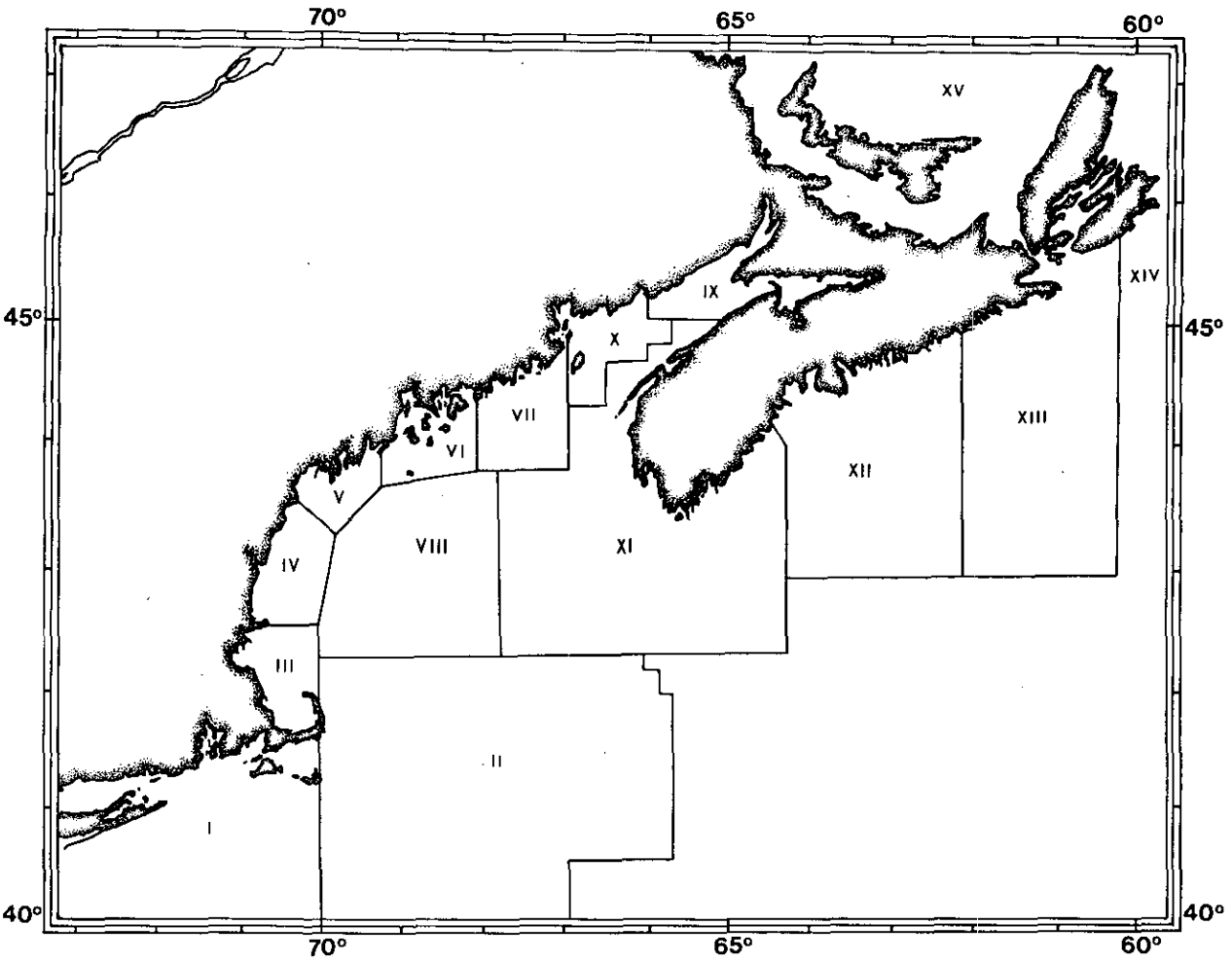
USA Regions

Region 1	41°31'N	72°00'W
	40°00'N	72°00'W
	40°00'N	70°00'W
	41°36'N	70°00'W
Region 2	41°36'N	70°00'W
	40°00'N	70°00'W
	40°00'N	66°55'W
	40°30'N	66°55'W
	40°30'N	65°40'W
	42°00'N	65°40'W
	42°00'N	65°50'W
	42°10'N	65°50'W
	42°10'N	66°00'W
	42°20'N	66°00'W
	42°20'N	70°00'W
	42°00'N	70°00'W
Region 3	42°35'N	70°42'W
	42°35'N	70°00'W
	42°00'N	70°00'W
Region 4	42°35'N	70°42'W
	42°35'N	70°00'W
	43°16'N	69°49'W
	43°34'N	70°12'W
Region 5	43°34'N	70°12'W
	43°16'N	69°49'W
	43°41'N	69°15'W
	43°55'N	69°15'W
Region 6	43°55'N	69°15'W
	43°41'N	69°15'W
	43°50'N	68°03'W
	44°20'N	68°04'W
Region 7	44°20'N	68°04'W
	43°50'N	68°03'W
	43°50'N	66°55'W
	44°49'N	66°55'W
	44°49'N	66°57'W
Region 8	43°50'N	67°50'W
	43°50'N	68°03'W
	43°41'N	69°15'W
	43°16'N	69°49'W
	42°35'N	70°00'W
	42°20'N	70°00'W
	42°20'N	67°50'W
	43°50'N	67°50'W

Canadian Regions

Region 9	45°15'N	66°00'W
	45°00'N	66°00'W
	45°00'N	65°10'W
Region 10	44°49'N	66°57'W
	44°49'N	66°55'W
	44°20'N	66°55'W
	44°20'N	66°30'W
	44°40'N	66°30'W
	44°40'N	66°00'W
	44°50'N	66°00'W
	44°50'N	65°40'W
	45°00'N	65°40'W
	45°00'N	66°00'W
	45°15'N	66°00'W
Region 11	45°00'N	65°10'W
	45°00'N	65°40'W
	44°50'N	65°40'W
	44°50'N	66°00'W
	44°40'N	66°00'W
	44°40'N	66°30'W
	44°20'N	66°30'W
	44°20'N	66°55'W
	43°50'N	66°55'W
	43°50'N	67°50'W
	42°20'N	67°50'W
	42°20'N	64°20'W
	44°00'N	64°20'W
	44°12'N	64°33'W
Region 12	44°12'N	64°33'W
	44°00'N	64°20'W
	43°00'N	64°20'W
	43°00'N	62°10'W
	45°58'N	62°10'W
Region 13	45°58'N	62°10'W
	43°00'N	62°10'W
	43°00'N	62°20'W
	45°43'N	60°20'W
Region 14	45°43'N	60°20'W
	43°00'N	60°20'W
	43°00'N	58°00'W
	46°00'N	58°00'W
	46°50'N	58°50'W
	47°30'N	57°35'W
	with NW boundary across Cabot Str. defined by line	
	46°50'N	60°20'W
	47°30'N	59°35'W
	47°40'N	59°20'W
Region 15	Gulf St. Lawrence bounded by lines across Cabot Str. (defined above) Belle Isle Str.	
	51°23'N	56°30'W
	51°40'N	56°31'W
	St. Lawrence R.	
	47°40'N	70°00'W
	47°55'N	70°00'W

ATTACHMENT 3. MAP SHOWING THE REGIONS WHOSE COORDINATES ARE LISTED IN ATTACHMENT 2



ATTACHMENT 4. SYNOPSIS OF HERRING FISHERIES IN REGIONS 1 TO 14

1. Region 1

The fishery in this southern New England region is conducted during winter and spring (December-April) principally by pair trawlers. The fishery is directed toward age 3 and older herring, and approximately 50% of the age 3 fish landed are <23 cm total length.

2. Region 2

There has been no significant fishery for herring in the Georges Bank region since the collapse of the stock after 1976.

3. Region 3

The fishery in this region (Massachusetts Bay) is conducted by pair trawlers and purse seiners, with the former being the dominant gear used. The season extends from January to April, and the fishery is directed toward age 3 and older herring. Approximately 70% of age 3 fish landed are <23 cm long.

4. Region 4

The fishery in this region occurs mainly during August-November, but fishing may begin as early as March when herring apparently begin to migrate northward, although few catches are made in May and June. The fishery is conducted principally by purse seiners but pair trawls are also utilized. During August-October, the fishery takes place on pre-spawning and spawning concentrations of age 3 and older fish, all of which exceed 23 cm in length.

5. Regions 5-7

The fishery usually begins in late May and generally extends to November but is most intense during July-September in the three regions. Stop seines and purse seines are utilized in regions 5 and 6, whereas the dominant gears in region 7 are stop seines and weirs, with purse seines used occasionally (legal only after 15 October). The fisheries in these regions are directed toward age 2 fish, but all age-groups are harvested. Age 3 fish are generally below 23 cm at the start of the fishery and increase in size as the season progresses.

6. Region 8

There is no herring fishery in this region.

7. Region 9

The fishery is conducted in June and July by purse seiners and primarily exploits prespawning and spawning fish.

8. Region 10

The fishery is conducted primarily from April to November, although a winter fishery occurs in some years. The fishery exploits juvenile herring which are mainly less than 23 cm long. The April-November fishery is conducted by weirs (area closed to purse-seining) and is mainly dependent on herring of age-groups 2 and 3. The winter fishery, conducted by purse seiners on age 2 fish, has been sporadic in recent years, and catches appear to be related to the sizes of recruiting year-classes.

9. Region 11

The fishery occurs mainly from April to October with purse seines, weirs and gillnets. The gillnet fishery exploits primarily spawning herring, although prespawning adults are taken in some years. The weir fishery is restricted to the Bay of Fundy and is dependant on age-groups 2, 3 and 4 fish, about 50% of which are <23 cm long. The purse-seine fishery exploits summer-feeding aggregations of juvenile and adult herring as well as prespawning and spawning adults. The fishery is most intense during August and September as the fish concentrate near or on the spawning grounds. In recent years, the mean size of the fish has increased due to increased demand for large herring and the termination of utilizating herring for fishmeal.

10. Region 12

The fishery is basically a summer gillnet fishery apparently exploiting small localized populations. The annual catch is usually small and consists primarily of herring >23 cm in length.

11. Region 13

Although there is a small fishery with gillnets during the summer, the principal fishery occurs in winter (November-March) almost exclusively with purse seines. The fishery is directed toward age 3 and older fish, and, although all age-groups are harvested, over 70% are greater than 23 cm in length.

12. Region 14

The principal fishery, in recent years, has been a purse seine fishery for overwintering adult herring. The fishery occurs during November-January and over 85% of the fish caught are greater than 23 cm in length. There is a small gillnet and trap fishery which occurs in April on prespawning and spawning fish, all greater than 23 cm.

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

Chairman: J. K. Pitt Rapporteurs: D. Cross, J. Baird

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, to consider and report on various matters referred to it by the Scientific Council (see Part D, this volume). Scientists attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France, and the Commission of the European Communities), Japan, Portugal, Spain, USSR and USA.

1. STATISTICS AND SAMPLING

1. CWP Activities Relevant to NAFO

a) Report of 11th Session of CWP (SCS Doc. 83/VI/10)

The Committee noted that the CWP (Coordinating Working Party on Atlantic Fishery Statistics) had met at Luxembourg during 21-28 July 1982. Mr. D. G. Cross, in his capacity as Deputy Secretary of CWP, reviewed the Report of the 11th Session, elaborating on various items of interest to NAFO.

i) Discrepancies in statistics held in data bases

EUROSTAT is developing a computer program to detect discrepancies in statistics reported to various international agencies. The elimination of these discrepancies, once detected, would involve cooperation between the agency secretariats and national reporting offices. It is anticipated that the frequency of discrepancies will be reduced in the future by exhange of reported revisions among the agency secretariats through the use of FISHSTATGRAM forms.

ii) Standard country identifiers

The CWP continued to urge the use of ISO 3-alpha identifiers for countries when needed for abbreviations in statistical tables.

iii) FAO would list of species items

The CWP recommended that FAO continue its current practice of supplying quarterly to the participating agencies complete updated lists covering all of the species items (approximately 800) in the FAO data base.

iv) Allocation of catches by nationality

The CWP again reviewed the allocation of catches by nationality, and, although recognizing that problems still existed, especially with regard to vessels using "flags of convenience", agreed that there be no fundamental change to the basic concept of considering the flag of the vessel as the paramount indicator of nationality. Accordingly, the CWP reiterated its previous recommendation with minor amendment:

"that participating agencies try to obtain the agreement of their contracting parties through appropriate channels to follow as closely as possible the following criteria:

" - that the flag of the vessel catching the fish should be considered the paramount indication of the nationality assigned to the catch data and that indication overridden only when on of the following arrangements between a foreign flag vessels and the host country exists:

(a) the vessel is chartered by the host country to augment its fishing fleet, and

(b) the vessel fishes for the country by joint venture or similar agreements (as opposed to the *ad hoc* practice of a vessel selling catches to a foreign vessel of landing catches at a foreign port) and the operation of such vessel is an integral part of the economy of the host country;

" - that, when goverments negotiate joint venture or other contracts in which vessels of one country land their catches at ports of another country or unload their catches to vessels of another country and the above criteria are applicable, the assignment of nationality to such catches and landings data be specified in the agreements."

v) Conversion factors

The CWP agreed that there was a need to continually update the FAO data base of conversion factors, and recommended that FAO should obtain country revisions and publish the list every 3 years, incorporating, where possible, factors for countries not already represented in the list.

vi) Fishing logbooks

The CWP recognized the important role of logbooks as a means of data collection, and recommended that FAO produce a report or manual identifying the requirements for planning, designing and implementing logbook systems and that this be completed as early as possible and not later than the 12th Session of the CWP in 1984.

vii) Future program of the CWP

The CWP considered that, apart from its role in standarization of concepts and definitions, greater effort would have to be applied to the socio-economic sector, and that, to maximize on secretariat resources, the development of a common data exchange format through magnetic tapes was highly desirable.

viii) Future meetings of the CWP

The CWP decided that an *ad hoc* interagency consultation will be held on 8-9 October 1983, immediately preceding the Annual Meeting of ICES in Gotenburg, Sweden. The object of the meeting, at which it is hoped that all CWP member organizations will be represented, is to review progress since the 11th Session and to plan for the 12th Session, which will be held at ICES Headquarters in Copenhagen, Denmark, during 25 July-1 August 1984.

ix) Secretary of the CWP

It was noted that Dormehl Gertenbach had retired as Secretary of the CWP, a post that he had held since its inception in 1959. The Committee expressed its appreciation for the contribution made by Mr. Gertenbach to fishery statistics in general and to the work of ICNAF and NAFO in particular. It was further noted that Mr. Akyüz (FAO) agreed to act as CWP Secretary and that FAO would continue to provide secretariat services.

b) Participation in the 12th Session of the CWP, July 1984

The Committee, recognizing the need to designate NAFO participation well in advance of CWP sessions,

recommends

that the Scientific Council of NAFO should be represented at the 12th Session of the CWP by the Chairman of STACREC, the Assistant Executive Secretary, and a representative of the fishery statistics service of the USSR.

It was agreed that the USSR should be requested to designate a suitable participant from its fishery statistics service as soon as possible.

2. Fishery Statistics

a) STATLANT 21A reports

These reports, with a 15 April deadline, consist of provisional nominal catches by species and division and are designed to provide the Scientific Council with reasonably complete annual statistics of fishing activity in the NAFO Area during the preceding year for use at its June Meeting. Although reporting for 1982 was generally more complete than for the previous years, reports from three countries, involving an appreciable proportion of the total catch, were not available at the start of this meeting. Therefore, the Secretariat was unable to produce a document of value in preparing the "Fishery Trends" section for inclusion in the STACFIS Report (Appendix I).

b) STATLANT 21B reports

These reports, with a 30 June deadline, contain detailed nominal catch and effort data by gear, tonnage class of vessel, main species, division and month. These data are extremely valuable for assessment purposes and are used as the final statistics for publication in the NAFO Statistical Bulletin.

i) Statistical Bulletin, Vol. 30 for 1980

After a delay of several months while awaiting final STATLANT 21B reports from a few countries, Volume 30 was printed in August 1982 and distributed in September 1982.

ii) Statistical Bulletin, Vol. 31 for 1981

The publication of this volume has been delayed due to the late arrival of data from a country whose statistics represent a significant proportion of the total catch. The data are now being processed, and it is hoped that Vol. 31 will be distributed in September 1983.

iii) STATLANT 21B reports for 1982

The deadline for the submission of these data for 1982 is 30 June 1983. Present indications are that reporting is slightly better than in previous years. If the outstanding reports become available during the next 2-3 months, Statistical Bulletin Vol. 32 could be published in late 1983 or early 1984.

c) Additional species items

It was noted that the Secretariat had recently received requests for the addition of certain species to the NAFO List of Species Items. The Committee accordingly

recommends

that the Secretariat take the necessary measures to check and assign appropriate common names and codes to the following species, which are to be added to the NAFO List of Species Items: (i) Lithodes maia (a stone crab), and (ii) Chlamys islandica (Icelandic sea scallop).

The Committee was informed that commercial quantities of several unlisted species were being reported for the NAFO Area but that the Secretariat needed more time to verify the reporting of such species with national statistical offices before requesting further additions to the List of Species Items.

3. Sampling

a) Report of *ad hoc* Working Group on Sampling Guidelines

The Working Group met on 19 June 1983 and its report is at Annex 1. There was considerable discussion about the recent requirement of submitting data for individual samples relative to the pre-1979 requirement of submitting data summarized on a monthly basis. The absence of requests for these detailed data and the lack of guidelines for producing appropriate summaries of the data lead to some doubt concerning the need for the Secretariat to continue acquiring and processing the data.

Some participants were concerned that to revert to the pre-1979 system would involve considerable work for statistical offices or research institutes to compile and resubmit the data in summarized form. However, it was agreed that the submission of voluminous detailed sampling data, for which there are no requests, fulfills no useful function. Furthermore, with the extension of fishery jurisdiction in 1977, the requirements for sampling data have changed, because most of the stock assessments are undertaken by coastal states, which obtain nearly all of the required sampling data from their domestic fisheries or from observers on other vessels operating in the national fishing zones.

Four general possibilities with respect to sampling data emerged from the discussion: (i) discontinue the submission of sampling data to the Secretariat; (ii) submit lists of sampling data available in the fisheries laboratories for annual publication; (iii) submit data in the pre-1979 format, and a list of samples which constitute the monthly summaries; and (iv) continue the present system. After considerable discussion on the various options, STACREC

recommends

i) that the pre-1979 format be adopted for submission of sampling data beginning in 1983; and

ii) that the backlog of detailed sampling data for 1979-82 be summarized, if possible, and submitted to the Secretariat in the pre-1979 format during the next few years.

The Committee noted that, since the submission of monthly length frequencies will include the actual numbers of individual samples, requests to the Secretariat for the individual samples could be forwarded to the appropraite fisheries institutes for actions.

4. Scientific Observer Program

The Committee was informed that, since the inception of the NAFO Scientific Observer Scheme in 1979, Canada has actively pursued the establishment of this program on a bilateral basis with all Contracting Parties to the NAFO Convention. All members of NAFO, that are still engaged in fishing in the Regulatory Area, have agreed to the Scheme, with the exception of Portugal and the EEC. Spain, although not yet a member of NAFO, has agreed that Canadian observers may be placed on Spanish vessels operating in the Regulatory Area.

Coverage by Canadian observers on vessels fishing outside the Canadian fishing zone involved 75 days in 1982 compared with 78 days in 1981.

5. List of Fishing Vessels (1980 and 1983)

The Committee noted that the List of Fishing Vessels for 1980 was published at the end of 1982, after a long delay in waiting for the submission from one country, and agreed that data for 1983 be solicited and published in the usual format.

6. Tagging Activities in 1982 (SCS Doc. 83/VI/8)

The Committee reviewed the summary of tagging activities in 1982, as reported to the Secretariat, and agreed that the program should be continued. It was noted that individual reports of tagging activities are distributed as they are received by the Secretariat through the Circular Letter series.

II. BIOLOGICAL SURVEYS

1. Review of Survey Activity in 1982

The Committee noted that the following documents contained information relevant to biological surveys in 1982: SCR Doc. 83/I/1, 7, 34, 35, 39, 41, 44, 45, 50, 53, 55, 57, 58, 59, 60, 61, 63, 65; SCS Doc. 83/IV/16. However, all of these contained the results of investigations already considered by STACFIS, and they will not be reviewed further here. Information on survey activities, provided by participants, enabled the compilation of the list of surveys in 1982 (Table 1).

2. Survey Plans for 1983 and Early 1984

Requests for information on surveys planned for 1983 and early 1984 resulted in the list given in Table 2. The Federal Republic of Germany participants indicated that plans for the autumn groundfish survey in Div. 2J are still somewhat tentative.

Table 1.. Inventory of biological surveys conducted in the NAFO Area during 1982.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
A. STRATIFIED-RANDOM SURVEYS					
E. Greenl.		DEU	9-10	Groundfish	111
1	ABC	GRL	7-8	Shrimp (photo)	31
	B	"	8	Shrimp (OTB)	32
	BCDEF	DEU	11-12	Groundfish	111
	CDEF	FRA	6	Cod	61
2	GHJ	CAN-N	9	Shrimp	36
	HJ	"	7	"	132
	J	"	10-11	Groundfish	164
		DEU	10-11	"	79
		FRA	1-2	Cod	26
3	K	CAN-N	7	Shrimp	3
	KL	"	10-11	Groundfish	77
		"	11-12	"	196
		FRA	2	"	17
	L	CAN-N	5	"	105
	M	"	1-2	"	109
	NO	"	3-4	"	138
	Pn	FRA	2	Cod	6
	Ps	"	3-4	Groundfish	79
		"	9-10	" (cod tagging)	95
		CAN-N	5-6	"	92
4	R	FRA	1	Cod	31
	T	CAN(SF)	9	Groundfish	72
	VWX	"	3	"	136
		"	7	"	155
		"	10	"	168
		FRA	8-9	Squid	116
	X	USA	4-5	Groundfish	33
			10-11	"	33
5	YZ	USA	3-5	Groundfish	179
			10-11	"	183
6	ABC	USA	3-4	Groundfish	163
			9-10	Groundfish	170
B. OTHER SURVEYS					
Ungava Bay		Can-N	9	Shrimp	84
E. Greenl.		GRL	8	Groundfish & shrimp (com.)	8
0+1		GRL	3	Marine mammals (aerial)	-
0	B	USSR	11	Groundfish (G. halibut)	53
1	AB	GRL	4,8-9	Groundfish & shrimp (com.)	57
		"	7,11	Plankton	76
	ABC	"	7-8	Groundfish & shrimp (com.)	16
	ABCD	"	7-8	Whale (sightings)	-
	BCDEF	"	2-11	Groundfish & shrimp (com.)	33
	CD	"	2-4	" " (res.)	11
	D	"	7	Plankton	24
		"	10-11	Salmon	59
	DE	"	12	Groundfish & shrimp (res.)	6
2	GHJ	USSR	11-12	Groundfish (G. halibut)	84
	J	CAN-N	3	Cod tagging	49
		CAN-N	10	Capelin	-
		USSR	10	Capelin (acoustic)	-

Table 1. (continued)

Sub-area	Div.	Country	Months	Type of survey	No. of sets
3	K	CAN-N	3	Cod tagging	45
		"	5	Crab	-
		"	9	Mackerel	-
		"	9-10	Cod tagging	-
		USSR	1	Groundfish (G. halibut)	67
		"	6-7	Groundfish	56
		"	10	Capelin (acoustic)	-
	KL	CAN-N	9-10	" "	-
	L	"	3	Cod tagging	31
		"	3-4	Herring	-
		"	3-5,11	Crab	-
		"	4-6	Capelin	-
		"	5	Shrimp	-
		"	6-8,10-11	Herring	-
		"	8-9	Crab tagging	-
		USSR	5-6	Groundfish	62
	LNO	CAN-N	6-7	Capelin (acoustic)	-
	M	USSR	4	Groundfish	70
	N	"	5	"	50
		CAN-N	5-6	Squid	23
	0	"	5-6	"	124
		USSR	5	Groundfish	43
	Ps	CAN-N	2	Herring	-
		"	2-3,7	Herring and capelin larvae	-
		"	5-6	Squid	37
		FRA	10	Scallop	122
4	R	CAN-N	1	Herring and capelin	31
		"	7	Scallop	101
		"	8-9	Redfish (acoustic)	-
	RST	CAN(G)	8-10	Shrimp and redfish	60
	S	"	5-6	Pelagic (acoustic and PS)	20
	T	"	5-8	Crab larvae	-
		"	5-6	Crab (photographic)	8
		"	7	Salmon (post-smolts)	10
		"	7-9	Crab juveniles	21
		"	8-9	Herring juveniles	70
		"	8	Scallop	8
		"	9-10	Groundfish	28
		CAN(SF)	6	Mackerel (plankton)	90
	TVW	"	6-7	" "	102
	Vn	"	6,8	Crab tagging	-
	V	CAN-N	2-3	Squid	149
	VW	CAN(SF)	1	Herring (acoustic)	-
		"	4,11	Shrimp	66
		USA	8-9	Clams (joint with Canada)	93
	VWX	CAN(SF)	3-4	Redfish	90
		"	5	Silver hake (adult)	159
		"	9-10	Ichthyoplankton	92
		"	10	Comparative fishing	58
		"	5-6	Squid	91
		"	11	Redfish	112
		USSR	9-10	Ichthyoplankton	92
		"	11	Silver hake (juveniles)	62
	W	CAN(SF)	3-4	Scallop	20
		"	4	Herring tagging	-
		"	11	Ichthyoplankton gear trials	-
		"	11	Pollock	-
		CUBA	5	Silver hake (selection)	40
	WX	CAN(SF)	1	Ichthyoplankton	41
		"	3	Herring larvae	150
		"	4	Silver hake (juveniles)	55
		"	10-11	Herring larvae (plankton)	157
	X	"	2	Groundfish (acoustic)	7
		"	6-7	Acoustics	-
		"	9	Benthic sampling	-
		"	9	Scallop	132
		"	10	Groundfish (acoustic)	15
		"	12	Crustaceans	10
		USA	2	Ichthyoplankton	11
		"	6	"	18
		"	11-12	"	17
4-5	VWXZ	USSR	2-4	Squid, ichthyoplankton	202
	WXZ	CAN(SF)	1	Ichthyoplankton	47
		"	5	"	35
		"	7	"	97
	XY	"	9,11-12	Herring larvae (plankton)	54
	XZ	"	8	Scallop and lobster	186
4-6		CAN(SF)	2	Squid (larvae & juveniles)	161
		JAPAN	1-3	" " "	...
5	YZ	USA	1-2	Herring	186
		"	2-3	Ichthyoplankton	113
		"	5-6	"	77
		"	11-12	"	92
		"	7-8	Scallops	304
	Z	"	7-8	Clams	41
		"	8-9	Clams (joint with Canada)	27
6	A	USA	1-2	Herring	113
	AB	"	3,5	Ichthyoplankton	57
		"	12	"	52
		"	6-7	Scallop	235
	ABC	"	7-8	Clams	231

Table 2. Biological surveys planned for the NAFO Area in 1983 and early 1984.

Country	Area	Type of survey	Dates
A. Surveys in 1983			
CAN-N	2HJ	Shrimp	Jul 6-26
	2J+3K	Capelin acoustics	Sep 30-Oct 25
	2J+3KL	Groundfish	Oct 27-Dec 9
	2J+3	Annual hydrographic	Jul 28-Aug 11
	2+3+4	Gear experiments	Sep 15-Oct 4
	3K	Crabs	May 12-Jun 2
		"	Aug 30-Sep 28
	3KL	Capelin	Apr 18-29
		"	May 25-Jun 30
		Inshore cod migration	May 12-25
	3L	Crabs	Mar 28-Apr 12
		"	May 3-11
		"	May 30-Jun 17
		"	Aug 10-22
		Capelin acoustics	Apr 19-May 10
		Groundfish	Jul 7-Aug 16
		"	Oct 6-Nov 15
		Herring and capelin larvae	Aug 9-25
		" " " "	Oct 5-21
		" " " "	Nov 28-Dec 9
	3LNO	Capelin acoustics	Jun 15-Jul 4
		Juvenile flatfish	Nov 17-Dec 6
	3LPs	Herring and capelin larvae	Jun 20-Jul 8
		" " " "	Jul 14-29
	3NO	Squid	May 27-Jun 13
		Fishery ecosystems	Jun 16-Jul 4
	3Ps	Scallops	Sep 21-28
		Spiny dogfish	Sep 26-Oct 1
	4RS	Groundfish acoustics	Sep 2-19
CAN(G)	4RS+3Pn	Cod	Jan 5-31
	4RS	Cod tagging, trophic studies	Aug 29-Sep 14
	4RST	Redfish ecology	Jun 2-21
		Shrimp and redfish	Sep 15-Oct 21
		Comparative fishing	Sep-Oct
	4T	Mackerel eggs	Jun 20-Jul 8
		Scallops and squid (explor.)	Jul-Aug
		Groundfish	Sep 6-30
		Crab tagging	Oct
CAN(SF)	4VW	Herring acoustics	Jan 7-25
		Shrimp	May 2-13
		"	Oct 3-14
		Acoustics	Oct 17-28
	4VWX	Ichthyoplankton	Feb 8-20
		"	Mar 5-17
		Squid - preseason	Jun 7-17
		" - late season	Sep 12-20
		Silver hake juveniles	Oct 31-Nov 10
		Pollock and redfish	Nov 14-30
		Shrimp	Nov 17-28
	4VWX+5Z	Groundfish	Mar 21-Apr 14
		"	Jul 4-29
		"	Oct 3-28

Table 2. (continued)

Country	Area	Type of survey	Dates
		Comparative fishing	Jul 6-29
	4W	Gear trials	Dec 2-11
	4WX	Ichthyoplankton	Apr 5-22
	4WX	Larval herring	Oct 31-Nov 14
	4X	Haddock	Jan 3-20
		" tagging	Mar 21-Apr 8
		" juveniles	Jun 20-30
		" "	Aug 1-12
		Haddock	Aug 1-19
		Shrimp	Jan 31-Feb 11
		Acoustics	Feb 15-23
		" (herring)	Apr 18-29
		" (trawling)	May 25-Jun 4
		" (herring)	May 23-Jun 3
		" "	Jul 11-22
		" (trawling)	Aug 29-Sep 9
		Lobster	Apr 11-15
		"	May 2-11
		"	Jun 6-10
		"	Jul 11-22
		"	Jul 25-29
		"	Aug 15-19
		"	Aug 22-Sep 2
		"	Sep 6-19
		"	Oct 11-14
		"	Nov 7-10
		Ichthyoplankton	Apr 18-Jun 14
		Live fish	May 12-20
		Benthos	Jun 13-24
		"	Aug 29-Sep 2
		"	Sep 12-23
		"	Nov 14-25
		Shad	Jun 22-Jul 8
		Scallops	Aug 1-26
		"	Sep 26-Oct 7
		Gonyaulax	Oct 17-Nov 4
	4X+5Z	Scallops	May 16-27
	6B	Squid larvae & juveniles	Jan 28-Feb 14
FRA	3Ps	Groundfish (strat.-random)	Feb 21-Mar 19
		" " "	Oct 6-31
		Scallops	Nov 1-10
	3P+4R	Cod (stratified-random)	Jan 18-Feb 19
	4VWX	Squid (stratified-random)	Aug 30-Oct 4
DEU	E. Greenl.	Groundfish (strat.-random)	Sep 12-Oct 21
	1B	" " "	Nov 11-Dec 20
	2J	" " "	Oct 12-Nov 23
GRL	E. Greenl.	Cod (commercial)	Aug
	1AB	Shrimp (photo)	Jul-Aug
	1ABC	Groundfish & shrimp (com.)	Jan-Dec
		" " (res.)	Nov
	1ABCD	Plankton	Jul-Nov
	1ABCDE	Whale (sightings)	Jun-Jul
USSR	0B	Groundfish (G. halibut)	Nov-Dec
	2+3K	" (strat.-random)	Dec-Jan
	2J+3K	Capelin acoustics	Nov
	3KL	Capelin, ichthyoplankton	Oct
	3KLNO	Groundfish (strat.-random)	May-Aug
	3LNO	Capelin acoustics	May-Jun
	3M	Groundfish (strat.-random)	Apr-May
		Ichthyoplankton	Apr-Jun
		Redfish acoustics	May
	4VWX	Squid larvae and juveniles	Feb-Jun
		Silver hake juveniles	Oct-Nov
USA	4X	Groundfish	Apr 11-May 6
		"	Oct 17-Nov 10
		Clams	Sep 13-28
	4-6	Ichthyoplankton	Feb 25-Mar 4
		"	May 23-Jun 23
		"	Nov 14-Dec 21
	5YZ	Groundfish (herring)	Feb 28-Mar 9
		Groundfish	Mar 28-May 9
		"	Oct 3-Nov 10
	5+6	Clams	Aug 17-Sep 9
		Scallops	Jul 26-Sep 2
	6	Groundfish (herring)	Feb 14-24
		"	Mar 7-Apr 8
		"	Sep 12-Oct 14
		Herring (or gear studies)	Oct 11-Nov 2

B. Surveys Planned for Early 1984

CAN-N	3L	Groundfish	Jan 5-Feb 13
		Herring and capelin larvae	Jan 30-Feb 17
		Herring	Mar 12-29
	3LN	Groundfish	Feb 15-28
	3LNO	Salmon	Jan 20-Feb 10
	3M	Groundfish	Feb 13-28
	3Ps	Herring	Jan 9-Feb 17
		Groundfish	Mar 1-20
		Cod tagging	Mar 22-Apr 2
	4Vs	Squid	Feb 20-Mar 13
CAN(SF)	4VW	Acoustics	Mar 19-30
	4VWX+5Z	Groundfish	Mar 2-30
	4W	Herring (acoustics)	Jan 16-24
	4WX	Herring larvae	Feb 27-Mar 16
	4WX+6B	Squid larvae and juveniles	Jan 2-21
	4X	Acoustics (trawling)	Jan 2-18
		Benthos	Jan 2-6
		Ichthyoplankton	Jan 23-Mar 30
		Cod tagging	Feb 1-18
		Haddock tagging	Mar 15-31
FRA	3P	Cod (strat.-random)	Jan 18-Feb 19
	3Ps	Groundfish (strat.-random)	Feb 21-Mar 19
FRA	4X-6	Groundfish	Feb 27-Apr 27
	4-6	Ichthyoplankton	Jan 9-Feb 10
		"	May 22-Jun 22
	5	Larval dynamics	May 7-18
	5+6	Scallops	Jul 24-Aug 31
		Clams	Aug 13-Sep 26
		Hydroacoustics (trawling)	Feb 14-24

3. Review of Stratification Schemes

The Committee noted that the only major gap in stratification schemes for research vessel surveys was in Div. 2G and 2H. Canadian scientists indicated that this would be done as soon as accurate navigational charts become available.

4. Coordination of Squid Surveys in 1984

No proposals were submitted for advice from STACREC regarding coordination of squid surveys in 1984, these matters being dealt with between countries on a bilateral basis. It was noted that some activity might arise from the Symposium of Squid Biology and Distribution to be held in September 1984.

III. OTHER MATTERS

1. Acknowledgements

There being no other matters to consider, the Chairman thanks the rapporteurs for their assistance in drafting the report and expressed his appreciation to all participants for their cooperation during the meeting and to the Secretariat for their usual efficient work.

ANNEX 1. REPORT OF AD HOC WORKING GROUP ON SAMPLING

Convener: T. K. Pitt

The Working Group met at NAFO Headquarters, Dartmouth, Canada, on 18 June 1983 to consider and report on the matter of extending the sampling data base in a format similar to that used prior to 1979, as requested at the June 1982 Meeting (NAFO Sci. Coun. Rep., 1982, page 61). Participants were: J. Baird (Canada), A. Forest (France), V. M. Hodder (NAFO Secretariat), Sv. Aa. Horsted (Denmark), and J. Messtorff (Federal Republic of Germany).

1. Review of Pre-1979 Sampling Data Base

At the June 1974 Meeting of ICNAF, the Standing Committee on Research and Statistics (STACRES) agreed to discontinue the publication of length frequencies and age-length keys in the Sampling Yearbook following the issue of Vol. 17 for the year 1972, as the data could be provided on computer printout to scientists upon request (ICNAF Redbook, 1974, page 128). Starting with Vol. 18 for 1973, only lists of commercial and research sampling data available in the Secretariat data base were published annually, and this was continued to the issue of Vol. 23 for 1978. Meanwhile, all of the sampling data reported to 1978 have been computerized in a standard format and stored on magnetic tape. Much of these data have, at one time or another, been supplied to individual scientists and to fisheries institutes involved in the work of ICNAF and NAFO.

Several times during the 1970's (e.g. ICNAF Redbook, 1978, page 88), it was agreed that the Secretariat, with its direct access to a large computer, could serve as the depository for sampling data collected in the Northwest Atlantic and should continue to maintain and update, as required, the current base of sampling data in accordance with previously established procedures.

2. Detailed Sampling Data Requirements

Sampling data requirements were significantly modified in 1979, with the adoption of new sampling forms for reporting in much greater detail than previously (ICNAF Redbook, 1979, page 95). In fact, the requirements for length composition data involved the collection and reporting of length frequencies for individual trawl catches, with detailed information on day of fishing, starting time of haul, actual position of haul, type and mesh size of gear, catch weight, sample weight, registration number and name of vessel, etc. Almost as much information was required in the reporting of age-length keys. The revised outline of the NAFO Sampling Program was presented at the June 1980 Meeting, and the Scientific Council emphasized that the new CFS-1 and CFS-2 forms are to be used in reporting data for 1979 and subsequent years, such data to include all national data and data collected by international observers.

3. Need for Summarization of the Detailed Data

The previous requirment was that monthly length compositions (per mile) were supplied with quarterly age-length keys and that these could be associated with each other in a standardized format, such that age compositions and mean length-at-age values could be calculated for each monthly length frequency. The lists of available sampling data by species, for inclusion in Sampling Yearbook, could therefore be readily compiled from these computer listings of length compositions and associated age-length keys.

The present requirements for reporting individual length samples by date (sometimes more than one sample per day) and by position (latitude and longitude) provides no basis for their association with age-length keys, which are normally submitted by month and division, unless some arrangement is made for grouping the length frequencies on the same basis (i.e. month and division). Although the individual length frequencies are useful for examining the variability associated with sampling during specific periods and in specific regions, it is not possible to use them for assessment purposes (i.e. in deriving monthly or quarterly age compositions) without grouping them to correspond with the available age-length keys.

To date, no scientist or fisheries institute has requested the Secretariat to provide the detailed sampling data with a view to studying the variability, and those scientists, who have requested data for assessment purposes, want the data in the format similar to the pre-1979 computer printout.

4. Conclusions and Recommendations

The Working Group agreed that the Secretariat should continue to operate as the depository for sampling data for the Northwest Atlantic, but that the data should be submitted in usable form. It was noted that any analysis of detailed sampling data could best be undertaken in the fisheries institutes where the data exist, and that representative compilations of length frequencies by month and division could only be made by the scientists responsible for collecting the raw data. Consequently, the Working Group proposes that the sampling data should be submitted to the Secretariat in the form of monthly length frequencies and monthly age-length keys by division (or subdivision, where applicable)

in an appropriate format. This will enable the Secretariat to extend its computerized sampling data base forward beyond 1978 and continue to provide computerized listings of data to scientists upon request. Presently, the data base contains all sampling data reported for 1966-78.

In view of the problems associated with setting guidelines for the summarization of detailed sampling data submitted since 1979, the Working Group further proposes that the Secretariat develop an appropriate format for the submission of monthly sampling data and request the fisheries institutes concerned to resubmit all sampling data in summarized form starting from 1979. The NAFO Sampling Yearbook, containing lists of sampling data, should be compiled in the same format as used previously for the ICNAF Sampling Yearbook and distributed to scientists and fisheries institutes involved in the work of NAFO.

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

Chairman: V. A. Rikhter Rapporteur: R. G. Halliday

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, on 9 and 21 June 1983 to consider and report on various matters referred to it by the Scientific Council. In attendance were V. A. Rikhter (Chairman), J. Messtorff and J. P. Minet (EEC), R. G. Halliday and A. T. Pinhorn (Canada), with T. K. Pitt substituting for A. T. Pinhorn on 9 June. The Chairman of the Scientific Council (R. Wells), the Executive Secretary (Capt. J. C. E. Cardoso) and the Assistant Executive Secretary (V. M. Hodder) also attended the sessions. Absent was H. Hatanaka (Japan), who had informed the Chairman of his resignation as a member of STACPUB.

1. Review of Scientific Publications since June 1982

a) Journal of Northwest Atlantic Fishery Science

Volume 3(2) containing 10 papers (84 pages) was published in December 1982. Volume 4, containing the "Guide to the Early Stages of Marine Fishes in the Western North Atlantic, Cape Hatteras to the Southern Scotian Shelf" (425 pages), is expected to be ready for distribution in late August or early September 1983. The Editor reported that he has in hand 25 papers which are presently under consideration for publication in the Journal. Volume 5(1) is planned for production towards the end of 1983 or early 1984.

b) Scientific Council Studies

Number 4, containing 12 papers (98 pages) initially presented at the Special Session on Remote Sensing in September 1981, was published in September 1982. Number 5, containing 12 papers (110 pages) initially presented at the Symposium on Environmental Conditions during 1970-79, held in September 1981, was published in December 1982. Several papers, including the Report of the Shrimp Ageing Workshop, are being prepared for the next issue (No. 6) planned for publication before the end of 1983.

c) Scientific Council Reports

The volume containing the reports of June and September 1982 meetings of the Scientific Council (109 pages) was published in December 1983.

d) Statistical Bulletin

Volume 30 for 1980 (279 pages) was published in August 1982. Production of Vol. 31 for 1981 has been delayed pending receipt of the submission from the United States. These data are now in hand, but publication is not possible until after August due to work involved in completing Journal Vol. 4.

e) List of Fishing Vessels

On recept of submissions from the four remaining countries, the triennial list for 1980 (47 pages) was finally published in March 1983.

f) Index and List of Titles of Meeting Documents

The index and list of titles for 1982 (35 pages) was issued in March 1983.

2. Editorial Policy regarding Scientific Council Publications

a) Editorial Board for the Journal

It was learned with regret that Mr. Parrish, who was appointed to the Editorial Board as Associate Editor for Vertebrate Fisheries Biology by the Council in September 1982, has found it necessary to resign, following his appointment to the post of General Secretary of ICES. Because about 80% of the workload is in this field, it was decided that two Associate Editors for Vertebrate Fisheries Biology are required. STACPUB reviewed suggestions for associate editors and

recommends

that R. G. Halliday (Canada) and M. D. Grosslein (USA) be invited to serve on the Editorial Board of the Journal of Northwest Atlantic Fishery Science as Associate Editors for Vertebrate Fisheries Biology.

b) Promotion and distribution

Distribution of the Journal was reviewed, and it was noted that free distribution to scientists of member goverments continued to be slightly less than 500 and that subscriptions were slowly increasing and now numbered between 35 and 40. The Executive Secretary reported on costs and revenues for the Journal in 1982 and also that advertisements had been placed for the Journal in a number of publications as requested by the Council. STACPUB noted that Council representatives had not provided lists of potential subscribers upon returning the results of their annual review of free national distribution. Indeed several national representatives have failed to return the results of their annual review. The success of Council representatives in distributing advertisements at scientific meetings and conferences is not known except for one case reported to STACPUB. STACPUB hopes that publication and review of Volume 4 (Guide to the Early Stages of Marine Fishes ...) will encourage interest in the Journal but has no further proposals to make on promotion.

Distribution of Studies was reviewed, and it was noted that the Secretariat had adopted a policy similar to that for the Journal except that a few exchanges were being undertaken for goodwill purposes. It was agreed that this was satisfactory, and STACPUB

recommends

that the policy for distribution and annual review thereof for Scientific Council Studies should be the same as that for the Journal, except that a few exchanges may be undertaken for goodwill purposes.

3. Promotion of Ichthyoplankton Studies

STACPUB noted that its recommendation on encouragement of studies on the taxonomy of fish eggs and larvae in the Northwest Atlantic has been accepted by the Council and that there was no further action which could be undertaken by STACPUB. The *ad hoc* Working Group has not met since September 1982 and there are no plans to have it meet in 1983.

4. Papers for Possible Publication

a) Status of stock discrimination symposium papers

Of the 18 papers recommended for publication, five have been submitted for consideration for the Journal and four for Studies. Although several more may be forthcoming at a later date, it is clear that there is little prospect of obtaining sufficient papers to merit a special issue of Studies. To avoid undue delays in the publication of papers already submitted by authors, STACPUB therefore

recommends

that papers nominated for publication from the Stock Discrimination Symposium of September 1982 be published in regular issues of the Journal and Studies as merited by content and as they become available.

b) Review of proposals in 1982

It was noted that, of the other papers proposed for publication in 1982, three were published in Journal Vol. 3(2) and two were scheduled for the next issue of Studies, with several others still under consideration.

c) Proposals for possible publication from 1983 documents

STACPUB reviewed the research (SCR) documents presented to date in 1983 and requested the Editor to invite the authors of the following documents to submit suitably revised manuscripts for possible publication in the Journal or Studies series: SCR Doc. 83/18, 19, 22, 23, 31, 32, 34, 41, 45, 49 and 52. A decision on SCR Doc. 83/61 and 62 was deferred to the June 1984 meeting, because they have not yet been presented to the Scientific Council.

It was noted that the question of publication of the report of the *ad hoc* Working Group on Herring Tagging (SCS Doc. 83/VI/18) had been referred to STACPUB by STACFIS. It was agreed that this most uesful report should be published and the Editor was requested to solicit, through the Convener, the views of the scientists involved in this research as to whether or not they would agreed to have this report published in the Studies series. If any of them have objection to this proposal, it is alternatively proposed that the report should be included in the Scientific Council Reports for 1983, as an annex to the June 1983 Report of STACFIS.

5. Utilization of Microfiche

The Executive Secretary reported that most recent cost estimates for production of suitable quality microfiche copies of all historical (30 years) research and summary documents (and their equivalents in early years) is now approximately $25,000 (Can.). He now has verbal commitments of financial support from essentially all Department of Fisheries and Oceans (Canada) libraries in Ottawa and the Atlantic region in exchange for complete sets of microfiche copies of historical documents as specified above. With indications of interest from some university libraries in North America and libraries of fisheries institutes in the USA and other countries, he feels confident that full cost recovery should not present a problem in the not too distant future. It was agreed that this project should be undertaken but that every effort should be made to obtain further expressions of support. STACPUB therefore

recommends

i) that the Executive Secretary be asked to obtain full technical specifications for the microfiche proposal and make these available as soon as possible to national representatives on the Scientific Council;

ii) that, because of the difficulties presented to the Executive Secretary in contacting appropriate institutions in member countries, Scientific Council representatives be asked, after receiving materials noted in (i), to undertake to approach their appropriate national authorities and/or institutions to obtain as clear expressions of interest and support as possible for this project;

iii) that the Scientific Council representatives be asked to inform the Executive Secretary and their national representatives on the General Council of responses they have received and to do so by the September 1983 Meeting of the General Council; and

iv) that the Scientific Council request the Executive Secretary to take the necessary steps to obtain from the General Council authorization to incur the expenses associated with implementation of this project.

It was noted that the time between this meeting and the September Meeting is very short and that it may not be possible to meet recommendation (iii) above. It is hoped that there will nevertheless be sufficient replies available by this time to better establish support for this project among national institutions.

6. Other Matters

It was noted that the Chairman had received the resignation from STACPUB of Dr. H. Hatanaka (Japan). The Council is therefore requested to appoint a replacement.

7. Acknowledgements

The Chairman thanked all members for their active participation in the meetings and the Executive Secretary and the Assistant Executive Secretary for their efficient job in support of the Committee's work.

PART C

REPORT OF SCIENTIFIC COUNCIL

Annual Meeting, September 1983

CONTENTS

REPORT OF THE SCIENTIFIC COUNCIL

Annual Meeting, September 1983

Chairman: R. Wells Rapporteur: V. M. Hodder

The Scientific Council and its Standing Committees on Fishery Science (STACFIS) and Publications (STACPUB) met at the Pribaltiyskaya Hotel, Leningrad, USSR, during 14-23 September 1983 to consider and report on various matters listed in the Agenda (see Part D, this volume). Representatives attended from Bulgaria, Canada, Cuba, European Economic Community (Denmark, Federal Republic of Germany, France, Netherlands, and the Commission), German Democratic Republic, Japan, Norway, Poland, Spain, and Union of Soviet Socialist Republics (USSR). The participants included scientists who presented papers to the Special Session on "Trophic Relationships in Marine Fishes Relevant to Fisheries Management in the Northwest Atlantic", which was held on 14-16 September 1983.

The reports of the Standing Committees, as adopted by the Council at this meeting are at Appendix I (STACFIS) and Appendix II (STACPUB). Brief summaries of these reports and other matters considered by the Council are given below.

I. FISHERIES SCIENCE (APP. I)

1. Special Session on Trophic Relationships in Marine Fishes

The Special Session took place on 14-16 September 1983 with V. A. Rikhter (USSR) and G. R. Lilly (Canada) as Co-conveners. The session focussed on factors influencing the feeding intensity and diet spectrum of many marine species in the Northwest Atlantic, on specific predator-prey interactions and on the potential and methodology of Multispecies Virtual Population Analysis (MSVPA) models. When reviewing the 21 scientific contributions, discussion centered on the merits of MSVPA, on the feeding behavior of commercial species, on the dynamics of the ecosystems supporting these species, and on the predator-prey factors influencing mortality of larvae and juveniles of commercial species and thus year-class success.

2. Environmental Research

The Council, noting the valuable contributions made by the Subcommittee on Environmental Research, endorsed the conclusions of STACFIS regarding its future work and agreed that the Subcommittee should continue to provide an annual updata of all relevant oceanographic data and to relate these oceanographic conditions to the norms of the base periods established in the overview presented at the June 1983 Meeting. The Subcommittee is further requested to advise on the effects of environmental factors on the distribution and movements of marine fishes in the Northwest Atlantic.

3. Other Scientific Documents

The Council noted that 30 research documents were presented at this meeting, 21 of which were reviewed at the Special Session. Of the remaining 9 documents, 6 were reviewed by STACFIS and 3 were deferred to the June 1984 Meeting.

4. Presentation of Assessment Material for STACFIS Reports

The Council noted the conclusions of STACFIS concerning the sections dealing with stock assessments in its report, and endorsed the recommendations of STACFIS to introduce a standard list of contents for mandatory use by authors, to cite page references for information and analyses referred to in its report, and to produce a STACFIS research document at the time of the meeting for all data and analyses considered but not included in its report or in other published form.

5. Conveners for Special Session in September 1984

The Council endorsed the recommendation of STACFIS regarding the appointment of Mr. T. Rowell (Canada) and Dr. Ch. M. Nigmatullin (USSR) as Co-conveners for the Special Session on "Biology and Ecology of Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic", to be held in September 1984.

II. PUBLICATIONS (APP. II)

1. Status of Publications

The Council was very pleased to note that Volume 4 of the Journal of Northwest Atlantic Fishery Science, containing a comprehensive "Guide to Early Stages of Marine Fishes in the Western North Atlantic", (425 p.), was recently completed. Editing of papers for Volume 5 is in progress and Number 1 is expected to be published in early 1984.

Publication and distribution of Volume 31 of the NAFO Statistical Bulletin, containing 1981 fishery statistics, is expected about mid-October 1983, and Number 6 of NAFO Scientific Council Studies is expected to be published in December 1983.

2. Editorial Matters

The Council was pleased to note that the Editorial Board of the Journal is now again complete by the appointment of R. G. Halliday (Canada) and M. D. Grosslein (USA) as Associate Editors for Vertebrate Fisheries Biology.

The Council noted that the quality of the various reports, which have been approved at recent meetings, has suffered from editorial errors such that an undue workload has been placed on the Assistant Executive Secretary in editing the reports afterwards for distribution, and therefore endorses the recommendation of STACPUB that the Scientific Council and its Standing Committees, Subcommittees and Working Groups substantially improve the quality of their reports at the time of their approval by reviewing in detail the reports for ambiguities and editorial errors and any other aspects so as to ensure the high quality worthy of such a scientific body.

3. Utilization of Microfiche

The Council noted that production of approximately 600 fiches would be required if all scientific research related documents in the ICNAF series, as referred to in the STACPUB Report, are to be reproduced.

National representatives to the Scientific Council are requested to now approach their appropriate national authorities and/or institutions to obtain clear expressions of interest in the purchase of sets of copies. The results of their enquiries should be communicated to the Executive Secretary by 31 March 1984 so that appropriate estimates can be included in the budget projections for 1985, which must be circulated 80 days prior to the September 1984 Meeting of the General Council.

The Assistant Executive Secretary is requested to provide all National Representatives with the background material which has been provided to members of STACPUB and to inform them of the decisions and resolutions made at this meeting of the Council, upon his return to headquarters. The Executive Secretary is requested, based on replies received from National Representatives by the deadline, and in consultation with the Chairman of STACPUB, to decide on the number of copies to be produced and hence on the appropriate budgetary estimate.

4. Papers for Possible Publication

The Council noted that STACPUB had reviewed the scientific papers presented to this meeting. With regard to documents presented at the Special Session on Trophic Relationships, it was noted that these papers should not be published as a compendium but each document should be considered on its own merits. The Council therefore endorses the recommendation of STACPUB concerning this matter. It was noted that STACPUB has recommended 14 papers for possible publication in one of the Council's publication series, subject to revisions by the authors and acceptance by the Editor.

III. FUTURE SCIENTIFIC MEETINGS

1. Mid-term Meeting for Assessment of Shrimp Stocks

The appropriate time for a mid-term meeting to assess the shrimp stocks in Subareas 0 and 1 and off East Greenland was discussed. The significance of including data from the current year's fishery and precruit surveys in the analysis of the present status of a stock and the determination of propects for the following year varies from species to species and from stock to stock. At one extreme is the squid (*Illex illecebrosus*) stock, in which the individuals to be harvested in 1984 are not yet born and hence no abundance indices can be derived from research surveys and the commercial fishery in 1983. In the case of redfish, the year-classes which will comprise the majority of the 1984 catch have been studied and exploited for several years, and cumulative information on their abundance from the commercial fishery and research surveys to the end of 1982 provides useful indication of their abundance in 1984. Redfish year-classes which were too young to be present in commercial catches and research surveys in 1982 will make no significant contribution to the 1984 fishery. Consequently, it is possible to give useful advise on management of the fishery in 1984 without including analysis of 1983 data. Analysis of the shrimp stocks in Subareas 0 and 1 and at East Greenland is an intermediate case. The year-classes supporting the 1982 fishery will not contribute significantly to the fishery in 1984, but shrimp recruiting to the 1983 fishery and young shrimp observed in 1983 research sruveys will sustain the fishery in 1984. Therefore, the inclusion of shrimp data collected in 1983 is particularly important in the provision of useful advice. Catch and effort data will be forthcoming from the fishery still being prosecuted in August and September. A further important source of information about the Davis Strait stock, including estimates of the abundance of recruiting shrimp, is the photographic survey conducted by Denmark.

The Scientific Council, at its June 1983 Meeting, deferred to the September 1983 Meeting its final decision on the timing of the meeting to assess the shrimp stocks, pending the receipt of proposals from interested parties. At that time, the Council concurred with the proposal of STACFIS that the best time for a meeting to assess the shrimp stocks would be in early 1984.

Information received at this meeting indicates that scientists from France and Norway can be prepared for a meeting in mid-November, whereas scientists from Canada and Denmark have indicated that adequate preparation of their data implies a meeting not earlier than January 1984. In its desire to provide appropriate advice based on adequate analysis of data, the Scientific Council therefore plans a meeting for the assessment of northern shrimp on 18-23 January 1984 at the Bedford Institute of Oceanography, Dartmouth, Canada.

The Council noted the invitation put forward by the EEC representative that the shrimp meeting in 1984 should take place in Copenhagen in late November at a date to be confirmed later. The Scientific Council therefore requests STACFIS at its meeting in January 1984 to consider this invitation and to advise the Scientific Council accordingly on the appropriate timing of a meeting to provide advice on the Davis Strait stock for 1985.

2. Regular Meeting in June 1984

As agreed at the June 1983 Meeting, the Scientific Council, together with its Standing Committees, Subcommittees and Working Groups, will meet at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada during 6-21 June 1984.

3. Annual Meeting in September 1984

The Scientific Council agreed that its meeting will begin on Wednesday in the week proceding the meetings of the General Council and Fisheries Commission in September 1984. The theme for the Special Session at that meeting is "Biology and Ecology of the Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic. [The dates for the Special Session at this meeting were subsequently established as 5-7 September 1984.]

4. Regular Meeting in June 1985

The Council tentatively agreed to meet during 5-20 June 1985 at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada.

5. Theme for Special Session at the 1985 Annual Meeting

The Council agreed that the theme for the 1985 Annual Meeting will be "Design and Evaluation of Biological Surveys in Relation to Stock Assessments".

IV. OTHER MATTERS

1. Procedures for Reporting Sampling Data to the Secretariat

The appropriateness of the current formats for reporting sampling data was discussed at the June 1983 Meeting. The matter was deferred to this meeting so that the Secretariat could obtain from representatives the time periods and areas appropriate for stock assessment purposes. Time was insufficient to complete the work prior to this weeking, and the matter was deferred for consideration at the June 1984 Meeting.

2. Provisional Report of Scientific Council, June 1983

The Council reviewed and adopted its report of the June 1983 Meeting (SCS Doc. 83/VI/21), with some additions and amendments, which have been incorporated in the published report (see Part B, this volume).

3. Death of a Prominent ICNAF/NAFO Scientist

The Council was saddened to hear of the recent passing away of Dr. K. G. Konstantinov of the Polar Research Institute of Marine Fisheries and Oceanography. His contributions to ICNAF and NAFO, and to the scientific community in general, have been great.

V. ELECTION OF OFFICERS FOR 1984-85

The Council was pleased to confirm, as a result of votes submitted to the Executive Secretary following the lack of a quorum at the June 1983 Meeting, the election of the following officers to serve from the end of the present meeting until the end of the 1985 Annual Meeting:

1. Scientific Council

Chairman - V. A. Rikhter (USSR)
Vice Chairman - J. Messtorff (EEC)

2. Standing Committees

Chairman of STACFIS - J. Carscadden (Canada)
Chairman of STACREC - J. Moller Jensen (EEC)
Chairman of STACPUB - J. Messtorff (EEC) (*ex officio*)

VI. ADJOURNMENT

The Chairman expressed his thanks to the chairmen and rapporteurs of STACFIS and STACPUB, to the conveners of the Special Session on Trophic Relationships in Marine Species, to the rapporteur of the Scientific Council, and to all participants for their cooperation and support during the course of the meeting. He made note of the unfailing and indispensible assistance of the NAFO Secretariat and the support staff for the Secretariat made available by the Soviet Union.

Dr. J. Messtorff, on behalf of all members of the Scientific Council, expressed appreciation for the excellent guidance rendered by the Chairman of the Council and its Committees during the last two years.

It was unanimously agreed that this meeting was even more pleasant than usual because of the opportunity to see the delightful city of Leningrad. The meeting was adjourned at 1200 hr on 23 September 1983.

APPENDIX 1. REPORT OF STANDING COMMITTEE ON FISHERY SCIENCE (STACFIS)

Chairman: J. P. Minet Rapporteurs: Various

The Committee met at the Pribaltiyskaya Hotel, Leningrad, USSR, during 14-19 September 1983 to consider and report on various matters referred to it by the Scientific Council. The Special Session on "Trophic Relationships in Marine Species Relevant to Fisheries Management in the Northwest Atlantic", the future of the Subcommittee on Environmental Research, appointment of conveners for the Special Session in September 1984, proposed changes in the presentation of its report, adoption of outstanding sections of the June 1983 report, and review of scientific documents were the major topics considered.

Scientists attended from Bulgaria, Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France, Netherlands, and the Commission), German Democratic Republic, Japan, Norway, Poland and USSR.

I. SPECIAL SESSION ON TROPHIC RELATIONSHIPS IN MARINE SPECIES RELEVANT TO FISHERIES MANAGEMENT IN THE NORTHWEST ATLANTIC

1. Introduction

The Special Session, convened by V. A. Rikhter (USSR) and G. R. Lilly (Canada), was held at the Pribaltiyskaya Hotel, Leningrad, on 14-16 September 1983. Twenty-one scientific contributions were presented. Two of the papers were keynote presentations: fisheries studies in freshwater and their relevance to marine systems (S. R. Kerr, Canada), and the aims, organization and preliminary results of the ICES stomach-sampling project in the North Sea (N. Daan, Netherlands). The various reports contributed considerably to knowledge of the spatial, temporal and size-related factors which influence the feeding intensity and diet spectrum of many species in continental shelf and slope areas of the Northwest Atlantic. There were also examination of specific predator-prey interactions and discussion of the potential of multispecies virtual population analysis (MSVPA) models.

2. General Considerations

There was considerable discussion of the merits of the multispecies virtual population analysis (MSVPA) models being developed for the North Sea. Although the application of similar models to Georges Bank might be rewarding, it was generally felt that such models might not be applicable to more northern areas, such as eastern Newfoundland, where most of the food of major predators is composed of invertebrates and other taxa which are not assessed by virtual population analysis (VPA) and therefore must be included in the "other food" component of current MSVPA models. Further complicating factors are the extensive annual migrations undertaken by some species and the division of certain species into several stocks, each with its own vital rates and migrations patterns.

It was clear that much more information was needed on the feeding behavior of species of commercial interest and, indeed, on the dynamics of the whole ecosystem supporting these species. Large-scale marine systems are difficult to manipulate experimentally, but considerable insight into their structure might be derived from long-term monitoring of the abundance of predators and prey, the food of predators, and a few carefully selected environmental parameters.

Considerable insight into the structure of marine ecosystems and the consequences of management decisions may be derived from a review of studies conducted in bodies of fresh water, or even in the coastal areas of the ocean, where it is usually easier to measure important aspects of the physical environment, to examine the physiological basis of empirical observations, and to conduct comparative studies and experimental manipulations. There was a suggestion that a comparison of trophic interactions in similar environmental conditions at various locations in the North Atlantic might reveal fresh insights into the structure of the ecosystems. For example, the Georges Bank region might be compared with the North Sea, and the area off eastern Newfoundland might be compared with the West Greenland, Iceland and western Barents Sea areas.

The high mortality rates reported for juvenile fish in the North Sea and on Georges Bank indicate that large-scale studies (such as the Flemish Cap Project), whose goal is to elucidate the factors influencing year-class success, should place greater emphasis on mortality of juveniles. Also, greater attention should be directed to the role of predation by invertebrates and small fish in the mortality of larvae.

As in earlier symposia, the need for intensive study of the rate of evacuation of food from predator stomachs, particularly at low temperatures (< 3°C) was emphasized. Such data are required to enable the calculation of feeding rate from stomach content weight.

3. Papers Presented

The following research documents were considered at the Special Session: SCR Doc. 83/IX/69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 86, 87, 88, 89, 92 and 93 (see Part D, this volume). Noting that many of these papers may be suitable for publication in the Journal or Studies series, the Committee

recommends

that STACPUB consider the matter of publication of the papers presented at the Special Session.

II. ENVIRONMENTAL RESEARCH

1. Future of Subcommittee on Environmental Research

The future of this Subcommittee, established by the Scientific Council in September 1981, was discussed at the June 1983 Meeting (see Part B, this volume). At that time, in view of the apparent lack of interest in the work of the Subcommittee (small participation of scientists, particularly oceanographers, and small amount of documentation presented), the question of discontinuing its existence was briefly discussed. However, it was agreed to defer the discussion on this matter to the present meeting because scientists wished to contact other scientists in their laboratories before taking a firm decision.

This matter was discussed further at the present meeting, and it was generally agreed that, even if difficulties presently exist, the Subcommittee on Environmental Research should be maintained within the framework of STACFIS. It was recognized that definition of its mandate had to be refined to encourage a larger input of scientific contributions, participation and discussion and to strengthen the links between oceanographers and fishery biologists.

STACFIS agreed that the task of the Subcommittee to gather annually all relevant oceanographic data should be continued in order to provide, on a regular basis, a better understanding of the environmental conditions in the Northwest Atlantic. Furthermore, it was agreed that more specific goals had to be defined in order to relate environmental factors to the dynamics of exploited populations. When discussing specific goals that could be referred to the Subcommittee, the Committee recognized again the important effects of environmental conditions on recruitment of various species. However, in view of the intractability of this problem, STACFIS proposed that the Subcommittee on Environmental Research should focus its work as soon as possible on the influence of environmental factors on the distribution, movements and migrations of marine species in the Northwest Atlantic. It was also agreed that, at the June 1984 Meeting, the Subcommittee should meet in the middle of the period allocated for stock assessment work in order to insure a larger participation of fishery biologists. In closing the discussion on this matter, STACFIS reiterated its confidence in the present Chairman of the Subcommittee (Dr. R. Trites, Canada) to undertake this difficult task.

2. Future Updating of the Overview of Environmental Conditions in 1982 (SCR Doc. 83/VI/23)

At its June 1983 Meeting, STACFIS had already noted the usefulness of the analysis presented in this overview for 1982. The need for updating these time series, on a yearly basis, was recognized by the Committee at the present meeting. It was noted that, even when scientists carrying out oceanographic research in the different areas of the Northwest Atlantic could not present detailed research documents on a yearly basis, specific data sets for the considered year should be included in the national reports. STACFIS requests the Subcommittee on Environmental Research to select those data sets which are considered useful, to coordinate their collection among participating parties and to propose a standard format of presentation.

III. OTHER SCIENTIFIC DOCUMENTS

Of 30 research documents available to the Committee at this meeting, 21 were presented and discussed during the Special Session on Trophic Relationships in Marine Species. Three of the nine remaining documents (SCR Doc. 83/IX/66, 67, 68) were deferred for review at the June 1984 STACFIS Meeting. The other six are briefly summarized below.

1. Morphometric Classification Between Golden and Beaked Redfishes (SCR Doc. 83/IX/94)

Morphometric characters were investigated to provide criteria for species identification of redfishes in the Northwest Atlantic. Standard length was utilized as a covariate to adjust morphometric values, because specimens of *S. marinus* were larger than those of beaked redfishes. Discriminant analysis with covariance was performed on 17 morphometric variables and resulted in an 11-variable discriminant function which explained 65% of the total variability. The discriminant function with two traditional discriminators (orbit width and length of symphysial tubercle) explained 56% of the total

variability. The discriminant analysis of 15 morphometric variables excluding the two traditional discriminators resulted in a 10-variable function which explained 58% of the total variability. The result demonstrated good (87-90%) separation of the golden redfish (*S. marinus*) from beaked redfishes (*S. mentella* and *S. fasciatus* combined). Orbit width, interorbital width, length of symphysial tubercle (beak), depth of caudal peduncle, width of fleshly attachment of pectoral fins and body depth at the level of the pectoral fins were determined as good morphometric discriminators.

2. Metazoan Parasites of Northwest Atlantic Redfishes (*Sebastes* spp.) (SCR Doc. 83/IX/95)

A total of 443 redfishes (209 *S. fasciatus*, 123 *S. marinus* and 111 *S. mentella*), obtained from Div. 2H, 2J, 3K, 3L, 3M, 3O and 3Ps during 1980-82, were examined for metazoan parasites, with 182 (87.1%) *S. fasciatus*, 120 (97.6%) *S. marinus* and 103 (92.8%) *S. mentella* being infected. Seventeen species of parasites were recovered (12 from *S. fasciatus*, 16 from *S. marinus* and 11 from *S. mentella*), with 22 instances of new host records. Quantitative data, including prevalence and intensity of infection, are given for each parasite by host species and NAFO division.

3. Trawl Selection Relative to Several Fishes in the Northwest Atlantic (SCR Doc. 83/IX/84)

This document summarizes results of experimental work on selective properties of trawl codends of different mesh sizes with respect to beaked redfish, Greenland halibut, roundnose grenadier, American plaice and yellowtail flounder. The results show that, in some cases, an increase in the mesh size had practically no effect on the retention and escapement of small fish. It is recommended that studies on the selectivity of trawl codends in relation to different fish species be continued and the results presented to future meeting, with special emphasis on the short-term losses and long-term changes.

4. Greenland Halibut By-catch in the Roundnose Grenadier Fishery (SCR Doc. 83/IX/91)

Information on the ratio of Greenland halibut and roundnose grenadier in commercial catches derived from USSR trawl-fishery statistics for Subareas 0, 1, 2 and Div. 3K were presented. Analysis of the data shows that, due to overlap in the areal distribution of these deepwater species on the continental slope, the by-catch of Greenland halibut is higher than the 10% established for directed fishing of other species and that this 10% limit hinders the specialized fishery for roundnose grenadier in Subarea 2. To make it possible for STACFIS to provide advice on a possible change in the 10% by-catch allowance, the Committee suggested that USSR scientists prepare for the next meeting a more detailed paper on the by-catch of Greenland halibut by areas, incorporating recent data on by-catches when the fishery was directed toward roundnose grenadier only.

5. *Maurolicus muelleri* Eggs in the North Atlantic (SCR Doc. 83/IX/85)

An extensive data base obtained from USSR ichthyoplankton surveys indicates that *M. muelleri* eggs are widespread in the North Atlantic. Spawning occurs in March-May in the northern areas and in February-November in more southern portions of the North Atlantic. Most intensive spawning occurs to the northeast of the Flemish Cap Bank, to the west and northwest of the Irish Shelf, in the Irminger Sea, and in the Central East Altantic. The egg structure, as well as its development, and the development of larvae of this species indicate that spawning and early stage development take place at depths greater than 50 m and the larvae do not feed extraneously for some time after hatching.

6. Length-age Composition and State of Cod Stock on Flemish Cap in 1976-1982 (SCR Doc. 83/IX/90)

Length and age composition data for 1976-82 and biomass estimates for 1980-82 were presented for cod on the Flemish Cap. Two (sometimes one) relatively strong year-classes occurred every 3 years. The biomass of cod in the area in 1982 was estimated at about 30,000-35,000 tons. It was not possible to deal adequately with the matter of age validation and discrepancies between USSR and Canadian age compositions due to the absence of Dr. Postolaky.

IV. PRESENTATION OF ASSESSMENT MATERIAL FOR STACFIS REPORTS

1. Introduction

At the June 1983 meeting of STACFIS, it was noted that reconstruction of stock assessment calculations from the STACFIS report was often difficult due to modifications (through working papers and discussion at the meeting) of original assessments contained in research documents. These changes are often not fully documented in the STACFIS report. Accordingly, STACFIS established an *ad hoc* working group to address the problem by developing an appendix to the STACFIS report which would contain all basic data and details of calculations in a standard format. The Working Group was convened by Dr. W. G. Doubleday (Canada), and participants were Dr. A. K. Chumakov, Dr. J. Messtorff, Dr. J. P. Minet, Mr. R. Wells, Mrs. N. V. Yanovskaya, and the Assistant Executive Secretary.

2. Feasibility of Documenting STACFIS Assessments to Permit Reconstruction of Calculations

The most recent assessments relating to 22 stocks were reviewed. Of these, 11 stocks were found to be age-structured analytical assessments (including shrimp in SA 0+1). The remaining 11 stocks were assessed on general biological information, although some had previously been assessed by using general production models. For stocks which were not subject to assessment by analytical or general production methods, only the background or "input" data need be documented. Inclusion of all input data in an appendix to the STACFIS report would add about two pages per stock or forty pages to the report, approximately doubling the length of the report. In the case of stocks assessed by analytical methods, the underlying model must be specified together with methods of estimation of parameters as well as the parameter estimates themselves and the results of projections and other calculations. Much of this information could be reported in about one page, but detailed intermediate calculations and output from VPA and catch projections could take up several pages per stock. The Committee noted that inclusion of all input data and detailed calculations in an appendix to the STACFIS report would greatly lengthen the report and would increase the workload of STACFIS due to duplication of results presented in research documents.

It was recognized that the current policy of STACFIS is to ensure complete documentation of asssessments either in the Research Document series or in the STACFIS report. Effective implementation of this policy would obviate the need for a detailed appendix to the STACFIS report itself. In practice, revised documents are not always promptly submitted and in some cases do not fully document the assessments. Accordingly, means were sought to improve the control of this process without the additional workload involved in producing a comprehensive appendix.

The Committee considered that a more systematic presentation of its report would considerably improve the documentation of the stock assessments. STACFIS therefore

recommends

i) Introduction of a standard list of contents and checklist for mandatory use by authors of the STACFIS report.

ii) Citation of page reference for information and analyses referred to in the STACFIS report but not included in the report, and

iii) Analyses considered by STACFIS that are too lengthy for inclusion in its report and do not occur in research documents available at the time of the meeting or in some other published form should be organized as a research document by STACFIS rather than be included as revisions to research documents submitted after the STACFIS report is approved.

3. Format of the STACFIS Report

A standard table of contents for STACFIS stock assessments and a checklist for their documentation is given in Annex 1. STACFIS recommends that this be used as a guide to the preparation of its report, with relevant sections to be adhered to by authors unless they can provide convincing reasons to do otherwise. The checklist should be distributed to authors at every STACFIS meeting and drafts should be verified against the checklist before acceptance.

V. OTHER MATTERS

1. Conveners for Special Session on Squids in September 1984

For its next Special Session on "Biology and Ecology of the Squids *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic", which will be held at the September 1984 Annual Meeting, STACFIS agreed that two conveners should be appointed, as this has worked well for the present symposium. Mr. T. Rowell (Canada) and Dr. Ch. M. Nigmatullin (USSR) were nominated as Co-conveners for the 1984 Special Session. Since that meeting will be held at Halifax, Canada, the Committee requests Mr. Rowell to take the lead in organizational arrangements.

2. Outstanding Section of June 1983 STACFIS Report

The outstanding section (Fishery Trends) of the STACFIS Report of the June 1983 Meeting was prepared by the Secretariat after the meeting due to incomplete reports in the 1982 catch statistics. This section was presented to the Committee and adopted at this September Meeting.

VI. ACKNOWLEDGEMENTS

The Chairman expressed his appreciation to Dr. G. R. Lilly and Dr. V. A. Rikhter who convened the Special Session on Trophic Relationships of Marine Species, to Dr. W.G. Doubleday who convened the *ad hoc* Working Group on Presentation of the STACFIS Reports, to the rapporteurs and participants for their keen interest and cooperation during the various sessions. The Chairman also acknowledged the Secretariat for their usual efficient work both in preparing for and during this meeting.

ANNEX 1. GUIDELINES FOR REPORTING STACFIS ASSESSMENTS

1. Introduction

The "introduction" should review qualitatively the fishing activity in the most recent year, putting recent events in the context of trends over the most recent decade. Ancillary information not explicitly used in the assessment should be documented in this section.

a) Description of fishery

- dates and location
- changes in area fished during the year
- composition of fishing fleets
- gears
- regulations affecting gears, by-catch, etc.

b) Nominal catches

- annual and monthly
- by gear and/or country

c) Anecdotal information relevant to the assessment

2. Input Data

Both the data used in the assessment and the methods by which the results are calculated should be documented in the STACFIS Report or in cited literature. The survey designs, sampling methods, grouping and other conbination of data must be unambiguously described. The years and weighting factors used in averaged data should be stated.

a) Commercial fishery data

- fishing effort and CPUE
- length and age compositions
- biological information useful for assessments: sex ratios, maturity stages, stomach contents, parasites
- discarded catches: weights, length distribution
- by-catches: weight and length distribution by species

b) Research data

- distributon, movements, migrations
- tagging experiments
- abundance estimates: trawling, acoustic and photographic surveys
- other research surveys: recruit-precruit (eggs, larvae, 0-group), experimental fishing
- selectivity studies
- length and age compositions
- biological data: sex ratio, maturity, fecundity, food and feeding, multispecies assocation, parasitism, ecological data (communities, ecosystems, etc.)

c) Environmental data

- temperature, salinity, clines
- winds, currents
- ice conditions

3. Estimation of Parameters

In all cases, the underlying mathematical model must be stated or cited. The method of estimation (e.g. unweighted least squares regression) must be unambiguously stated or cited, together with the input data (see section 2 above).

a) Virtual population analysis (VPA)

- partial recruitment values
- natural mortality (and any immigration or emigration rates)
- fishing mortality (F) for the last year and oldest age
- correlations of various assessment parameters with survey data and other independent estimates of abundance (commercial catch rates, survey catch rates, survey biomass estimates, etc.)

b) General production model

- model parameters and standard errors

c) Growth curve

- model parameters and standard errors

d) Yield-per-recruit

- partial recruitment values
- natural mortality rates
- weights-at-age
- other model parameters

e) Pooling of abundance estimates

- formula used and weighting factors
- resulting index

f) Mark and recapture estimates

- mortality rates of marked animals
- catchabilities of marked and unmarked animals
- rates of tag loss, immediate and long-term
- mixing of marked and unmarked animals
- non-reporting of tags
- stock abundance

4. Assessment Results

Detailed results of assessment calculations must be reported in research documents or in the STACFIS Report. Where results may be of direct interest to commissioners, they should be summarized in tabular and/or graphical form, where feasible, in addition to the detailed tables.

a) Virtual population analysis (VPA)

- population numbers at age
- fishing mortality at age
- biomass at age
- total biomass and biomass of exploitable stock (specify date)
- recruiting year-classes: numbers and calculation of geometric mean, if required for prognosis input

b) Yield-per-recruit

- specific fishing mortalities (F_{max} and $F_{0.1}$)
- yield per recruit and exploitable biomass per recruit for a systematic series of F values including F_{max} and $F_{0.1}$

c) General production analysis

- maximum sustainable yield and fishing effort
- yield at 2/3 MSY effort and associated fishing effort

5. Catch Projections and Prognoses

Relevant conclusions, projections and general prognoses should be clearly stated, and without reference to technical terms, whenever possible.

a) General biological information

- future implications of observed trends in catches and catch rates
- implications of biological information regarding year-class size, exploitation rates and stock abundance at present and in future
- implications of observed trends in fishing effort, fleet composition, etc., on future exploitation rates
- implications of research data regarding recent exploitation rates and current and future stock abundance

b) General production model

- current fishing effort in relation to f(MSY) and 2/3 f(MSY)
- projected catch at f(MSY) and 2/3 f(MSY)
- implications of model calculations (e.g. strong recruitment forecasts from young-fish surveys)

c) Catch projections

- table of imput parameters

Age	Number (initial year)	Catch or F (initial year)	Weight (initial and subsequent years)	Partial Recruitment

- F or catch for projected years (input)
- recruitment for projected years (input)
- table of catch-at-age by number and weight for each year
- table of population-at-age by number and weight for each year
- total catch in weight
- total population biomass (and other biomass estimates, as relevant)
- average fishing mortality rate by year (specify weighting scheme)

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

Chairman: J. Messtorff Rapporteur: A. T. Pinhorn

The Committee met at the Pribaltiyskaya Hotel, Leningrad, USSR, on 19-20 September 1983 to consider and report on various matters referred to it by the Scientific Council. In attendance were J. Messtorff and J. P. Minet (EEC), R. G. Halliday and A. T. Pinhorn (Canada), and S. Kawahara (Japan). The Chairman of the Scientific Council (R. Wells), the Executive Secretary (Capt. J. C. E. Cardoso), the Administrative Assistant (H. Champion) and the Assistant Executive Secretary (V. M. Hodder) also attended the session. Absent was V. A. Rikhter (USSR), Chairman of STACPUB, who was unable to attend this meeting, and Dr. Messtorff agreed at act as Chairman.

1. Status of Publications

a) Journal of Northwest Atlantic Fishery Science

i) Volume 4, containing "Guide to the Early Stages of Marine Fishes in the Western North Atlantic, Cape Hatteras to the Southern Scotian Shelf" by M. P. Fahay (425 p.), was recently completed, and copies were mailed on 9 September 1983. STACPUB expressed its appreciation to the Assistant Executive Secretary and the Administrative Assistant for the successful production of this outstanding volume in a most effective and timely manner.

ii) Volume 5: 32 papers are currently in various stages of processing; 6 of these have been formally accepted and 5-6 others are expected to be ready for publication in Vol. 5(1) in December 1983 or January 1984.

b) NAFO Scientific Council Studies

i) Number 6: Publication of this volume was delayed for 5-6 months due to emphasis being placed on editing and printing of Vol. 4 of the Journal. However, 4 contributions have been processed, and the editing of 3-4 other papers should be completed in time for printing in November or December 1983.

c) NAFO Statistical Bulletin

i) Volume 31: The outstanding 1981 fishery statistics for the United States were received in July 1983, preparation of the material for printing was completed in early September, and distribution is expected about mid-October 1983.

2. Editorial Matters

a) Editorial Board

With the recent (1 July 1983) appointment of two scientists as Associate Editors for Vertebrate Fisheries Biology, the Editorial Board consists of the following:

Editor: V. M. Hodder, NAFO, Dartmouth, Nova Scotia, Canada

Associate Editors:

- Biological Oceanography:	A. J. Lee, Lowestoft, United Kingdom
- Biomathematics:	W. G. Doubleday, Ottawa, Ontario, Canada
- Invertebrate Fisheries Biology:	E. J. Sandeman, St. John's, Newfoundland, Canada
- Vertebrate Fisheries Biology:	R. G. Halliday, Dartmouth, Nova Scotia Canada, and M. D. Grosslein, Woods Hole, Mass., USA

b) Scientific Council Report

The reports of Scientific Council meetings held in each calendar year are published annually in a red-covered volume called *NAFO Scientific Council Reports*. Recently, the quality of the reports, as approved at Scientific Council meetings, has suffered from editorial errors. This has placed an undue workload on the Assistant Executive Secretary, who has the task of editing the report after the completion of each Scientific Council meeting. STACPUB considers that it is the responsibility of the Scientific Council to ensure that the quality of the reports are of a high standard, and therefore

recommends

that the Scientific Council and its Standing Committees, Subcommittees and Working Groups substantially improve the quality of their reports at the time of their approval by reviewing in detail for ambiguities and editorial errors and any other aspect that will ensure the high quality worthy of such a scientific body.

To achieve this end, Chairmen of Standing Committees, Subcommittees and Working Groups must ensure, when scheduling meetings, that sufficient time is allocated for report approval in the detail outlined above, they must discipline themselves and the members of their committee to ensure that such detailed report approval takes time, and they must further ensure that relevant members of all bodies are present up to and including the time of complete report approval. The Assistant Executive Secretary should have only minor editorial change to execute and this should serve to reduce his already heavy workload.

3. Utilization of Microfiche

In accordance with Recommendation (a), Section III, Item 4 of the June 1983 Scientific Council Report, the Executive Secretary provided STACPUB with technical and financial information on production of microfiche copies of historical documents. It was not possible, due to time constraints, to distribute this information prior to the meeting. Thus, Recommendations (b) and (c) could not be implemented.

The Executive Secretary noted that microfiche can be obtained in "positive" and "negative" formats and examples of both were made available to STACPUB members. Copies are available for all national delegations to the Scientific Council. Positive format produces better hard copies but, on inspection of samples of copies made from both positive and negative fiche, that from negative fiche was judged to be of satisfactory quality. Negative format is easier to read in a microfiche reader and it was agreed that this would be the more suitable format to use.

The Executive Secretary provided members with literature on readers and reader/printers and their costs (in Canada). He indicated that the Secretariat would require a reader/printer with a current cost of $9,500 to produce copies of suitable quality. Non-printing readers are available at a cost of $300 to $600. STACPUB noted that production of approximately 600 fiches would be required if all scientific research related documents in the ICNAF series are to be reproduced. This includes all Meeting Documents (1951-64), all Research Documents (1965-79), all Summary Documents (1973-79) and selected Commissioner's Documents (1965-72), selection to be based on the same criteria as was used for separation of Summary and Commissioner's Documents subsequent to 1972.

Present cost for production of a master fiche is $13.30 (Can.) and each copy costs $0.48. Based on these costs (including a reader/printer for the Secretariat), production and sale of 10 or more set of copies will result in a price of $2,000 or less per set.

It is recommended that Scientific Council representatives now approach their appropriate national authorities and/or institutions to obtain clear impressions of interest in the purchase of sets of copies, the cost of which will be a maximum of $2,000 per set. The results of their enquiries should be communicated to the Executive Secretary by 31 March 1984 so that appropriate estimates can be included in the budget projections for 1985. (Budget projections must be circulated 90 days prior to the September 1984 meeting of the General Council.)

4. Papers for Possible Publication

It was considered that the documents presented at the "Special Session on Trophic Relationships" should not be published as a compendium but that each document should be considered on its own merits. STACPUB therefore

recommends

that papers nominated for publication from the Special Session on Trophic Relationships in September 1983 be published in regular issues of the Journal or Studies as merited by content and as they become available.

STACPUB reviewed the research documents presented at the September 1983 Meeting and requested the Editor to invite the authors of the following documents to submit suitably revised manuscripts for possible publication in the Journal or Studies series: SCR Doc. 83/IX/73, 74, 75, 78, 79, 80, 81, 82, 83, 85, 87, 88, 94, 95.

It was noted that SCR Doc. 83/IX/66, 67, 68 were deferred for consideration at the June 1984 Meeting of STACFIS and were therefore not considered for possible publication at present.

5. Acknowledgements

The Chairman thanked all members for their active participation in the meetings and the Executive Secretary, Assistant Executive Secretary and Administrative Assistant for their efficient job in support of the Committee's work. The Committee was grateful to Dr. Messtorff for agreeing to chair this STACPUB meeting at such short notice.

PART D

MISCELLANEOUS

CONTENTS

I. AGENDA FOR SCIENTIFIC COUNCIL MEETING, 1983

A. SPECIAL MEETING, JANUARY 1983

1. Opening (Chairman: R. Wells)
   a) Appointment of rapporteur
   b) Adoption of agenda
   c) Plan of Work
2. Fishery Science (STACFIS Chairman: J. P. Minet)
   a) Shrimp in Subareas 0 and 1*
      i) Review of fishery trends
      ii) Distribution and biology
      iii) Catch and effort
      iv) By-catches in the shrimp fishery
      v) Discarding of shrimp
      vi) Biomass estimates
      vii) Total allowable catches
      viii) Future research needs
   b) Shrimp at East Greenland*

      (i to viii as in 2(a) above)
   c) Other Business
   d) Adjournment

* The Canadian and EEC requests for advice on management of the shrimp stocks in 1983 were contained in the requests considered at the June 1982 Meeting of the Scientific Council (see NAFO Sci. Coun. Rep. for 1982, pages 95-96).

B. REGULAR MEETING, JUNE 1983

1. Opening (Chairman: R. Wells)
   a) Appointment of rapporteur
   b) Adoption of agenda
   c) Plan of Work
2. Fishery Science (STACFIS Chairman: J. P. Minet)
   a) General review of catches and fishing activity in 1982
   b) Assessment of finfish and invertebrate stocks
      i) Stocks lying completely outside the 200-mile fishery zones of coastal states in Subarea 3, as required by the Fisheries Commission:
         - Cod (3M)
         - Redfish (3M)
         - American plaice (3M)
      ii) Stocks lying within or partly within the Canadian 200-mile fishery zone in Subareas 2, 3 and 4, for which advice on conservation measures in 1984 was requested by Canada (Annex 1):
         - Cod (2J+3KL, 3NO)
         - Redfish (3LN)
         - Silver hake (4VWX)
         - American plaice (3LNO)
         - Witch flounder (3NO)
         - Yellowtail flounder (3LNO)
         - Greenland halibut (2+3KL)
         - Roundnose grenadier (2+3)
         - Capelin (2+3K, 3L, 3NO)
         - Squid-*Illex* (3+4)
      iii) Stocks within the EEC fishing zone in Subarea 1 and at East Greenland, for which advice on conservation measures in 1984 was requested by the EEC (Annex 2):
         - Cod (1)
         - Redfish (1)
         - Wolffishes (1)
         - Northern shrimp (East Greenland)
      iv) Stocks overlapping the Canadian and EEC fishery zones in Subareas 0 and 1, for which advice on conservation measures in 1984 was requested by Canada and EEC (Annexes 1 and 2):
         - Greenland halibut (0+1)

- Roundnose grenadier (0+1)
- *Northern shrimp (0+1)*

c) Assessment of harp and hooded seal stocks in the Northwest Atlantic, as requested jointly by Canada and the EEC (Annex 3):

i) Review of fishery trends
ii) Research in 1982 and 1983
iii) Special biological studies
iv) Population assessment
- vital rates
- pup production and stock size
- replacement yield
- sustainable yield
v) Future research needs
vi) Coordination with ICES
vii) Other matters

d) Environmental research (Subcommittee Chairman: R. W. Trites)

i) Marine Environmental Data Service report for 1982
ii) Review of environmental studies in *1982*
iii) Overview of environmental conditions in 1982.
iv) Review of remote-sensing activities
v) Synoptic sea-surface temperature maps
vi) Environmental data products available on board ship
vii) Distribution of squid larvae and juveniles re oceanography (winter and spring survey results)
viii) Other environmentally-related work on squid
ix) Other matters

e) Squid biology and abundance

i) Biological characteristics
- size composition and growth
- maturation, fecundity and spawning
- food and feeding
- mortality
ii) Migration patterns
iii) Fishery and abundance trends

f) Flemish Cap Project (Working Group Convener: J. T. Anderson)

i) Review of recent work on Flemish Cap
ii) Research in 1982 and early 1983
iii) Comparative ichthyoplankton sampling (Circ. Letter 83/7)
iv) Analysis of fixed station and stratified-random trawling data (Circ. Letter 83/7)
v) Cod recruitment re environmental variability
vi) Future cooperative research plans
vii) Other matters

g) Ageing techniques and validation studies (see Circ. Letter 83/7)

i) Redfish ageing by Canadian and Federal Republic of Germany scientists
ii) Roundnose grenadier ageing by scientists of Federal Republic of Germany and German Democratic Republic
iii) Canada-USSR cod otolith exchange for Div. 3M
iv) Review of discrepancies in ageing silver hake
v) Other studies

h) Gear and selectivity studies

i) Review of research documents not considered *in items (a) to (h) above*

j) Other matters

i) Outstanding report of Working Group on Herring Tagging (January 1982)
ii) Progress report on work of Task Force on Larval Herring
iii) Progress report on contributions for the Special Session at the September 1983 Annual Meeting.

3. Research Coordination (STACREC Chairman: T. K. Pitt)

a) Statistics and sampling

i) CWP activities relevant to NAFO
- report of CWP Session, July 1982
- participation in CWP Session, July 1984

ii) Fishery statistics
- Progress report for 1982/83
- Review of requirements
- Adequacy of national reporting

iii) Sampling data (acquisition and processing)
iv) Report of *ad hoc* Working Group on Sampling Guidelines
v) Review of scientific observer program
vi) List of fishing vessels (1980 and 1983)
vii) Review of tagging activity for 1982
viii) Other matters

b) Biological surveys

i) Review of survey activity in 1982
ii) Survey plans for 1983/84
iii) Review of stratification schemes
iv) Coordination of squid surveys in 1984
v) Other survey matters

c) Review of relevant research documents not considered in items (a) and (b) above.

d) Other matters

4. Publications (STACPUB Chairman: V. A. Rikhter)

a) Review of scientific publications since June 1982

b) Review of matters from previous meeting (see NAFO Sci. Coun. Rep., 1982, pages 85-87).

c) Editorial policy re Scientific Council publications

i) Editorial board
ii) Promotion and distribution

d) Promotion of ichthyoplankton studies

e) Papers for possible publication

i) Status of "stock discrimination session" papers
ii) Review of publication proposals for 1982
iii) Review of 1983 documents

f) Utilization of microfiche or microfilm

g) Other matters

5. Collaboration with Other Organizations

a) Report of NAFO/ICES Study Group on Redfish at Greenland

b) Twelfth Session of CWP in July 1984

6. Adoption of Reports

a) Provisional Report of Scientific Council, January 1983

b) Standing Committee on Fishery Science (STACFIS)

c) Standing Committee on Research Coordination (STACREC)

d) Standing Committee on Publications (STACPUB)

7. Future Scientific Meetings, 1983 and 1984

8. Election of Officers 1984-85

9. Other Business

a) Arrangements for Special Session at the September 1984 Meeting

b) Theme for Annual Meeting in September 1985

10. Adjournment

C. ANNUAL MEETING, SEPTEMBER 1983

1. Opening (Chairman: R. Wells)

a) Appointment of rapporteur
b) Adoption of agenda
c) Plan of work

2. Fishery Science (STACFIS Chairman: J. P. Minet)

   a) Special Session on Trophic Relationships in Marine Species Relevant to Fisheries Management in the Northwest Atlantic

      i) Spatial and temporal variability in species interactions, and influence of biotic and abiotic factors
      ii) Feeding behavior: preference and switching; functional and aggressive responses
      iii) Variability in prey mortality induced by changes in abundance and size structure of predators and prey
      iv) Response of predators to changes in prey distribution and abundance
      v) Estimation of feeding and digestion rates
      vi) Mathematical modelling (e.g. Multispecies virtual population analysis)
      vii) Other considerations

   b) Stock assessments (if required)

   c) Environmental research

      i) Future of Environmental Research Subcommittee
      ii) Further consideration of SCR Doc. 83/VI/23, and the matter of future updating

   d) Other matters

      i) Appointment of convener(s) for Special Session on "Biology and Ecology of the Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic", to be held during the Annual Meeting in September 1984
      ii) Proposed changes in presentation of STACFIS reports to be considered by an *ad hoc* working group
      iii) Adoption of outstanding section of STACFIS Report of June 1983 Meeting
      iv) Review of documents not considered at the Special Session

3. Publications (STACPUB Chairman: V. A. Rikhter)

   a) Review of editorial matters re Scientific Council publications

   b) Review of progress on proposal to microfiche historical scientific meeting documents

   c) Papers for possible publication

   d) Other matters

4. Adoption of Reports

   a) Standing Committee on Fishery Science (STACFIS)

   b) Standing Committee on Publications (STACPUB)

   c) Provisional Report of June 1983 Meeting (SCS Doc.83/VI/21)

5. Review of Future Meeting Arrangements

   a) Assessment of shrimp stocks (deferred from June 1983 Meeting)

   b) Further assessment of capelin stocks (if required)

   c) Meeting of Scientific Council and its Committees in June 1984

   d) Conveners for Special Session on squids at the September 1984 Meeting

6. Other Matters

   a) Further consideration of procedures for reporting sampling data

7. Election of Officers for 1984-85

8. Adjournment

ANNEX 1. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1984 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1983 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1984:

Cod (Div. 2J, 3K and 3L; Div. 3N and 3O)
Redfish (Div. 3L and 3N)
American plaice (Div. 3L, 3N and 3O)
Witch flounder (Div. 3N and 3O)
Yellowtail flounder (Div. 3L, 3N and 3O)
Greenland halibut (Subarea 2 and Div. 3K and 3L)
Roundnose grenadier (Subareas 2 and 3)
Silver hake (Div. 4V, 4W and 4X)
Capelin (Subarea 2 and Div. 3K; Div. 3L; Div. 3N and 3O)
Squid (Subareas 3 and 4)

It is further suggested that, subject to the concurrence of the other coastal states concerned, the Scientific Council prior to the 1983 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1984 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 and for the Flemish Cap (Div. 3M) stocks:

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 1984 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those expected to be at the $F_{0.1}$ level. Management options for arriving at the latter stock size on a shorter time scale should be developed. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1984 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. Parson
Acting Assistant Deputy-Minister for Atlantic Fisheries
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 2. EEC REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1984 OF CERTAIN STOCKS IN SUBAREAS 0 AND 1

1. The EEC requests the Scientific Council to provide advice for the following stocks, subject to the agreement of the other coastal state concerned in the case of joint stocks:

   a) Stocks occurring in both the EEC and Canadian fishery zones in Subareas 0 and 1:

      Greenland halibut
      Roundnose grenadier
      Northern shrimp

   b) Stocks occurring in the EEC fishery zone in Subarea 1:

      Atlantic cod
      Atlantic redfish
      Wolffish (catfish)

2. For the above mentioned stocks, the present state of exploitation should be reviewed and options for management in 1984 given. Where possible, these should be expressed graphically in terms of catch in 1984 and the size of the spawning stock biomass on 1 January 1985 for a range of values of F which covers at least -50% to +25% of F in 1981.

3. For cod in Subarea 1, it is requested that catches for each year up to and including 1986 and spawning stock biomasses for each year up to and including 1987 are calculated for maintaining F at the following levels from 1984 onward: $F = F_{0.1}$, F_{max}, and $F = F_{1981}$. All values of F refer to that on the most heavily exploited age groups. A TAC at the same level as in 1982 may be assumed for 1983.

   As the Scientific Council advises that "since the dependency of recruitment upon spawning stock size cannot be ignored, the rebuilding of the spawning stock to a much higher level than at present should form the basis for management", it is asked that the stock and recruitment relationships on which this advice is based should be illustrated and the advice examined in relation to both this relationship and the known dependency of recruitment success on water temperatures at the time of spawning.

   The Scientific Council is also asked to examine the possible effects of an increased stock size of cod on that of shrimp in quantitative terms if possible, otherwise qualitatively.

4. Management options for shrimp at East Greenland should also be given in coordination with ICES.

E. Gallagher, Director General
Directorate General for the Fisheries
Commission for the European Communities
Brussels, Belgium

ANNEX 3. JOINT REQUEST OF CANADA AND THE EEC FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1984 AND 1985 OF THE SEAL STOCKS IN THE NORTHWEST ATLANTIC

1. The Government of Canada and the European Economic Community request advice of the NAFO Scientific Council on the scientific basis for management in 1984 and 1985 on harp seals and in 1984 for hooded seals within national fishery limits in NAFO Subareas 0, 1, 2, 3 and 4. Specifically, the Scientific Council is requested to review and advise on the following:

   a) Northwest Atlantic harp seals

      i) Current stock size and pup population and recent trends in these parameters.

      ii) Current replacement yield and sustainable yield at present stock size and in the long term and under varying options of age compositions in the catch, including that recently occurring; specifically, how would the replacement yield change if the age composition of the catch changed from that recently observed?

      iii) Trends in population size based upon differing levels of catch assuming quota regulation of all removals except that by traditional hunting in the Canadian Arctic and at Greenland.

      iv) Trends in catches in Canada, north of 60°N latitude and at Greenland.

      v) Future research requirements and need for coordination with ICES.

   b) Hooded seals

      Advice for hooded seals, to the extent possible, is requested on the above questions, as well as consideration of the limits to any change in the population abundance of hooded seals over the next five years, given a range of catch levels maintained during that period.

L. S. Parsons
Acting Assistant Deputy-Minister for Atlantic Fisheries
Department of Fisheries and Oceans
Ottawa, Ontario

and

E. Gallagher, Director General
Directorate General for the Fisheries
Commission for the European Communities
Brussels, Belgium

II. LIST OF RECOMMENDATIONS, 1983

A. SPECIAL MEETING, JANUARY 1983

1. Research Requirments for Shrimp in Subareas 0 and 1 (page 13)

That an in-depth analysis of a time series of biological data from the Greenland fishery be initiated in 1983.

That the annual photographic survey be continued and efforts be made to redefine size categories for shrimp observed in the photographs.

That stratified-random trawl surveys be conducted annually, possibly through cooperative arrangements between participating countries.

That data indicating reproductive success, such as fecundity levels, proportion of non-maturing female, proportion of females spawning for the first time, incidence of non-viable eggs and larval abundance be routinely collected for future correlation with stock abundance indices and environmental records.

That the observer program be continued and efforts increased to improve the quality of data on discards.

That countries participating in the shrimp fishery continue efforts to ensure that fishing vessel logbooks are completed and made available to authorities as soon as possible.

2. Research Requirements for Shrimp at East Greenland (page 16)

That catch-rate data and biological samples from this stock in its whole area of distribution on a year-round basis be obtained.

That plankton surveys be carried out to observe the drift of shrimp larvae.

That a tagging experiment be carried out to determine the migration patterns of various size groups of shrimp.

That a study on environmental conditions be undertaken, including the current circulation in the area.

B. MAIN SCIENTIFIC MEETING, JUNE 1983

1. Sampling Data Base (pages 24-25, 105)

That length frequencies and age-length keys be submitted to the Secretariat in summarized form by time periods and areas appropriate for stock assessments, starting with data for 1983.

That the fisheries institutes which had submitted detailed sampling data for 1979-82 be requested to resubmit these data in the same summarized form during the next few years.

2. Utilization of Microfiche (pages 26, 113)

a) that the Executive Secretary obtain and forward as soon as possible to national representatives on the Scientific Council technical specifications for the microfiche proposal, including (i) firm cost of copying the historical research and summary documents which are actually necessary to be copied, (ii) cost of equipment necessary within the Secretariat, (iii) type and approximate cost of equipment necessary for national laboratories to utilize microfiche copies, and (iv) an actual microfiche copy of a research document of the quality to be expected.

b) That Scientific Council representatives be requested, after receiving the material noted in (a) to approach their appropriate national authorities and/or institutions to obtain as clear expressions of interest and support as possible for this project.

c) That the representatives inform the Executive Secretary of responses which they have received in time for consideration at the September 1983 Meeting of the Scientific Council.

3. Research Requirements for Harp Seals (page 59)

Because an estimate of harp seal pup production in 1984 would aid in narrowing the feasible range of natural mortality estimates, STACFIS suggested that a mark-recapture experiment be

conducted in 1984. In addition, more use should be made of catch-at-age data in estimating total population numbers and vital rates. STACFIS also recommended that the mathematical models presently employed to determine stock size and projected yields be subjected to sensitivity analyses, in order to determine the influence of parameter estimates on estimates of stock size and projected yields.

4. Research Requirements for Hooded Seals (pages 60, 61)

That further detailed analyses of historical catch-at-age data for hooded seals be carried out to provide better estimates of natural mortality.

That an intensive one-year coordinated program for hooded seals be undertaken, involving:

i) simultaneous aerial surveys of the Front and Davis Strait breeding populations and the requisite ground-truthing;

ii) collection of adequate biological samples (500-750 females) for age composition analysis and reproductive rates at the Front, in Davis Strait and along the Greenland coast; and

iii) tagging of pups at the Front and in Davis Strait and at Jan Mayen.

5. Publication of Hooded Seal Workshop Contributions (page 62)

That the Scientific Council consider publication of the proceedings of the Hooded Seal Workshop and associated papers in one of its series.

6. Flemish Cap Research Project (pages 65, 66)

That the results of intercalibration of USSR and Canadian ichthyoplankton sampling gear be presented at the earliest opportunity.

That a comparison of fixed-station and stratified-random bottom trawl surveys be made during the June 1984 Meeting of the Scientific Council.

That analysis and interpretation of all outstanding data relevant to the aims of the Flemish Cap Project be presented to STACFIS as soon as it is available, including data on physical oceanography, plankton, juveniles, adults and food and feeding of cod and redfish.

That research trawl surveys be continued on Flemish Cap to extend the series of estimates of numbers at age available to the research trawls to ensure comparative measurements of stock size and, in particular, recruitment in relation to the terms and objectives of the Flemish Cap Project.

That the next meeting of the Flemish Cap Working Group be held, after consultation with all participants, only when there is reasonable assurance that sufficient information is available upon which evaluation of objectives of the project for the future can be made.

7. Theme for Special Session at the 1985 Annual Meeting (page 70)

That the Scientific Council consider "Design and Evaluation of Biological Surveys in Relation to Stock Assessments" as a possible theme for the September 1985 Annual Meeting.

8. Proposed Changes in Presentation of STACFIS Reports (page 70)

That a small ad hoc working group of assessment experts, together with the Assistant Executive Secretary, meet at the September 1983 Meeting of the Scientifc Council to (i) examine the technical feasibility to produce such an annex, and (ii) to develop a standard format for the presentation of the required information.

9. Base Periods for Analysis of Environmental Data (page 75)

That the following base periods be used with respect to environmental variables:

i) base periods for environmental data for the NAFO area should conform with those of the World Meteorological Organization convention of a 30-year mean, using the previous 3 decades, the current base period being 1951-80;

ii) where the data are of shorter duration, 20-year (1961 to 1980) or a 10-year (1971 to 1980) base period should be used; and

iii) variability of anomaly conditions relative to the above base periods should be indicated by calculating the standard deviation about the mean for each anomaly published.

10. Scientific Council Representation at July 1984 Session of CWP (page 104)

That the Scientific Council of NAFO should be represented at the 12th Session of the CWP by the Chairman of STACREC, the Assistant Executive Secretary, and a representative of the fishery statistics service of the USSR.

11. Additions to NAFO List of Species Items (page 105)

That the Secretariat take the necessary measures to check and assign appropriate common names and codes to the following species, which are to be added to the NAFO List of Species Items: (i) Lithodes maia (a stone crab), and (ii) Chlamys islandica (Icelandic sea scallop).

12. Editorial Board for the Journal (page 111)

That R. G. Halliday (Canada) and M. D. Grosslein (USA) be invited to serve on the Editorial Board of the Journal of Northwest Atlantic Fishery Science as Associate Editors for Vertebrate Fisheries Biology.

13. Distribution of Scientific Council Studies (page 112)

That the policy for distribution and annual review thereof for Scientific Council Studies should be the same as that for the Journal, except that a few exchanges may be undertaken for goodwill purposes.

14. Status of Stock Discrimination Symposium Papers (page 112)

That papers nominated for publication from the Stock Discrimination Symposium of September 1982 be published in regular issues of the Journal and Studies as merited by content and as they become available.

C. ANNUAL MEETING, SEPTEMBER 1983

1. Proper Documentation of STACFIS Assessments (page 124)

Introduction of a standard list of contents and checklist for mandatory use by authors of the STACFIS report.

Citation of page reference for information and analyses referred to in the STACFIS report but not included in the report.

Analyses considered by STACFIS that are too lengthy for inclusion in its report and do not occur in research documents available at the time of the meeting or in some other published form should be organized as a research document by STACFIS rather than be included as revisions to research documents submitted after the STACFIS report is approved.

2. Format of STACFIS Report (page 124)

A standard table of contents for STACFIS stock assessments and a checklist for their documentation is given in Annex 1. STACFIS recommends that this be used as a guide to the preparation of its report, with relevant sections to be adhered to by authors unless they can provide convincing reasons to do otherwise. The checklist should be distributed to authors at every STACFIS meeting and drafts should be verified against the checklist before acceptance.

3. Quality of Scientific Council Reports (page 129)

That the Scientific Council and its Standing Committees, Subcommittees and Working Groups substantially improve the quality of their reports at the time of their approval by reviewing in detail for ambiguities and editorial errors and any other aspect that will ensure the high quality worthy of such a scientific body.

III. LIST OF RESEARCH AND SUMMARY DOCUMENTS, 1983

RESEARCH DOCUMENTS, 1983

SCR Doc.	Serial	
83/I/1	N639	KANNEWORFF, P. Biomass of shrimp (*Pandalus borealis*) in NAFO Subarea 1 in 1977-1982, estimated by means of bottom photography. (24 pages)
83/I/2	N640	PARSONS, D. G.,P. J. VEITCH, and G. E. TUCKER. The Canadian fishery for shrimp (*Pandalus borealis*) in Division 0A, 1982. (21 pages)
83/I/3	N641	DUPOUY, H., and B. FONTAINE. Catch, effort and biological characteristics of shrimp (*Pandalus borealis*) in the French fishery off West Greenland, 1982. (16 pages)
83/I/4	N642	DUPOUY, H., P. DERIBLE, and A. BISEAU. Catch, effort and biological characteristics of shrimp (*Pandalus borealis*) in the French fishery off East Greenland in 1982. (21 pages)
83/I/5	N643	JAKOBSEN, T., and S. TORHEIM. Norwegian investigations on shrimp, *Pandalus borealis*, off West Greenland in 1982. (8 pages)
83/I/6	N644	JAKOBSEN, T., and S. TORHEIM. Norwegian investigations on shrimp, *Pandalus borealis*, in East Greenland waters in 1982. (7 pages)
83/I/7	N645	HORSTED, Sv. Aa. A trawl survey with R/V *Dana* on the offshore shrimp grounds in Div. 1B, July-August 1982. (5 pages)
83/I/8	N646	CARLSSON, D. M. Data on the shrimp fishery in NAFO Subareas 0 and 1 in 1981 and 1982. (29 pages)
83/I/9	N647	CARLSSON, D. M. Data on the shrimp fishery at East Greenland, 1980-82. (16 pages)
83/VI/10	N658	RIKHTER, V. A., Yu. S. GRINKOV, and V. F. TUROK. Distribution of some groundfish species and short-finned squid on Scotian Shelf slope during the 1982 fishing season from data obtained by USSR observers. (10 pages)
83/VI/11	N659	BAKANEV, V. S. Results of instrumental assessment of capelin abundance in Divisions 2J and 3K in October 1982. (7 pages)
83/VI/12	N660	ARMSTRONG, R. S. Variation in the shelf water front position in 1982 from Georges Bank to Cape Romain. (8 pages)
83/VI/13	N661	CELONE, P. J., and C. A. PRICE. Anticyclonic warm core Gulf Stream rings off the northeastern United States during 1982. (14 pages)
83/VI/14	N662	COOK, S. K. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1982. (6 pages)
83/VI/15	N663	CRIST, R. W., and R. S. ARMSTRONG. Bottom temperatures on the continental shelf and slope of New England during 1982. (7 pages)
83/VI/16 (Revised)	N664	INGHAM, M. C., and D. R. McLAIN. Sea surface temperatures in the northwestern Atlantic in 1982. (11 pages)
83/VI/17	N665	JOSSI, J. W., D. E. SMITH, and G. A. WHITE. Continuous plankton records: Massachusetts to Cape Sable, N.S., and New York to the Gulf Stream, 1982. (4 pages)
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83/VI/19	N668	BOWERING, W. R., and D. E. STANSBURY. Regressions of weight on length of witch flounder (*Glyptocephalus cynoglossus*) in the eastern Newfoundland Area (NAFO Divisions 2J+3KL). (10 pages)
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83/VI/22	N671	FEDULOV, P., A. REMESIO, and T. SHCHERBAKOVSKAYA. Some features of spatial temporal variability and WCE formation in the Gulf Stream area from Florida to 55°W in 1975-82. (8 pages)
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83/VI/32	N685	COELHO, M. L., and A. A. ROSENBERG. Causal analysis of some biological data on *Illex illecebrosus*. (19 pages)
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83/VI/61 N721 FEDULOV, P. P., A. I. ARKHIPKIN, E. N. SHEVCHENKO, and A. I. REMESLO. Distribution of some squid species in the Northwest Atlantic in relation to physical oceanographic features. (12 pages)

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83/I/1	N648	NAFO. Provisional Report of Scientific Council, Dartmouth, Canada, 19-24 January 1983. (17 pages) + Corrigendum (1 page)
83/VI/2	N650	PARSONS, L. S. Canadian request for advice on the scientific basis for management in 1984 of certain stocks in Subareas 0 to 4. (2 pages)
83/VI/3	N651	GALLAGHER, E. EEC request for scientific advice on management in 1984 of certain stocks in Subareas 0 and 1. (1 page)
83/VI/4	N652	PARSONS, L. S., and E. GALLAGHER. Joint request by Canada and the European Economic Community on mangement in 1984 and 1985 of the seal stocks in the Northwest Atlantic. (1 page)
83/VI/5	N653	NAFO SECRETARIAT. Historical catches of selected species by stock area and country for the period 1972-81. (38 pages)
83/VI/6	N654	NAFO. First report of the joint NAFO/ICES study group on biological relationships of the West Greenland and Irminger Sea redfish stocks, Copenhagen, 21-23 February 1983. (11 pages)
83/VI/7	N655	NAFO SECRETARIAT. Summary of reported sampling data for 1981. (13 pages)
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83/VI/10	N672	NAFO SECRETARIAT. Report of the eleventh session of the Coordinating Working Party on Atlantic Fishery Statistics (CWP), July 1982. (1 page) + FAO Fish. Rept. 274 (41 pages)
83/VI/11	N673	COADY, L. W., J. S. SCOTT, J. BOULVA, J. P. LUSSIAA-BERDOU. Canadian research report, 1982. (18 pages)
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83/VI/21	N730	NAFO. Provisional report of Scientific Council, Dartmouth, Canada, 8-23 June 1983. (81 pages) + Revised Addenda (2 pages) + Corrigenda (1 page)
83/IX/22	N737	NAFO SECRETARIAT. Provisional nominal catches in the Northwest Atlantic, 1982. (47 pages)
83/IX/23	N761	ERNST, P. German Democratic research report for 1982. (6 pages)
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IV. LIST OF PARTICIPANTS IN SCIENTIFIC COUNCIL MEETINGS, 1983

		Meetings
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