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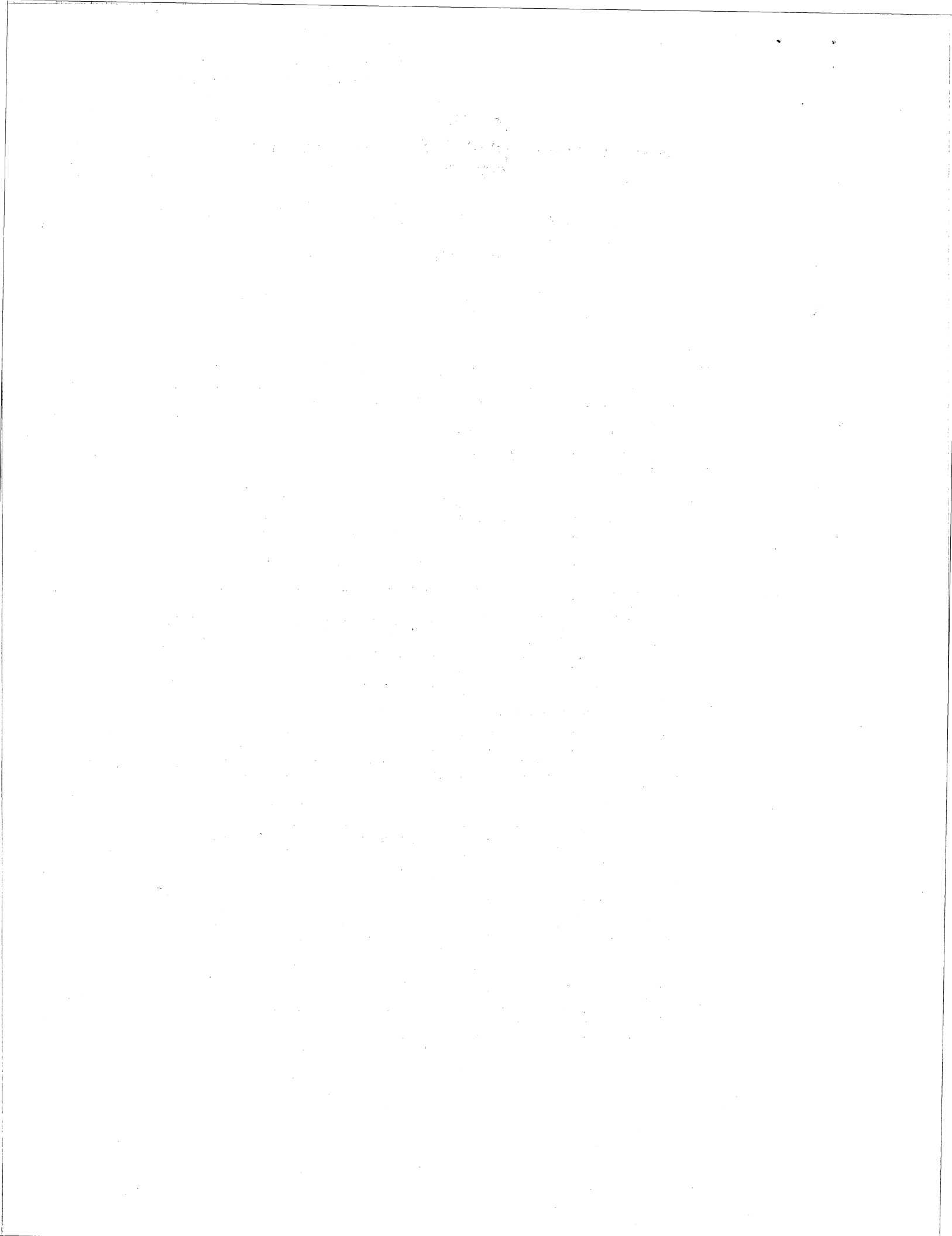
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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

Special Meeting, January 1984

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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

Special Meeting, January 1984

Acting Chairman: J. E. Carscadden

Rapporteur: V. M. Hodder

The Council met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 18-23 January 1984 to provide scientific advice for 1984 on management 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. In the absence of Dr. V. A. Rikhter, who communicated his regrets for not being able to attend this meeting, and Dr. J. Messtorff who was reported to be ill, it was unanimously agreed that this meeting of the Council be conducted by the Chairman of the Standing Committee on Fishery Science (Dr. J. E. Carscadden).

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 for the meeting, list of relevant documents, and list of participants are given in Appendices II, III and IV respectively. Brief summaries of the stock assessments and other matters considered by the Council are given below.

I. STOCK ASSESSMENTS

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, 1982 and 1983 but allowable catches totalling 35,000, 34,800 and 34,625 tons respectively were set by the coastal states involved. Provisional statistics for 1983 indicate an offshore catch of about 38,000 tons (Table 1). Because of ice conditions in the first 4 months of the year, the winter and spring fishery in 1983 was severely reduced, but, during the last half of the year, the main fishery occurred on the northern and western parts of the Store Hellefiske Bank in Div. 0A and 1B. This fishing pattern was similar to the fishing pattern in 1982 but different from 1980 and 1981 when a northward shift in the fishery occurred.

Table 1. Total catches (metric tons) of shrimp in Subarea 0 and the offshore part of Subarea 1 in 1974-83, with the corresponding TACs for 1977-83.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Catch	11,945	29,190	42,766	34,300	26,869	27,087	36,652	37,300	37,527 <sup>1</sup>	38,259 <sup>1</sup>
Advised TAC	-	-	-	36,000	40,000	29,500	29,500	29,500	29,500	29,500
Effective TAC	-	-	-	36,000	40,000	29,500	29,500	35,000 <sup>2</sup>	34,800 <sup>2</sup>	34,625 <sup>2</sup>

<sup>1</sup> Provisional data

<sup>2</sup> Includes TAC of 5,000 tons in Subarea 0

All available biological information on length distribution and sexual components and all data on trends in catch rates and biomass estimates were considered in advising on management of the fishery in 1984. It was noted that, after the decline in abundance observed during 1976-78, there has been a general upward trend in overall catch rates from 1979 to 1983. However, catch rates in recent years may be biased upward due to increased efficiency of gear and the effects of ice conditions. Although the effects of these factors cannot be estimated, it is quite possible that they could account for the observed increase and the stock may not have increased over the period. The incidence of small shrimp in research and commercial length frequencies and the photographic samples showed a decrease from 1982 and from the high numbers observed in 1981.

Although the fishable stock may have remained stable since 1979, the Council noted the likely poor recruitment in 1984, and therefore advises that the overall TAC for the offshore grounds in Subarea 1 and adjacent parts of Subarea 0 in 1984 should not exceed the level advised in previous years (29,500 tons).

In order to improve the basis for assessing the stock in Subareas 0 and 1, the Council endorsed the recommendations of STACFIS regarding further research requirements.

2. Assessment of Shrimp Stock in Denmark Strait

The shrimp fishery in this area expanded rapidly from 1977 to 1980. The total catch on both sides of the midline between Greenland and Iceland was 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 4,100 tons in 1983. The fishery took place in the area of Strede and Dohrn Banks as in earlier years, but like 1982, the area was more restricted than in 1980 and 1981. The available data indicated that the catch rates of Norwegian and Greenland vessels, which took the bulk of the catch, were similar in 1982 and 1983 but lower than the 1980 and 1981 levels. However, due to the effect of ice on the distribution of the fishery in both 1982 and 1983 and incomplete data for 1983, it was not possible to reach a conclusion on the reasons for the trends observed in catch rates in recent years.

Table 2. Nominal catches (metric tons) of shrimp in Denmark Strait for 1978-83, with corresponding TACs for 1981-83.

	1978	1979	1980	1981	1982	1983
Catch	363	1,285	8,260	4,792	4,902	4,129 <sup>1</sup>
Advised TAC	-	-	-	-	4,200	4,200
Effective TAC <sup>2</sup>	-	-	-	8,000	4,500	5,725

<sup>1</sup> Provisional data

<sup>2</sup> On western side of midline

Catches were again composed of larger shrimp with no shrimp less than 19-20 mm in the 1983 length frequencies. This observation supports the earlier conclusion that young shrimp are not present on the fishing grounds, and, if the stock is self-sustaining, they likely inhabit areas farther north.

Although it was noted that STACFIS could not reach firm conclusions about the catch rates in recent years, the Council urges that a cautious approach to exploitation be maintained because little is known of the recruitment to this stock, and because this stock lives under extreme environmental conditions and may be very sensitive to over-exploitation. The Council therefore advises that the overall TAC for 1984 should not exceed the previously advised level of 4,200 tons.

In order to improve the basis for assessing the stock in Denmark Strait the Council endorsed the recommendations of STACFIS regarding future research requirements.

II. FUTURE SCIENTIFIC MEETINGS

1. Scientific Council Meeting, June 1984

The Council confirmed that its next meeting will take place at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 6-21 June 1984, to deal with its regular business, involving the work of the three standing committees (STACFIS, STACREC and STACPUB) and associated subcommittees and working groups.

2. Annual Meeting, September 1984

The Council noted that this meeting was scheduled for 5-14 September 1984, with 3 days (5-7 September) being allocated for the Special Session on "Biology and Ecology of the Squids, *Illex illecebrosus* and *Loligo pealei*, in the Northwest Atlantic.

III. OTHER BUSINESS

1. Future Meeting to Assess the Shrimp Stocks

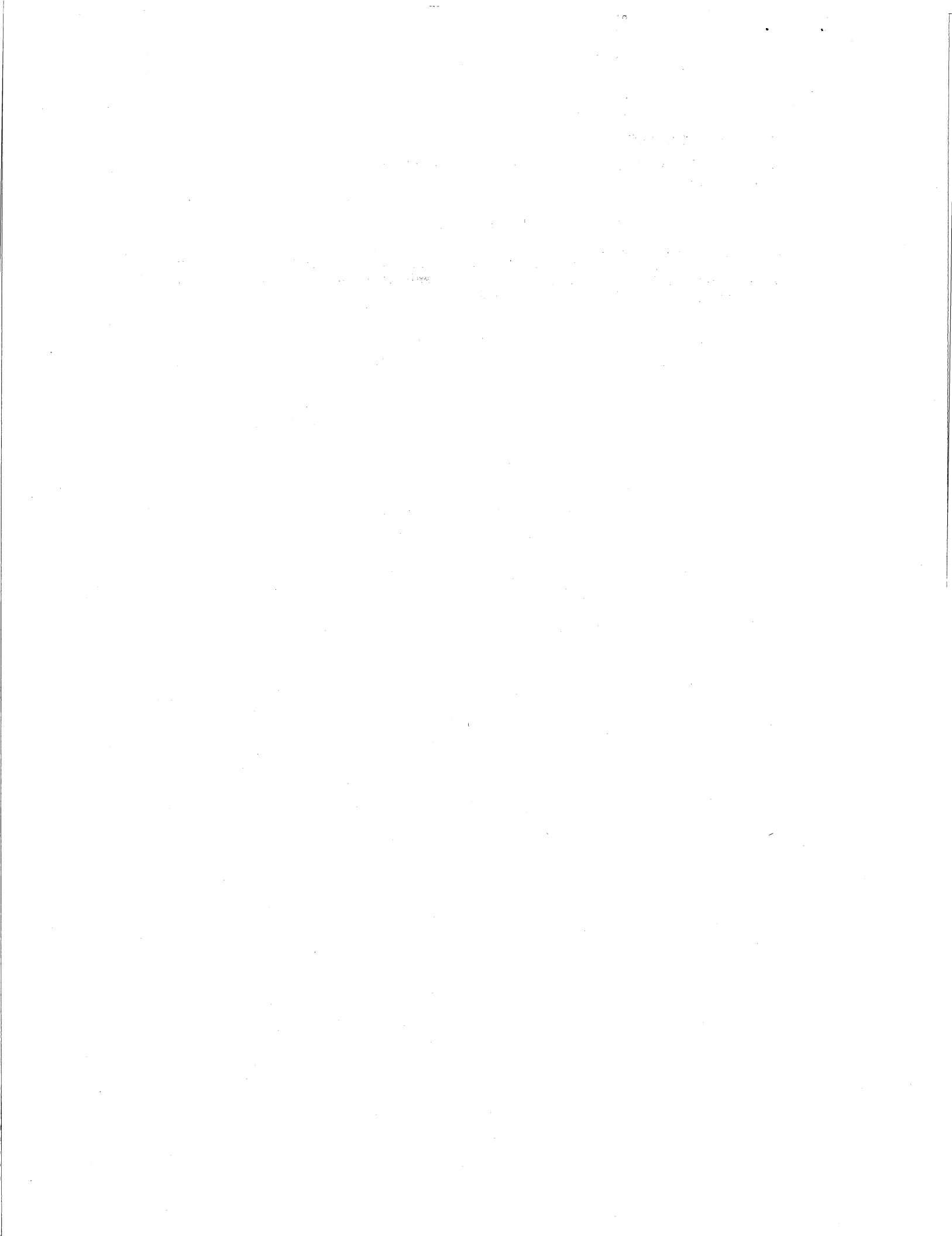
At the September 1983 Meeting, the Council requested STACFIS to consider the invitation by the EEC representative that the next meeting to assess the shrimp stocks be held at Copenhagen in late November 1984. The Council noted the concern of STACFIS that certain data collected in 1984 could not be adequately analyzed in time for a meeting in November 1984 and that commercial fishery data for the latter part of 1984 would not be available at that time, and therefore concurs with the view of STACFIS that a meeting to provide scientific advice for the management of the shrimp stocks in 1985 should not be held prior to January 1985.

2. Shrimp Ageing Workshop

The Council endorsed the recommendation of STACFIS regarding the possible need for another Shrimp Ageing Workshop.

IV. ADJOURNMENT

The Acting Chairman expressed his thanks to the participants for their cooperation and support during the course of the meeting and acknowledged the indispensable assistance of the NAFO Secretariat in organizing and servicing the meeting. The participants expressed their appreciation to Dr. J. E. Carscadden who agreed to conduct the meeting in the absence of the Chairman and Vice-Chairman.



APPENDIX 1. REPORT OF STANDING COMMITTEE ON FISHERY SCIENCE (STACFIS)

Chairman: J. E. Carscadden

Rapporteurs: Various

The Committee met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 18-23 January 1984 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) (Appendix II, Annexes 1 and 2). In addition, as requested by the EEC, the Committee reviewed the status of the shrimp stock in Denmark Strait (Appendix II, Annex 2). Scientists attended from Canada, EEC (Denmark, France, and the Commission of the European Communities), 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. Introduction (SCR Doc. 84/I/2, 3, 9)

The nominal catch of shrimp in Subareas 0 and 1 (inshore and offshore) increased from less than 10,000 tons prior to 1973 to 50,000 in 1976, decreased to about 35,000 tons in 1978 and 1979 and increased to a level of 46,000 tons in 1981 and 1982 (Table 1). Preliminary statistics for 1983 indicate a total catch of about 46,000 tons in Subareas 0 and 1, of which 38,000 tons were taken on the offshore grounds. The inshore fishery at West Greenland has been relatively stable at 7,000-8,000 tons since 1972 (except 10,000 tons in 1974).

The offshore shrimp fishery has been regulated by TAC (total allowable catch) since 1977. In 1977 and 1978, the total offshore catches in the Davis Strait region were about 34,000 and 27,000 tons compared with 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.

Area	Country	1975	1976	1977	1978	1979	1980	1981	1982 <sup>2</sup>	1983 <sup>2</sup>
SA 0	Canada	-	-	-	-	-	59	1,590	859	1,938
	Denmark	-	-	68	86	67	-	1,923	946	1,365
	Faroes	-	-	239	-	115	-	1,686	700	680
	France	-	-	-	21	7	-	-	-	-
	Greenland	-	-	-	-	149	815	85	8	-
	Norway	-	65	150	15	791	-	-	-	-
	Spain	-	327	-	-	-	-	-	-	-
	Total	-	392	457	122	1,129	874	5,284	2,513	3,983
SA 1	Canada	-	-	-	-	245	590	-	-	-
	Denmark	1,142	2,717	5,842	3,382	1,327	872	995	959	401
	Faroes	5,300	11,179	12,612	8,070	6,867	3,554	1,234	529	475
	France	-	803	924	805	353	247	535	672	416
	F. R. Germany	-	-	31	-	-	-	-	-	-
	Greenland (a) <sup>3,4</sup>	8,700	7,300	7,800	7,600	7,500	7,500	7,500	7,500	7,500
	Greenland (b) <sup>3</sup>	1,089	2,478	7,081	5,531	12,527	27,501	28,197	32,016	32,500
	Japan	-	146	-	-	-	-	-	-	-
	Norway	8,678	11,658	7,353	8,959	4,639	3,014	1,055	838	484
	Spain	6,948	6,925	-	-	-	-	-	-	-
	USSR	6,033	6,468	-	-	-	-	-	-	-
	Total	37,890	49,674	41,643	34,347	33,458	43,278	39,516	42,514	41,776
	Offshore	29,190	42,374	33,843	26,747	25,958	35,778	32,016	35,014	34,276
SA 0+1 offshore catch	29,190	42,766	34,300	26,869	27,087	36,652	37,300	37,527	38,259	
SA 0+1 advised TAC	-	-	36,000	40,000	29,500	29,500	29,500	29,500	29,500	
SA 0+1 effective TAC	-	-	36,000	40,000	29,500	29,500	35,000 <sup>5</sup>	34,800 <sup>5</sup>	34,625 <sup>5</sup>	

<sup>1</sup> Data for 1975-78 pertain to ICNAF Subareas 0 and 1, and subsequently to the new NAFO Subareas 0 and 1.

<sup>2</sup> Provisional data.

<sup>3</sup> a = inshore, b = offshore catches.

<sup>4</sup> Estimated catches.

<sup>5</sup> Includes TAC of 5,000 tons in Subarea 0.

Since 1981, Canada and EEC have set separate TACs for Subareas 0 and 1 respectively. The TAC for Subarea 0 has been 5,000 tons for the last three years, whereas the TAC in Subarea 1 was 30,000 tons in 1981, 29,800 tons in 1982 and 29,625 tons in 1983. For the same period, the Scientific Council advised that the TAC for Subarea 1 and adjacent areas of Subarea 0 should remain at the same level advised for the two preceding years (29,500).

The fishery in 1983 was severely hampered by ice conditions in the first 4 months of the year. From May to October, Greenland vessels fished mainly west and north of Store Hellefiske Bank (Div. 1B) as in 1982. The distribution of fishing effort by Greenland vessels in 1983, as in 1982, did not exhibit the northward shift that was evident in 1980 and 1981. The severe ice conditions in the spring of 1982 and 1983 thus caused delayed achievement of the allowable catch and a change in the distributional pattern of the fishery compared to the situation in the years preceding 1982. The special management area off Disko Bay was fished more heavily and for a longer period in 1982 and 1983 than in earlier years. Danish, Faroese, French and Norwegian vessels also fished in Subarea 1 in 1983, but the effort was generally lower than in 1982. As in 1982, Canadian vessels fished mainly between 58°W and 59°W longitude and 67°N and 68°N latitude in Div. 0A. The Norwegian vessels had some effort in Div. 1D, but most of their fishing activity occurred in Div. 1B. There was no information available on the distribution of fishing effort by the other countries.

In Subarea 1, a total of 48 vessels (>80 GRT) participated in the fishery in 1983 compared to 56 in 1982. In Subarea 0, a total of 9 vessels participated in 1983 compared to 8 in 1982.

## 2. Input Data

### a) Fishing effort and CPUE (SCR Doc. 84/I/2, 3, 9)

Catch and effort information available for the shrimp fishery in 1983 included Canadian data based on logbook records and observer reports for Subarea 0, Norwegian data based on logbook records and Greenland data based on logbook records and corresponding landings for Subarea 1.

Canadian data sources showed a decrease in catch rates for the period July-September from 1982 to 1983 of about 19%. Norwegian data from Div. 1B showed no significant change in CPUE figures for the same period between 1982 and 1983. Data for Greenland trawlers (630-722 GRT) showed a declining trend in catch rates throughout the fishing season in Div. 1B in 1983 as in 1982. Because of ice conditions, no fishing occurred from mid-January until late April. Catch rates peaked in April and declined steadily through to and including September. Compared to 1982, catch rates were higher in June and July and lower in the other months (SCR Doc. 84/I/9).

Indices of mean catch rates in the July-September period 1976-83 for the different national fisheries in Div. 1B (standardized to 1976) and for the Canadian fishery in Div. 0A (standardized to the average of the other indices in 1980) are given in Table 2. In general, all indices decline by about the same proportion from 1976-1979 and fluctuate similarly between 1980-1983, except for the abnormally high 1981 figures for the French fishery (no CPUE-index is available from France for 1983) and the stabilization of the Norwegian index between 1982 and 1983; for both countries, however, the indices are derived from relatively small catches.

Table 2. CPUE indices for Greenland, Norwegian and French fisheries for shrimp in Div. 1B and the Canadian fishery in Div. 0A, 1976-83.

	Div.	1976	1977	1978	1979	1980	1981	1982	1983
Greenland	1B	1.00	0.74	0.67	0.51	0.63	0.59	0.74	0.66
Norway	1B	1.00	0.84	0.60	0.47	0.60	0.43	0.57	0.56
France <sup>1</sup>	1B	1.00	1.13	0.61	0.48	0.58	0.80	0.60	-
Canada <sup>2</sup>	0A					0.60	0.66	0.78	0.63

<sup>1</sup> July only.

<sup>2</sup> Div. 0A (1980 is average of the other 3 indices).

The influence of the introduction by some countries of more efficient gears in the shrimp fishery around 1980 on CPUE indices was discussed, but no information on the relative use of different types of gears was available. Also, the late opening of the fishery in 1982 and 1983 due to ice resulted in a reduction of fishing pressure on heavy concentrations of berried females. This might have resulted in higher than normal abundance later in the season after the shrimp were more dispersed. Therefore, it was agreed that CPUE indices for July-September 1982 and 1983 might have been biased upwards. It is not possible to quantify either of these factors.



b) Biology (SCR Doc. 84/I/2, 3, 4, 9)

Shrimp samples from Canadian research and commercial activities in Subareas 0 and 1 from 1978 to 1981 were analyzed for sex and maturity, age interpretation and natural mortality (SCR Doc. 84/I/4). The data showed that generally less than 5% of transitional and female shrimp in the area sampled failed to spawn in a given year and that females spawning for the first time appeared to lay the eggs earlier in the year. Five age-groups of juvenile and male shrimp were interpreted from the data. A conversion of carapace length-at-age to total length enabled an estimation of natural mortality using an equation relating  $M$  to  $L^\infty$ ,  $K$  and an average environmental temperature. It was recognized that the number of samples was limited and that a closer examination of a more extensive database must be undertaken before these estimates could be verified.

Length frequencies from the Canadian (SCR Doc. 84/I/3) and Norwegian (SCR Doc. 84/I/2) fisheries and from Greenland research samples (SCR Doc. 84/I/9) indicated a continued decrease in the abundance of small shrimp in Div. 0A and 1B from levels observed in 1981.

Proportions of ovigerous females in Canadian commercial samples from October and November (SCR Doc. 84/I/3, p. 14) indicated that most females had spawned. However, Greenland maturity data from areas farther north in Div. 1A showed a high proportion of non-maturing females (SCR Doc. 84/I/9), similar to an observation from the French fishery in July-September 1982 (*NAFO Sci. Coun. Rep.*, 1983, page 10). Other Greenland samples (SCR Doc. 84/I/9) from Div. 1B were consistent with the Canadian observations.

c) Photographic survey (SCR Doc. 84/I/6)

A bottom photographic survey was carried out in the area from 66°N to 71°N covering depths of 100-600 m, and the sampled data were incorporated into a shrimp distribution model to derive estimates of biomass in the area from 66°00'N to 69°30'N for the 1978-1983 period. The general good agreement with the July-September CPUE figures over the sampling period, which was noted in earlier reports, was no longer observed.

A new version of the model taking into account hydrographic observations reflected a biomass trend similar to that of the catch rates. However, this model utilizes only data from the last 3 years. The Committee noted that, although some improvement of the model has been achieved, the variances associated with the photographic model still are not known and that caution should be maintained about fully accepting the results.

The proportion of small shrimp in the photographic samples indicated a decline in relative abundance from the high level observed in 1981.

d) Discarding of shrimp (SCR Doc. 84/I/2, 3)

The discarding of shrimp in Div. 0A during 1983 was similar to observations in the previous 2 years (below 5% of total shrimp catch in most months). However, discards varied among vessels, due to different discarding practices, and also during the year, possibly in response to changing catch rates. Size distributions of discarded shrimp showed unimodality at 20-23 mm carapace length and, compared to previous years, there were very low numbers of shrimp less than 19 mm in the total catch.

Observations in Div. 1B on one Norwegian trawler indicated much higher discard rates in June and July 1983 than in previous years, ranging from 10 to 40% of the shrimp catch, with a mean of 20%. The highest discard rates were observed in shallow water. Norwegian discards showed lower incidence of small shrimp of the modal length group at 17.5 mm than found in 1982. It was noted that the level of discarding may vary from vessel to vessel depending on the type of processing on board.

e) By-catches in the shrimp fishery (SCR Doc. 84/I/2, 3, 9)

Generally, by-catches in the shrimp fishery do not appear to be a problem for the fisheries in Subareas 0 and 1. Logbook records from eight Greenland trawlers showed by-catches at the same very low levels in 1983 (0.8% by weight of the total shrimp catch) as in the previous 2 years, a sharp decline from the highest by-catch rate (23.1%) in 1978. In 1983, the only reported species in the by-catch was redfish.

By-catches in the Canadian shrimp fishery in Div. 0A, were, as in previous years, dominated by redfish. However, in 1983, the redfish by-catch never exceeded 4% of the total catch weight in any month. Redfish (<15 cm) also dominated in the Norwegian by-catch, but the by-catch rate was at the same low level as 1982.

### 3. Conclusions and Management Advice

Catch rates from Canadian and Greenland fisheries in Div. 0A and 1B respectively for the July to September period decreased from 1982 to 1983. It is likely that the high abundance of small shrimp (<20 mm) observed in 1981 was mostly recruited in 1982 and that 1983 recruitment depended more than previously anticipated on the relatively lower abundance of small shrimp observed in the photographic samples and from research and commercial length frequencies in 1982 (*NAFO Sci. Coun. Rep.*, 1983, page 12). Although the CPUE indices suggest that the stock has shown an increasing trend since 1979, these indices may be biased upwards in recent years because of the possible influences of improved trawl design since 1980 and ice conditions in 1982 and 1983. Although the effects of these factors cannot be estimated, it is quite possible that they could account for the observed increase, and the stock indeed may not have increased over the period (Fig. 1).

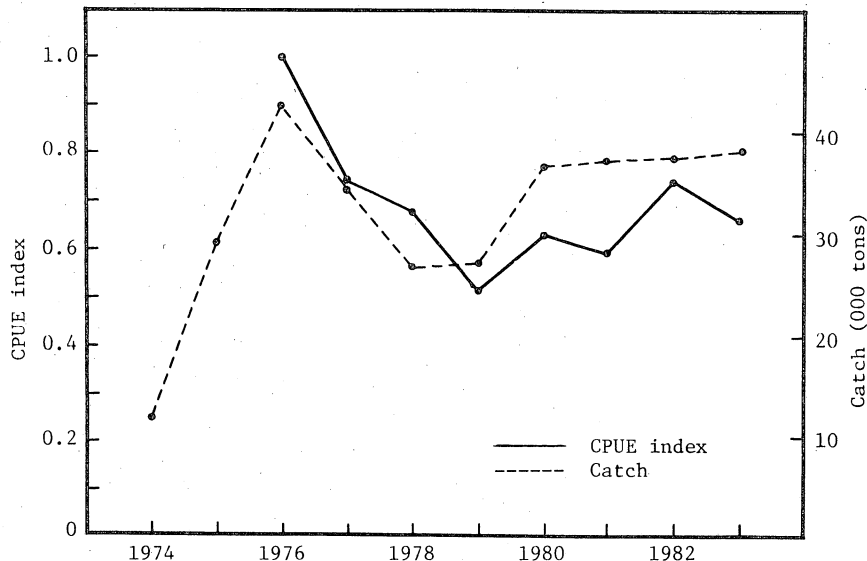


Fig. 1. Indices for mean CPUE for the period July-September, 1976-1983 in Div. 1B compared to total offshore catches in Subareas 0 and 1. (Mean catch rates are based on logbook information for seven trawlers (630-722 GRT) of the Royal Greenland Trade Department. Offshore catch in 1983 is provisional.)

Recruitment to the fishery in 1984 may be poor, as evidenced by a continued decrease in the incidence of small shrimp in the commercial and research length frequencies and in the photographic samples, relative to the higher numbers observed in 1981. Thus, catch rates in 1984 may be expected to decline further from the 1982 level as the fishery becomes increasingly dependent on the older age-groups.

Although the fishable stock appears to have remained stable since 1979, concern was expressed over the likelihood of reduced recruitment and a reduction in the spawning stock in 1984. However, STACFIS could not quantify the expected reduction in the spawning stock and therefore advises that the overall 1984 TAC for the offshore grounds in Subarea 1 and the adjacent parts of Subarea 0 should not exceed the level advised for 1979-83 (29,500 tons). The Committee also noted that allowing catches to exceed the advised TAC (as has occurred since 1980) would add further pressure on the spawning stock in 1984 which in turn may adversely affect recruitment in subsequent years.

STACFIS also agreed that the practice of allowing only a small portion of the TAC for the offshore grounds in Subarea 1 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.

### 4. Future Research Requirements

In response to the recommendations from the January 1983 Meeting (*NAFO Sci. Coun. Rep.*, 1983, page 13), a number of projects were initiated to improve the knowledge of the biology of shrimp in Subareas 0 and 1. Canadian and Danish scientists initiated a study of a time series of biological data from the Greenland fishery which included observations on reproductive success. The mathematical model for the photographic survey was revised and a redefinition of the size categories of shrimp

observed in the photographs was begun. The observer programs were continued in 1983, providing length frequencies, biological samples and estimates of by-catches and discards. It was generally agreed that more improvements could be made, and STACFIS therefore

recommends

- i) that stratified-random trawl surveys be conducted on a seasonal basis for a number of years to determine seasonal changes in distribution and abundance;
- ii) that the annual photographic survey be continued along with efforts to improve the model and to redefine size categories;
- iii) that the observer program be continued;
- iv) that the reporting of discards should be closely monitored to ensure reliability and consistency with observer reports;
- v) that countries participating in the shrimp fishery continue efforts to ensure that fishing vessel logbooks are completed and copies made available to scientists as soon as possible; and
- vi) that a study be undertaken to determine the relative efficiency of gear types used in the Davis Strait shrimp fishery in recent years, in an attempt to quantify the effects of recent changes in gear on CPUE indices.

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

1. Introduction (SCR Doc. 84/I/1, 5, 7, 8)

The shrimp fishery in this area (Table 3) was begun in 1978 by an Icelandic vessel on the eastern side of the midline between Greenland and Iceland. Nominal catches increased to 1,300 tons in 1979 when Norwegian trawlers participated in the fishery and exceeded 8,200 tons in 1980 with the additional involvement of Danish, Faroese, French and Greenland vessels. In 1981, the total catch from both sides of the midline declined to 4,800 tons, 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. The reported catches in 1982 totalled 4,900 tons. In 1983, the EEC set a TAC of 5,725 tons whereas the Scientific Council advised an overall TAC of 4,200 tons (as in 1982). Provisional data indicate a catch of 4,100 tons in 1983.

Table 3. Nominal catches (metric tons) of shrimp (*Pandalus borealis*) reported from Denmark Strait, 1978-83.

Country	1978	1979	1980	1981	1982 <sup>1</sup>	1983 <sup>1</sup>
Denmark	-	-	702	581	740	204
Faroes	-	-	4,233	713	737	443
France	-	-	50	353	414	273
Greenland	-	-	200	1,004	1,115	1,467
Iceland	363	485	614	125	-	15
Norway	-	800	2,461	2,016	1,896	1,727
Total	363	1,285	8,260	4,792	4,902	4,129
Advised TAC	-	-	-	-	4,200	4,200
Effective TAC <sup>2</sup>	-	-	-	8,000	4,500	5,725

<sup>1</sup> Provisional data

<sup>2</sup> On the western side of the midline

The shrimp fishery in Denmark Strait in 1983 took place in the area of Strede and Dohrn Banks as in earlier years, and, like 1982, the area was more restricted than in 1981 and especially 1980. Ice conditions early in the fishing season were variable and affected the distribution of fishing. During April and May, the Norwegian fishery was conducted south of 66°N and, due to ice conditions, most of the vessels left the fishing grounds in early May. However, during the summer and autumn, some Norwegian vessels returned to the fishing grounds. In April and early May, French vessels fished south of 66°N from 30°00' to 31°30'W because of ice further north. At the end of May and beginning of June, the fishery moved northward between 66° and 67°N. Because of incomplete data, the influence of environmental conditions and distribution of shrimp on the activity of Greenland vessels were not known. However, the limited information indicated that fishing occurred between 65°N and 67°N during March and April, with the bulk of the catch coming from south of 66°N. Because of

good fishing in the Icelandic coastal area and unfavourable weather and ice conditions offshore, there was very little fishing by Icelandic vessels on the eastern side of the midline in 1983.

Except for one vessel fishing in January, the overall fishing period in 1983 extended from March to November. The main fishing period occurred from March to June. Forty-one vessels (excluding Icelandic vessels) participated in the fishery in 1983, compared with forty-two in 1982.

## 2. Input Data

### a) Fishing effort and CPUE (SCR Doc. 84/I/1, 5, 7, 8)

Monthly catch rates and corresponding fishing effort, based on logbook data for the Danish, French, Greenland, Icelandic and Norwegian fisheries in 1980-83 are listed in Table 4. In 1980 and 1981, catch rates were highest during March-April, whereas in 1982 catch rates were highest in May. In 1983, the highest catch rates were from the Greenland fishery in March (except for the Icelandic estimate in October based on very low effort). Ice conditions differed considerably from month to month, making the evaluation of CPUE data difficult. This difficulty was compounded by incomplete data on catch location and fishing effort for a substantial portion of the fleet. The CPUE data from the French vessels showed a decline in April from 1981 to 1983 but were similar for May and June over the same period. However, French vessels accounted for less than 8% of the catch in those years. The Greenland and Norwegian vessels exhibited catch rates which were similar in 1982 and 1983 but lower than the 1980 and 1981 levels. However, due to the effect of ice on distribution of the fishery both in 1982 and 1983 and the incomplete data for 1983, it was not possible to reach a conclusion on the reasons for the trends observed in catch rates in recent years.

Table 4. Monthly catch rates (kg per hour trawling) and corresponding effort (hours trawling) from the logbooks available from the shrimp fishery off East Greenland, 1980-83.

Year	Month	Denmark and Greenland		France		Iceland <sup>1</sup>		Norway	
		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	... <sup>2</sup>	119	1,101
	Jul	--	--	--	--	78	... <sup>2</sup>	--	--
	Aug	--	--	--	--	39	... <sup>2</sup>	42	167
	Sep	--	--	--	--	--	--	46	65
1982	Mar	160	763	--	--	--	--	197	1,548
	Apr	195	1,570	216	331	--	--	171	4,450
	May	280	1,394	264	563	--	--	248	3,339
	Jun	--	--	185	238	--	--	--	--
1983	Mar	345	484	--	--	--	--	--	--
	Apr	160	457	165	248	--	--	128	2,734
	May	--	--	254	245	50	2	255	1,439
	Jun	--	--	162	206	99	48	143	1,797
	Jul	--	--	--	--	--	--	133	45
	Aug	--	--	--	--	--	--	98	622
	Sep	--	--	--	--	--	--	--	--
	Oct	--	--	--	--	400	5	--	--
	Nov	--	--	--	--	135	59	--	--

<sup>1</sup> Data from Iceland side of midline; data from other countries from the Greenland side of the midline.

<sup>2</sup> Monthly data not available; total effort was 1,480 hours.

b) Biology (SCR Doc. 84/I/1, 5, 7, 8)

Data on the biology of the shrimp stock in Denmark Strait were available from Norwegian, Greenland and French trawlers in 1983 and from Icelandic fishery data for 1976-83. The length frequencies from all sources showed that most shrimp in the sampled catches ranged in size from 26 to 32 mm. Modal lengths were 29 mm from the Greenland and Norwegian data and 28 mm from the French data, while the Icelandic samples showed a dominant mode at 30 mm in August and 29 mm in October. Very few shrimp less than 26 mm were observed in both the Greenland and Norwegian samples, but the French and especially Icelandic (August) samples showed significant numbers of smaller shrimp between 20 and 26 mm.

The French and Icelandic samples also showed that males ranged in size from 20 to 28 mm and transitionals and females from 25 to 35 mm. These size ranges are similar to those observed in the French and Greenland data of the previous year (*NAFO Sci. Coun. Rep.*, 1983, page 14). The Greenland samples were collected in April from the southern part of the fishing area and contained only females and transitionals. The French data indicated that hatching took place between mid-May and mid-June and that higher proportions of ovigerous females were found on the southernmost part of the fishing area. The Icelandic data showed that most females (60%) were ovigerous in August. It is likely that most of the females without eggs in August would spawn later in the season, but, as observed in the French (SCR Doc. 84/I/7) and Greenland (SCR Doc. 84/I/5) data, a small proportion of females do not reproduce in a given year.

As in the previous two years, small shrimp less than 19-20 mm were absent in all of the 1983 length frequencies. This supports the conclusion that young shrimp are not present on the fishing grounds, and, if the stock is self-sustaining, they likely inhabit areas farther north.

The Icelandic length distributions for August 1979 to 1983 were averaged and deviations from the average by length group for each year interpreted for growth (SCR Doc. 84/I/8). The authors concluded that the depletion of large shrimp due to the fishing is reflected in negative deviations for shrimp greater than 32 mm from 1981 to 1983, compared to positive deviations prior to 1981, and that growth of shrimp between 26 and 34 mm could be as low as 1.0 to 1.5 mm per year.

c) Discarding of shrimp (SCR Doc. 84/I/1)

Data on discarding of shrimp in Denmark Strait were available only for one Norwegian vessel. Because of the large size of the shrimp, only damaged individuals were discarded. Discarding was 0.8% (by weight) of the total catch in 1983 compared to 11.5% in 1981 and 3.7% in 1982.

d) By-catches in the shrimp fishery (SCR Doc. 84/I/1, 5, 7)

Data on by-catches of fish in the shrimp fishery were reported for French, Greenland and Norwegian vessels. The total by-catch of fish taken in the shrimp fishery by French vessels was composed mainly of redfish and capelin, although some cod was also caught. The by-catch by Greenland vessels was 2.0% by weight and consisted mainly of redfish. In the Norwegian shrimp fishery, small redfish dominated the by-catches. The mean number of cod per haul decreased from 23 in 1982 to 3 in 1983. The mean number of fish per kg of shrimp caught in the Norwegian fishery remained about the same in 1983 as in 1982 (0.18 and 0.16 respectively).

3. Conclusions and Management Advice

No estimates of the biomass of the stock in Denmark Strait were available, but the Committee noted the following points: (i) catch rates in two of the series (Greenland and Norway) were lower in 1982 and 1983 than in 1980 and 1981, while those for French fishery were approximately the same in 1983 in two of the three months as in previous years, but it was not possible to reach a conclusion on the reasons for these recent trends; (ii) at least 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 (iii) the stock may be living under extreme and unstable environmental conditions.

Concern was expressed that this stock may be very sensitive to overexploitation, but there are insufficient new data on which to revise previous advice. STACFIS therefore advises that the overall TAC for 1984 should not exceed the advised level for 1983 (4,200 tons).

4. Future Research Requirements

More information on some biological characteristics of shrimp in Denmark Strait was contained in the Greenland, Norwegian, French and Icelandic data, but its usefulness in assessing the stock was limited by the lack of information on a year-round basis. No other data were available on the environmental and biological questions outlined at the January 1983 Meeting (*NAFO Sci. Coun. Rep.*, 1983, page 16). STACFIS reiterates the concerns of the previous two meetings, 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;*
- iv) *that a study on environmental conditions be undertaken, including the circulation of currents in the area; and*
- v) *that the Icelandic samples collected from 1976 to 1983 be analyzed in greater detail to determine seasonal changes in maturity.*

III. OTHER MATTERS

1. Mid-term Meeting for Assessment of Shrimp Stocks

At the September 1983 Meeting, the Scientific Council requested STACFIS to advise on the appropriate timing of a meeting to provide advice on both the Davis Strait and Denmark Strait stocks for 1985 (*NAFO Sci. Coun. Rep.*, 1983, page 119). Scientists from Canada, Denmark, France and Norway indicated, at the present meeting of STACFIS, that the most appropriate time would not be earlier than January 1985. Based on past experience, sufficient information from the 1984 commercial fishery (such as vessel logbooks and catch composition data) will not be available to scientists before January 1985 and some research data (i.e. the photographic survey) cannot be completely analyzed before January. The catch-per-unit-effort data derived from the logbooks have been considered the most reliable indicator of stock status in the past, and the results of the photographic survey have provided biomass estimates. The information derived from commercial and research length frequencies is used as an indicator of recruitment to the fishable stock. A meeting held in late November 1984 would have data mainly from the 1983 commercial fishery and research survey. The size groups which supported the 1983 fishery will not contribute significantly in 1985 but shrimp recruiting in 1984 will be important to the 1985 fishery. Also, any prerecruit shrimp observed in the 1984 photographic survey will be important to assess recruitment prospects in 1985. Therefore, the inclusion of shrimp data collection in 1984 is particularly important in the provision of useful advice for 1985. Since not all of these data would be available before January 1985, STACFIS would not be able to evaluate the status of the stock in 1984 nor would it be possible to provide any advice on the projected status of the stock in 1985 even in a qualitative sense, prior to January 1985.

STACFIS noted that the Davis Strait shrimp stock has at best remained relatively stable since 1979, and, as a result, the advised TAC level has not changed. Generally, stocks of *P. borealis* have been known to fluctuate substantially from year to year and STACFIS is concerned that, if a meeting were held prior to January of the year for which advice is being provided, there would not be adequate information available to detect changes in the status of the stock prior to the results of such changes being experienced by the commercial fishery.

2. Possible Need for Further Workshop on Ageing Shrimp

One of the conclusion from the Shrimp Ageing Workshop in 1981 was that more thorough investigations of biological characteristics were necessary before age structure and growth of shrimp could be fully understood (*NAFO Sci. Coun. Studies*, No. 6, page 97). It was agreed at that meeting that research should continue in this direction and that another workshop be held in 2-3 years to review progress. In response to the recommendation of the Ageing Workshop, STACFIS

recommends

*that the participants of the 1981 Workshop be contacted to see if there has been sufficient progress to warrant another session and that a report of the survey be made available to STACFIS at the June 1984 Meeting.*

IV. ACKNOWLEDGEMENTS

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

APPENDIX II. AGENDA FOR SCIENTIFIC MEETING, JANUARY 1984

- I. Opening (Chairman: V. A. Rikhter)<sup>1</sup>
  1. Appointment of rapporteur
  2. Adoption of agenda
  3. Plan of work
  
- II. Fishery Science (STACFIS Chairman: J. E. Carscadden)
  1. Shrimp in Subareas 0 and 1 (Annexes 1 and 2)
    - a) Review of fishery trends
    - b) Distribution and biology
    - c) Catch and effort
    - d) By-catches in shrimp fishery
    - e) Biomass estimates
    - f) Total allowable catches
    - g) Future research needs
  2. Shrimp at East Greenland (Annex 2)

(Items (a) to (g) in 1 above)
  3. Other Matters
  
- III. Review of Future Meeting Arrangements
  1. Regular Meeting, June 1984
  2. Annual Meeting, September 1984
  
- IV. Other Matters
  1. Future meetings to assess the shrimp stocks
  
- V. Adjournment

<sup>1</sup> In the absence of Dr. V. A. Rikhter, Dr. J. E. Carscadden acted as Chairman for this meeting.

ANNEX I. CANADIAN REQUEST FOR ADVICE ON THE SCIENTIFIC BASIS FOR  
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 30)  
Redfish (Div. 3L and 3N)  
American plaice (Div. 3L, 3N and 30)  
Witch flounder (Div. 3N and 30)  
Yellowtail flounder (Div. 3L, 3N and 30)  
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 30)  
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 (EF) which is two thirds that calculated to be required to take the MSY catch in the long term.
  - (c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence on stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stock.

L. S. Parsons  
Acting Assistant Deputy-Minister  
Dept. of Fisheries and Oceans  
Ottawa, Ontario, 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:  $F = F_{0.1}$ ,  $F = F_{max}$ , 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

APPENDIX III. LIST OF RESEARCH AND SUMMARY DOCUMENTS

A. Research Documents

<u>SCR No.</u>	<u>Ser. No.</u>	<u>Title</u>	<u>Author(s)</u>
84/I/1	N770	Norwegian investigations on shrimp, <i>Pandalus borealis</i> , in East Greenland waters in 1983.	O. M. Smedstad S. Torheim
84/I/2	N771	Norwegian investigations on shrimp, <i>Pandalus borealis</i> , in West Greenland waters in 1983.	O. M. Smedstad S. Torheim
84/I/3	N772	Details of catch, effort and CPUE from the Canadian fishery for shrimp ( <i>Pandalus borealis</i> ) in Division OA, 1983.	D. G. Parsons P. J. Veitch G. E. Tucker
84/I/4	N773	Observations of some biological characteristics of shrimp ( <i>Pandalus borealis</i> ) from the Davis Strait, 1978-81.	D. G. Parsons G. E. Tucker
84/I/5	N774	Data on the shrimp fishery at East Greenland in 1983 compared to earlier years.	D. M. Carlsson
84/I/6	N775	Biomass of shrimp ( <i>Pandalus borealis</i> ) in NAFO Subarea 1 in 1978-1983 estimated by means of bottom photography.	P. Kannevorff
84/I/7	N776	Catch, effort and biological data of shrimp ( <i>Pandalus borealis</i> ) in the French fishery off East Greenland in 1983.	A. Biseau B. Fontaine
84/I/8	N777	Some data on the Icelandic catch of shrimp in the Denmark Strait area in 1983.	I. Hallgrimsson U. Skuladotter
84/I/9	N778	Data on the shrimp fishery in NAFO Subarea 1 in 1982 and 1983.	D. M. Carlsson

B. Summary Documents

<u>SCS No.</u>	<u>Ser. No.</u>	<u>Title</u>	<u>Author(s)</u>
84/I/1	N779	Provisional Report of Scientific Council, Special Meeting, January 1984.	NAFO

APPENDIX IV. LIST OF PARTICIPANTS

CANADA

Carscadden, J. E. Northwest Atlantic Fisheries Centre, P.O. Box 5667, St. John's, Nfld.  
Parsons, D. G. " " " " " "  
Etter, M. L. Dept. of Fisheries and Oceans, P.O. Box 550, Halifax, N. S.  
Halliday, R. G. Marine Fish Division, Dept. of Fisheries and Oceans, BIO., P.O. Box 1006,  
Dartmouth, N. S.

EUROPEAN ECONOMIC COMMUNITY (EEC)

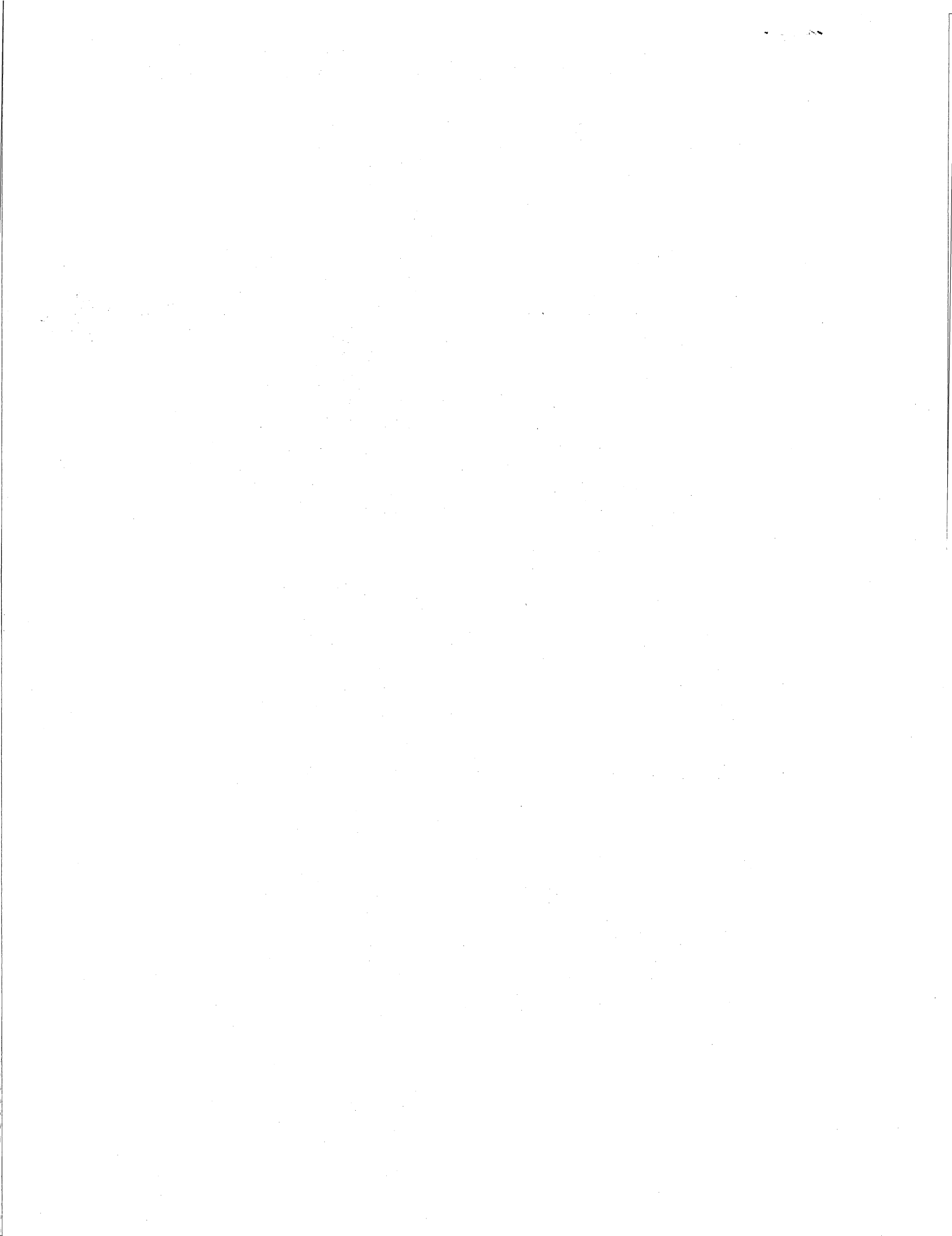
Noé, R. Commission of the European Communities, 200 Rue de la Loi, 1049  
Brussels, Belgium  
Forest, A. Institut Scientifique et Technique des Pêches Maritimes, B. P. 4240,  
F-97500 Saint Pierre, St. Pierre et Miquelon, France  
Carlsson, D. M. Grønlands Fiskeriundersøgelser, Tagensvej 135, DK-2200, Kobenhavn N,  
Denmark  
Kannevorff, P. " " " " " "

ICELAND

Eiriksson, H. Hafrannsóknastofnunin, Marine Research Institute, P. O. Box 390,  
121- Reykjavik  
Hallgrimsson, I. " " " " " "

NORWAY

Smedstad, O. M. Institute of Marine Research, P.O. Box 1870-72, N-5011, Bergen-Nordnes



Northwest Atlantic



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(Corrigenda)

PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

Special Meeting, January 1984

Corrigenda

Page 3 (5 lines from bottom): spelling Subarea.

Page 4 (Section II(2)): insert Quotation mark (") after Northwest Atlantic.

Page 7 (Section I(1) Introduction): insert documents 84/I/4 and 6.

Page 9 (Paragraph 1, line 1): "appeared to lay their eggs .....

Page 13 (Section 3, line 3): "those for the French fishery .....