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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

January 1987 Meeting

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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

January 1987 Meeting

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

The Scientific Council met at the Greenland Fisheries and Environmental Research Institute, Copenhagen, Denmark, during 28 January-02 February 1987, to consider matters that were deferred from the June 1986 Meeting, namely, the provision of advice on the status of the shrimp stocks in Subareas 0 and 1 and on the scientific basis for their management in 1987, as requested by Canada and by Denmark on behalf of Greenland, and also the shrimp stock in Denmark Strait as requested by Denmark (Greenland). The Council also agreed to deal with the Canadian request for an analysis of the research activity that is necessary to allow estimation of total biomass, distribution of biomass between subareas, and target levels for removals in Subareas 0 and 1. The specific requests are given in Annexes 1, 2 and 3 to the agenda (Appendix II). Representatives attended from Canada, Denmark (Greenland), European Economic Community (EEC), Iceland and Norway (Appendix III). The participants were welcomed to the Institute by Sv. Aa. Horsted (Director).

The stock assessments were undertaken by the Standing Committee on Fishery Science (STACFIS), whose report, as approved by the Council at this meeting, is at Appendix I. The list of research and summary documents relevant to this meeting is at Appendix IV. A brief summary of the Committee's report and other matters considered by the Council is given below.

1. FISHERIES SCIENCE (APP. I)

1. Assessment of Shrimp Stock in Subareas 0 and 1

In 1979 and 1980, the offshore shrimp fishery in the Davis Strait region was regulated by an overall TAC (total allowable catch) of 29,500 (metric) tons, and the nominal catches were 27,000 and 37,000 tons respectively (Table 1). The same TAC was advised for each year of 1981-84, but the coastal states set overall TACs of 35,000, 34,800, 34,625 and 34,925 tons respectively. Provisional statistics for 1985 and 1986 indicate overall offshore catches of 43,600 and 44,600 tons respectively. These nominal catches do not include 4,300 and 11,000 tons of shrimp in 1985 and 1986 respectively from a trial fishery by Greenland trawlers north of 71°N, which was considered to be outside the fishing areas for which previous TAC advice had been given.

The shrimp fisheries in 1985 and 1986 were not hampered by ice to the same extent as in 1982-84, and the fishing grounds were generally open to the fishery at the beginning of the year. Greenland vessels, which comprise the largest component of the fishery, operated in Div. 1B, 1C and 1D throughout 1985 and 1986, with fishing effort being more widely distributed in these divisions than in earlier years.

Table 1. Nominal catches (tons) of shrimp in Subarea 0 and the offshore grounds in Subarea 1 (south of 71°N), with advised and effective TACs for 1977-86.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Catch	34,500	26,869	27,087	36,652	37,300	36,827	39,267	35,883	43,618	44,584[1]
Advised TAC	40,000	40,000	29,500	29,500	29,500	29,500	29,500	29,500	36,000	36,000
Effective TAC[2]	36,000	40,000	29,500	29,500	35,000[3]	34,800[3]	34,625[3]	34,925[3]	42,120[4]	42,120[4]

[1] Provisional data.
[2] Total of coastal states' TACs.
[3] Includes TAC of 5,000 tons for Subarea 0.
[4] Includes TAC of 6,120 tons for Subarea 0.

Catch rates declined during 1976-78 but they generally showed an increasing trend during 1977-86. Abundance indices, based on photographic surveys, showed relative stability in recent years to 1985. Unfortunately, the survey was not successful in 1986. It is believed, however, that the increasing trend in catch rates may be strongly influenced by advanced gear technology since 1980 and particularly by the use of larger trawls during the last 2-3 years. Until the effects of these changes can be quantified, the further use of commercial catch rates as an index of stock abundance is unacceptable.

A TAC of 40,000 tons was advised for 1977 and 1978. The TAC was reduced by about 26% to 29,500 tons for 1979, in recognition of the decrease in abundance from 1976 to 1978. An increase in TAC was not advised for 1979-84 because of the difficulty in interpretating the catch-rate series and of the concern about recruitment prospects for the stock. Despite the continuing uncertainty about recruitment, catch rates have not decreased. Because of the apparent stability of the stock, with higher-than-average yields during this period of stability, the Council, at its meeting in January 1985, advised that the overall TAC for Subarea 0 and the offshore grounds of Subarea 1 in 1985 should not exceed 36,000 tons, which corresponds to the average catch during 1979-84. The stability of the stock was again evident from the survey data and commercial catch rates in 1985, and the Council, at its meeting in January 1986, advised that the overall TAC for 1986 should be set at the same level as advised for 1985 (i.e. 36,000 tons). With the lack of survey data for 1986 and the unacceptable nature of the catch-rate data as an index of stock abundance, the Council has no basis to advise a change in the TAC for 1987 from the previously-advised level of 36,000 tons.

The Council endorsed the recommendations of STACFIS concerning future research needs in Subareas 0 and 1.

2. Assessment of Shrimp Stock in Denmark Strait

The shrimp fishery in this region expanded rapidly from 1978 to 1980. Total catches on both sides of the midline between Greenland and Iceland declined sharply from about 8,300 tons in 1980 to 4,800 tons in 1981 (Table 2), when the fishery west of the midline was regulated by a TAC of 8,000 tons, which was set by the EEC. During 1982-85, when the TACs on the western side of the midline (set by the EEC) were 4,500, 5,725, 5,245 and 6,090 tons respectively, the nominal catches in

Denmark Strait were 4,900, 4,200, 6,700 and 8,100 tons. In 1986, an effective TAC of 7,225 tons was set by Denmark (Greenland), but catch in the region as a whole was approximately 10,800 tons.

Table 2. Nominal catches (tons) of shrimp in Denmark Strait in 1978-86, with advised and effective TACs for 1981-86.

	1978	1979	1980	1981	1982	1983	1984	1985	1986
Catch	363	1,285	8,260	4,792	4,902	4,175	6,731	8,100	10,815[1]
Advised TAC	-	-	-	-	4,200	4,200	4,200	5,000	6,000
Effective TAC[2]	-	-	-	8,000	4,500	5,725	5,245	6,090	7,225

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

As in 1984 and 1985 , the 1986 fishery took place in the area of Strede Bank and Dohrn Bank and on the slopes of Storfjord Deep. Due to favourable ice conditions, the fishery was more widespread in 1985 and 1986 than in earlier years. Catch rates for the March-May period declined during 1978-80 but have remained relatively stable since then to 1985. The stock has sustained catches averaging about 6,000 tons annually since 1980 without an apparent decline in commercial catch rate or a decrease in the size range of shrimp. The following scenarios were implied from these observations at the January 1986 Meeting: (i) the shrimp fishery began at a time when the stock was expanding and the catches since 1980 have approximated the surplus production, implying a TAC of 6,000 tons for 1986; and (ii) the stock was at a maximum equilibrium level in the late 1970's and accumulated catches since then have not had a significant impact on stock abundance, implying that a TAC of 6,000 tons for 1986 was conservative.

New information at the present meeting indicated conflicting trends in catch rates of different fishing fleets. In view of the variation which is believed to exist among these fleets relevant to increased efficiency of fishing, the Council could not fully evaluate the catch-rate data, particularly in relation to the previous scenarios. Data from the research vessel surveys in 1985 and 1986 indicated that recent catches have not adversely affected the stock, but the available data were not sufficient to allow the Council to advise a precise TAC for 1987 in this region.

The Council endorsed the recommendations of STACFIS for future research in Denmark Strait, particularly with reference to the need for environmental studies.

3. Other Fishery Science Matters

a) Proposal for further work on ageing of shrimp

The Council agreed with the proposal of STACFIS that some shrimp experts should meet sometime during 1987 to analyze the West Greenland shrimp samples and that a working group on shrimp ageing should be convened at the June 1988 Meeting to consider these analyses and any other contributions on ageing of shrimp.

b) Canadian request for analysis of research activities

With regard to the Canadian request for analysis of research activities that would be required to allow estimation of total biomass in Subareas 0 and 1 and to advise on target levels for removals, the Council agreed that an extensive stratified-random trawl survey of all shrimp grounds in the entire region would be necessary. Such a survey could best be undertaken during June-July and would require approximately 50 days at sea.

II. OTHER MATTERS

1. *Question of Need for Future Special Meetings on Shrimp*

Some representatives doubted the need for continuation of a special meeting in January to assess the shrimp stock, because it has not been possible to provide realistic advice on the TAC due to the difficulties of interpreting the abundance indices from the commercial fishery and the photographic surveys and the absence of an adequate time series of trawl surveys. However, the Council was informed that the results of discussions at the January meeting form the basis for Greenland authorities to establish the TAC for the ensuing year. The Council agreed to discuss this matter further at its meeting in June 1987, when representatives from more Contracting Parties will be present.

III. ADJOURNMENT

On behalf of the Scientific Council, the Chairman expressed his gratitude to the Director and Staff of the Greenland Fisheries and Environmental Research Institute for the excellent meeting facilities and hospitable atmosphere. He also thanked the Chairman of STACFIS and all other participants for their cooperation and support during the course of the meeting and acknowledged the assistance of the NAFO Secretariat and those of the Institute Staff who assisted the Secretariat.

The meeting was adjourned at 1830 hr on 02 February 1987.

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

Chairman: W. R. Bowering Rapporteurs: Various

The Committee met at the Greenland Fisheries and Environmental Research Institute, Copenhagen, Denmark, during 28 January-02 February 1987 to review the status of the shrimp stocks in Subareas 0 and 1, as referred to it by the Scientific Council, based on the specific requests of Canada and Denmark (Greenland). Furthermore, the Committee addressed the addendum to the Canadian request concerning an analysis of research activities that are necessary to allow estimation of total biomass, distribution of biomass between the two subareas, and advice on target levels for removals. At the request of Denmark (Greenland), the Committee also reviewed the status of the shrimp stock in Denmark Strait. Scientists attended from Canada, Denmark (Greenland), EEC, Iceland and Norway.

I. ASSESSMENT OF SHRIMP STOCK IN SUBAREAS 0 AND 1

1. Fishery Trends (SCR Doc. 87/1, 8)

The nominal catch of shrimp in the offshore areas of Subareas 0 and 1 increased from less than 1,000 tons before 1972 to almost 43,000 tons in 1976, decreased to 27,000 tons in 1978 and 1979, and increased to about 38,000 tons annually in 1981-84 (Table 1). Preliminary statistics for 1985 and 1986 indicate total offshore catches of about 43,600 and 44,600 tons respectively in the region south of 71°N. In addition, the experimental fishery north of 71°N yielded about 4,300 and 11,000 tons in 1985 and 1986 respectively. This northern area is considered to be outside the fishing area for which TAC advice had been given previously. The West Greenland inshore fishery

Table 1. Nominal catches and TACs (metric tons) of shrimp (Pandalus borealis) in Subareas 0 and 1, 1977-86.

		1977	1978	1979	1980	1981	1982	1983	1984	1985[1]	1986[1]
SA 0	Canada	-	-	-	59	1,590	858	2,030	448	206	126
	Denmark	68	86	67	-	1,923	946	2,627	526	151	1,208
	Faroes	239	-	115	-	1,686	-	756	730	-	530
	France	-	21	7	-	-	-	-	436	-	-
	Greenland	-	-	149	815	85	8	-	2	2,696	1,131
	Norway	150	15	791	-	-	-	-	-	-	-
	Total	457	122	1,129	874	5,284	1,812	5,413	2,142	3,053	2,995
SA 1	Canada	-	-	245	590	-	-	-	-	-	-
	Denmark	5,842	3,382	1,327	872	995	959	451	397	426	572
	Faroes	12,612	8,070	6,867	3,554	1,234	530	1,583	360	581	481
	France	924	805	353	247	535	672	408	404	431	535
	Fed. Rep. of Germany	31	-	-	-	-	-	-	-	-	-
	Greenland (N of 71°N)	-	-	-	-	-	-	-	-	4,349	11,045
	Greenland (S of 71°N)(I)[2]	7,800	7,600	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
	Greenland (S of 71°N)(O)[2]	7,081	5,531	12,527	27,501	28,197	32,016	30,929	32,129	38,674	39,537
	Norway	7,353	8,959	4,639	3,014	1,055	838	483	451	453	464
	Total	41,643	34,347	33,458	43,278	39,516	42,515	41,354	41,241	52,414	60,134
	Offshore (S of 71°N)	33,843	26,747	25,958	35,778	32,016	35,015	33,854	33,741	40,565	41,589
SA 0+1	Offshore Catch (S of 71°N)	34,300	26,869	27,087	36,652	37,300	36,827	39,267	35,883	43,618	44,584
SA 0+1	Advised Offshore TAC	40,000	40,000	29,500	29,500	29,500	29,500	29,500	29,500	36,000	36,000
SA 0+1	Effective Offshore TAC	36,000	40,000	29,500	29,500	35,000[3]	34,800[3]	34,625[3]	34,925[3]	42,120[4]	42,120[4]

[1] Provisional data.
[2] I = Inshore; O = Offshore.
[3] Includes TAC of 5,000 tons in Subarea 0.
[4] Includes TAC of 6,120 tons in Subarea 0.

has been relatively stable with estimated catches of 7,000-8,000 tons annually since 1972 (except 10,000 tons in 1974).

The offshore fishery has been regulated by TAC since 1977. Advised TACs by the Scientific Council were 40,000 tons for 1977 and 1978, 29,500 tons annually for the 1979-84 period, and 36,000 tons for 1985 and 1986. Both effective TACs and nominal catches were below or at the advised TAC level in 1977-79, but they have since been substantially higher. Since 1981, Canada and the EEC (from 1986, the Greenland Home Rule Authorities) have set separate TACs for Subareas 0 and 1 respectively. The effective TAC for Subarea 0 was 5,000 tons annually during 1981-84 and 6,120 tons for 1985 and 1986, whereas effective TACs in Subarea 1 were in the range of 29,625-30,000 tons in 1981-84 and 36,000 tons in 1985 and 1986.

Ice conditions in the spring months of 1982, 1983 and 1984 severely hampered access to the main fishing grounds in Davis Strait, but the 1985 and 1986 situations were more similar to conditions in earlier years when fishing grounds in the southern part of Div. 1B were open to the fishery from the beginning of the year. Greenland vessels fished in Div. 1C and 1D and on the southern grounds in Div. 1B throughout the year both in 1985 and 1986, with more effort being expended in these areas than in earlier years. In 1986, the northern grounds in Div. 1B and the southern grounds in Div. 1A were fished throughout the year. Also, Greenland vessels fished in Div. 1A north of 70°52'N from June to November. The Norwegian fishery in 1986 occurred in Div. 1B and 1D compared to Div. 1C and 1D in 1985. Two French vessels fished in Davis Strait during 1986, one of which fished in Div. 1B in July and in Div. 1B and 1C in August. There was no information on the distribution of fishing effort by other countries in Subarea 1. In Subarea 0, Canadian, Danish, Faroese and Greenland vessels fished from June to November, mainly in the region of 58°-59°W and 67°-68°N, as in previous years.

In Subarea 1, a total of 52 vessels (>80 GRT) participated in the fishery in 1986, compared to 56, 48, 47 and 50 in 1982-85 respectively. The Greenland trial fishery north of 71°N took place from May to December, with 27 vessels (>80 GRT) participating. Information on the geographical distribution of this northern fishery in 1985 and 1986 was available from logbooks of these trawlers.

2. Input Data

a) Commercial fishery (SCR Doc. 87/1, 8)

i) Catch rates

Catch and effort data for the shrimp fishery in 1986 were available from Canadian observer reports for Subarea 0 and from French, Greenland and Norwegian logbook records for Subarea 1. Canadian observer reports showed an increase in catch rates in 1986 relative to 1985, with the June 1986 catch rate (682 kg/hr) being the highest ever

reported from the Canadian shrimp fishery in Div. 0A. The general increase in the catch rate for the July-September period was about 10% higher than for the same period in 1985. Norwegian logbook data showed an increase in mean catch rate for Div. 1D from 213 to 299 kg/hr for the May-July period. Mean catch rates for Div. 1B in May and June were also higher than in the corresponding months of 1982, 1983 and 1984. Logbook data from one French trawler which fished in Div. 1B in July and August and in Div. 1C in August showed a substantial increase in mean catch rate relative to earlier years. However, the rates are not directly comparable, because this trawler is larger than those from which the earlier data originated.

Logbook data from seven Greenland trawlers (630-722 GRT) showed increasing catch rates in Div. 1B from January to April. This was followed by a decline in May and an increase in July to almost the same level that was observed in April. Catch rates declined again from July to October, followed by an increase in November and December. Although the expected spring peak in catch rate was found in April, it was not followed by a decline throughout the year, as was the case in most years since the fishery started. STACFIS was not able to explain this difference in the yearly development of the catch rates, but it was noted that favourable ice conditions in 1985 and 1986 may have influenced the distribution of the fishery on the different components of the stock.

Mean catch-rate indices for the July-September period of 1976-86 for the 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. Generally, all indices declined by about the same proportion from 1976 to 1979 and fluctuated similarly from 1980 to 1984, except for the abnormally high 1981 value for the French fishery (no index available for 1983-85) and the stabilization of the Norwegian index for 1982 and 1983 (no index available for 1985-86). These exceptions, however, were based on relatively small catches. From 1984 to 1985, there was an increase in the Greenland index of about 12%, while the Canadian index showed a minor decrease. From 1985 to 1986, all available indices increased, the Greenland figure by about 11% and the Canadian figure by about 10%. The French figure increased by more

Table 2. CPUE indices (July-September) from Greenland, Norwegian and French fisheries for shrimp in Div. 1B and the Canadian fishery in Div. 0A, 1976-86.

	Div.	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Greenland	1B	1.00	0.74	0.67	0.51	0.63	0.59	0.74	0.66	0.67	0.76	0.84
Norway	1B	1.00	0.84	0.60	0.47	0.60	0.43	0.57[1]	0.56	0.61[1]	-	-
French[2]	1B	1.00	1.13	0.61	0.48	0.58	0.80	0.60	-	-	0.62	1.01
Canada[3]	0A	-	-	-	-	0.60	0.66	0.78	0.63	0.64	0.61	0.67

[1] July only.
[2] All French data are from July only except for 1985 (August only) and 1986 (July and August).
[3] Div. 0A (1980 is average of the other 3 indices).

than 60%, but this may at least be partly explained by the use of a larger vessel in 1986, as noted above.

Figure 1 shows a comparison between total offshore catches in Subareas 0 and 1 (excluding catches in the northern trial fishery) and the catch rates of the Greenland vessels in Div. 1B. As STACFIS has pointed out several times before, the introduction of more efficient gears around 1980 may have resulted in an upward bias of catch rates since then, but the effects have not been quantified. In the last 2 years, this bias may be even more pronounced as new high-opening trawls, with reportedly-higher catch rates, have been introduced, together with trawl-positioning systems that allow better checks of the performance of the gear. Furthermore, new net materials, with reduced water resistance, allows the use of larger trawls which are towed at higher speeds with the same engine power. Again, STACFIS was not able to quantify the effects of these improvements in fishing power but agreed that more efficient gears may partly explain the increase in mean catch rates and that the rates may not be directly comparable from year to year.

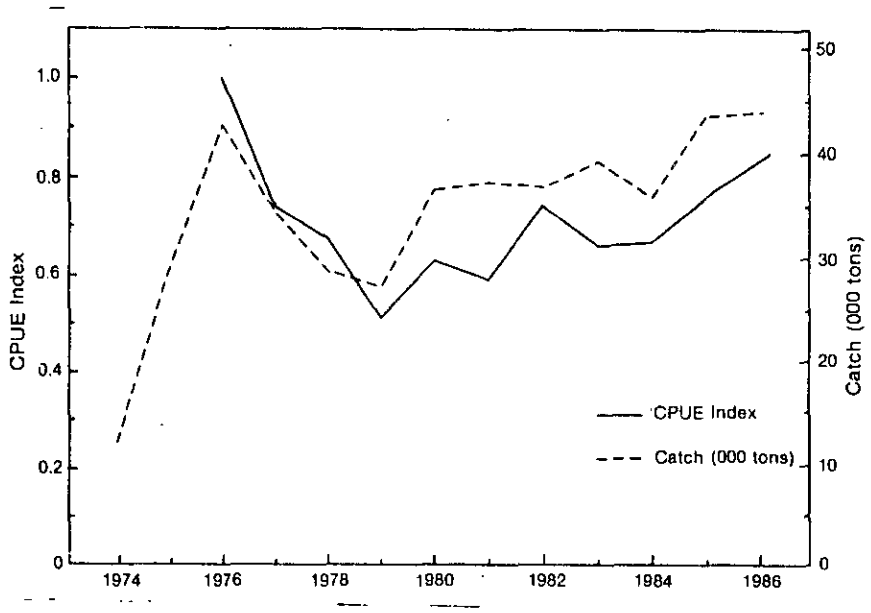

Fig. 1. Shrimp CPUE indices for the July-September period of 1976-86 in Div. 1B compared with total offshore catches in Subareas 0 and 1 excluding catches in the Greenland trial fishery. (Mean CPUE values are based on logbook records of seven trawlers of the Greenland Home Rule; catches for 1985 and 1986 are provisional.)

ii) Biological data

A times series of commercial samples from a Greenland trawler in August 1986 showed substantial changes in the proportions of the various sexual components over a 24-hour period. Such changes should be considered when determining the size composition of the commercial catches. The data also showed that the catches in August consisted primarily

of male shrimp around 21-22 mm CL (carapace length) and that primiparous females (spawning for the first time) were relatively scarcer than males and older (multiparous) females (SCR Doc. 87/8).

iii) Shrimp discards

The observed discarding of shrimp in Div. 0A during 1986 averaged 2.3%, which was lower than levels observed in previous years (SCR Doc. 87/1). No length frequencies were available to determine the size range of discarded shrimp.

iv) By-catches

Logbook records for eight Greenland trawlers showed a by-catch of 2.8% (by weight) of the shrimp catch in 1986, compared to 2.1% in 1985 and 1984 and about 1% in 1981-83. The dominant species in the by-catch was redfish (SCR Doc. 87/8). In the Canadian fishery in Div. 0A, the observed monthly by-catch ranged from 15-30% of the total catch, higher than in the previous year. Catch rates of redfish in 1986 were the highest observed over the 1980-86 period. As in previous years, the by-catch of Greenland sharks increased in October and November (SCR Doc. 87/1).

b) Research vessel surveys (SCR Doc. 87/5, 8)

i) Abundance estimates from photographic surveys

In 1986, the standard photographic survey was not carried out, but a special sampling survey to obtain information on diel variation in abundance was attempted. However, due to technical problems, no data were available from this survey. During the 1977-85 period, data from bottom photography were used for describing the distribution of shrimp off West Greenland in the region from 66°00'N to 69°30'N at depths between 100 and 600 m. From 1980, a regression model was used to investigate the dependence of shrimp abundance on various physical variables and to give an estimate of the total biomass in the area. During the years when this model was used, STACFIS expressed its concern about the apparently high variances involved in the data and thus their implications for the final calculation of the biomass estimates. STACFIS also noted that indications of variation in abundance of small shrimp from the photographic material have not been reflected in later variations in catch rates. Despite these concerns, STACFIS noted the continuing improvements in the model and expressed optimism on its continued use as an independent index of stock abundance.

STACFIS considered that, in view of the recent development in commercial trawling gear towards the use of high-opening trawls, the photographic data might represent only a very small proportion of the total shrimp stock, because the data includes only that part of the stock which is actually situated on the bottom. The problems are further complicated by diel variation in size composition of the shrimp in commercial catches (SCR Doc. 87/8), for which it has not been possible to adjust the photographic data in a

reliable way. Off-bottom photographic sampling was not considered to be a feasible technique for obtaining information on shrimp distribution.

Comparisons of data on abundance of the different size-groups from the photographic sampling and from biological trawl samples at approximately the same time and place (SCR Doc. 87/5) showed poor agreement between the two sets of data. It was noted that some reduction in variance from the photographic sampling might be achieved by increasing the number of sampling stations to obtain a better coverage of the different bottom types, and by adjusting the abundance estimates to account for diel migrations, if they can be determined quantitatively.

ii) Biological data

Research samples from the Greenland trawl survey showed modal size-groups of males around 12, 15, 18-19 and 21-22 mm CL (SCR Doc. 87/8). The group of 12-mm males was dominant in a sample from shallow water (190 m) on the western slope of Store Hellefiske Bank, indicating the possible existence of a specific nursery area.

Length frequencies from the Canadian fishery in Div. 0A showed that two size-groups dominated in the catches in all months. The modal group of males at 21-22 mm CL (similar to the Greenland data) might represent the 1981 year-class, and the larger mode at 25 mm CL (females) might represent primarily the 1980 and 1979 year-classes. Despite previous concerns over the possibility of a poor 1981 year-class, this presumed year-class was well represented in the 1986 fishery data.

Canadian research samples from Div. 0A were analyzed for age composition and showed that males formed a single mode which was presumed to be at age 5. Primiparous and multiparous females (possibly ages 6 and 7) had average lengths of 23 and 25 mm CL respectively, but the former comprised only 6% of the total sample, which is consistent with the Greenland data for Subarea 1. An additional modal group of females (27.5 mm CL) of uncertain age was also interpreted from the data.

3. Prognoses

Catch rates from the Canadian fishery in Div. 0A for the July-September period in 1986 were about 10% higher than in the previous year. Norwegian data showed that catch rates in Div. 1D from May to July increased from 213 kg/hr in 1985 to 299 kg/hr in 1986. Data from a French trawler showed higher catch rates for July and August in Div. 1B and 1C than in previous years, but it was noted that this trawler was larger than those used previously. The Greenland data also showed an increase in catch rate for the July-September period of about 10% from 1985 to 1986. The trend in the Greenland data was an overall increase from 1979 to 1986. It was noted that this trend may have resulted from the influence of improved trawl design since 1980 and unfavourable ice

conditions in the spring of 1982, 1983 and 1984. Although the effects of these factors cannot be estimated, it is possible that they could account for the observed increase.

In 1985, STACFIS recognized that, despite concerns about possible poor recruitment, catch rates in recent years had not declined (NAFO Sci. Coun. Rep., 1985, page 20). Also, because of the apparent stability of the stock, with higher-than-advised yields during the period of stability, STACFIS advised an overall TAC of 36,000 tons, which corresponded to the average catch during 1979-84. At the January 1986 Meeting, data from the commercial fishery and the photographic surveys indicated continued stability in abundance since 1982. Therefore, it was advised that the overall TAC in 1986 should not exceed 36,000 tons. Because similar data were not available at the present meeting from the Greenland survey in 1986 and because it could not be established whether the increasing trend in catch rates was due to technological effects or represented a real increase in the stock, STACFIS has no basis on which to advise a change in TAC, for the offshore grounds in Subarea 1 south of 71°N and the adjacent parts of Subarea 0, from the previously-advised level of 36,000 tons.

4. Greenland Shrimp Fishery North of 70°52.5'N (Div. 1A) (SCR Doc. 87/7)

The Greenland trial shrimp fishery north of 70°52.5'N in Div. 1A was initiated in 1985. At that time, this area was not considered to be a part of the commercial shrimp fishing areas for which TAC advice was given by STACFIS, and therefore it was not included in the quota regulation of the Greenland shrimp fishery in 1985. Nominal catches were 4,349 tons in 1985 and 11,045 tons in 1986. For 1987, the Greenland Home Rule Administration has proposed a preliminary TAC at 11,500 tons for the area north of latitude 71°00'N.

STACFIS evaluated the preliminary data and shrimp samples from Greenland trawlers which fished north of 71°N. After considering similar data from the West Greenland shrimp fishery south of 71°N, the Committee was unable to discern a significant difference between stocks from the two areas, although differences in mean size within the trial area were observed. Thus, the Committee was unable to decide whether the shrimp north of 71°N constitute a separate, self-sustaining stock or represent a northward extension of southern stocks or a combination of both.

It is possible that the stock depends on larval drift or movement of adult and juvenile shrimp from southern areas, in which case the stock may be able to sustain a continued fishery at a certain level. If, in fact, the stock is self-sustaining, a very cautious approach is recommended until further investigations have been made, because low temperatures in the area and the possibility of low reproductive potential are factors which may cause very slow renewal of the stock.

5. Future Research Requirements

Some of the recommendations from the January 1986 Meeting (NAFO Sci. Coun. Rep., 1986, page 16) have been addressed (e.g. sampling data were collected from the trial fishery north of 70°52.5'N,

and some effort was made to determine possible nursery grounds). STACFIS agreed that previous recommendations which were not addressed during 1986 should be reiterated. These are as follows:

i) Because recent developments in commercial fishing gear technology has reduced the value of catch rates as indices of abundance, STACFIS again recommends

that stratified-random trawl surveys be conducted for a number of years to determine changes in distribution and abundance.

ii) Because there was no evident expansion of the observer programs in 1986, STACFIS again recommends

that observer programs be continued and extended to cover a greater portion of the fleet with the main objectives to obtain sampling data on shrimp catches, by-catches and objective estimates of discard rates.

iii) Since no selectivity studies were carried out during 1986, STACFIS again recommends

that selectivity studies be conducted for shrimp in Davis Strait to determine optimal mesh size.

iv) Because a knowledge of the nursery areas and their extension is of utmost importance, STACFIS accordingly recommends

that research surveys be continued to determine the location of nursery grounds for shrimp in the Davis Strait.

v) Because CPUE data as indices of shrimp abundance have been more difficult to evaluate due to the introduction of more efficient trawls and the use of trawl-positioning equipment, STACFIS therefore recommends

that a study be undertaken to quantify the effects of new gear technology in the fishery.

II. ASSESSMENT OF SHRIMP STOCK IN DENMARK STRAIT

1. Fishery Trends (SCR Doc. 87/3, 4, 9)

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

Table 3. Nominal catches and TACs (tons) of shrimp (Pandalus borealis) in Denmark Strait, 1978-86.

Country	1978	1979	1980	1981	1982	1983	1984	1985[1]	1986[1]
Denmark	-	-	702	581	740	204	443	353	500
Faroe Islands	-	-	4,233	713	737	443	668	674	727
France	-	-	50	353	414	291	500	642	780
Greenland	-	-	200	1,004	1,115	1,467	2,250	2,596	5,781
Iceland	363	485	614	125	-	43	742	1,784	1,030
Norway	-	800	2,461	2,016	1,896	1,727	2,128	2,051	1,997
Total	363	1,285	8,260	4,792	4,902	4,175	6,731	8,100	10,815
Advised TAC	-	-	-	-	4,200	4,200	4,200	5,000	...
Effective TAC[2]	-	-	-	8,000	4,500	5,725	5,245	6,090	7,225

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

TAC of 6,090 tons for the Greenland side of the midline, whereas the Scientific Council advised an overall TAC of 5,000 tons; the reported catch was 7,500 tons. In 1986, Greenland authorities set a TAC of 7,225 tons for the Greenland side of the midline, whereas the Scientific Council proposed two scenarios, one of which implied at TAC of 6,000 tons for the area as a whole and the other indicating that this figure may be conservative; the reported total catch in 1986 was 10,815 tons.

In 1986, the shrimp fishery in Denmark Strait took place in the area of Strede Bank and Dohrn Bank as well as on the slopes of Storfjord Deep, with higher catch rates in more easterly areas than in 1985. Although ice conditions in 1985 allowed for a more widespread fishery than in earlier years, poor weather and ice conditions hampered the fishery in early 1986. The main fishing area in 1986 extended from 65°30'N to 67°N (about 30 nautical miles farther north than in 1985) and between 29°W and 31°W.

In 1983, the overall fishing period extended from March to November, with the main fishing period from March to June. In 1984, the fishing periods west and east of the Greenland-Iceland midline differed considerably. West of the midline, the fishing period extended mainly from January to May, ending in May when most national allocations had been taken, but Faroese vessels continued fishing in November and December. East of the midline, on the other hand, the fishing period extended from June to December, the main fishing period being September and October. In 1985, fishing took place throughout the year with a larger proportion of the catch being taken in the second half of the year than in 1984 and previous years.

A total of 41 vessels participated in the fishery in 1983 and 1984, and there were 47 vessels in 1985 (excluding Iceland vessels). In 1986, there were 59 vessels actively engaged in the fishery, with occasional fishing by Iceland vessels. However, the latter vessels fished more actively off northern Iceland, thereby reducing by 43% their activity on the eastern side of Dohrn Bank relative to 1985.

2. Input Data

a) Commercial fishery (SCR Doc. 87/3, 4, 9)

i) Catch rates

Monthly catch rates and corresponding fishing effort, based on logbook data for the French, Greenland, Iceland and Norwegian fisheries during 1981-86, are listed in Table 4. Catch rates were highest during March-April in 1981 and 1983 and during May in 1982. The catch rates for Greenland vessels in January 1984 were almost as large as the highest that have been observed in that month, but they then declined during February and March. This high January catch rate did not occur in 1985 or 1986, but the catch rates for the other months were similar to the respective rates in previous years, except for the October-December catch rates, which were the highest on record. However, these were based on a low level of catch. The catch rates for the French vessels were considerably higher in April and May of 1981 and 1984 than in the same months of 1982, 1983, 1985 and 1986, with the catch rates of 1985 being higher than the corresponding rates for 1982, 1983 and 1986. The catch rates for Norwegian vessels have shown little change from year to year since 1982, although a decreasing trend may be seen. The Iceland catch rates were stable in June from 1980 to 1983 (no fishing took place in 1982), declined in 1984, increased in 1985 and remained stable in 1986.

Ice conditions differed considerably from month to month throughout the years and thereby affected the distribution of the fishery, making the evaluation of CPUE data difficult. This difficulty was compounded by incomplete data on catch location and fishing effort for a substantial portion of the fleet. Having one series of catch rates that shows a decrease and three series that show little difference, and bearing in mind the difficulties with ice, gear improvements and lack of logbook information for many vessels, the Committee could not interpret the changes that have been observed in catch rates.

ii) Biological data

Data on the biology of shrimp in Denmark Strait were available from Greenland, Iceland and Norwegian trawlers in 1986. Data from Greenland trawlers in January and April did not show the pronounced changes in the proportions of the sexual stages over a 24-hour period that were evidenced in the West Greenland data. The samples showed the presence of both male and female shrimp in the catches, and the component of large females up to 35 mm CL was still present. Iceland data showed that 77-84% of the egg-bearing females in April and late May also had developing head roe, indicating that most females spawn annually, which is contrary to some previous findings. The deviation method was used in an attempt to detect strong year-classes from the historical length-frequency data, but

Table 4. Monthly catch rates (kg per hour trawling) and corresponding effort (hours trawling) from available logbooks of vessels involved in the shrimp fishery off East Greenland, 1981–86.

Year	Month	Greenland[1]		France		Norway		Iceland[2]	
		CPUE	Effort	CPUE	Effort	CPUE	Effort	CPUE	Effort
1981	Mar	–	–	–	–	364	137	–	–
	Apr	486	1,343	433	157	296	3,848	–	–
	May	263	914	261	522	161	4,057	–	–
	Jun	123	6	144	257	119	1,101	99	688
	Jul	–	–	–	–	–	–	78	603
	Aug	–	–	–	–	42	167	39	245
	Sep	–	–	–	–	46	65	–	–
1982	Mar	160	763	–	–	197	1,548	–	–
	Apr	195	1,570	216	331	171	4,450	–	–
	May	280	1,394	264	563	248	3,339	–	–
	Jun	–	–	185	238	–	–	–	–
1983	Mar	345	484	–	–	–	–	–	–
	Apr	160	457	165	248	128	2,734	–	–
	May	–	–	254	245	255	1,439	50	2
	Jun	–	–	162	206	143	1,797	99	52
	Jul	–	–	–	–	133	45	–	–
	Aug	–	–	–	–	98	622	–	–
	Sep	–	–	–	–	–	–	–	–
	Oct	–	–	–	–	–	–	172	80
	Nov	–	–	–	–	–	–	155	158
1984	Jan	600	105	–	–	–	–	–	–
	Feb	356	312	–	–	232	341	–	–
	Mar	224	281	316	132	224	2,777	–	–
	Apr	–	–	487	723	183	4,000	–	–
	May	–	–	304	349	167	2,994	–	–
	Jun	–	–	–	–	–	–	42	53
	Jul	–	–	–	–	–	–	69	655
	Aug	–	–	–	–	–	–	70	116
	Sep	–	–	–	–	–	–	99	1,546
	Oct	–	–	–	–	–	–	154	1,887
	Nov	–	–	–	–	–	–	74	2,391
	Dec	–	–	–	–	–	–	118	569
1985	Jan	311	647	–	–	–	–	–	–
	Feb	302	610	–	–	–	–	105	53
	Mar	271	697	–	–	181	3,094	13	7
	Apr	222	625	342	257	163	4,510	22	19
	May	–	–	299	402	128	1,386	70	2,256
	Jun	–	–	219	137	–	–	114	1,620
	Jul	–	–	–	–	–	–	100	3,066
	Aug	–	–	–	–	–	–	82	2,992
	Sep	–	–	–	–	–	–	88	3,337
	Oct	–	–	252	294	–	–	49	247
	Nov	–	–	243	37	–	–	55	317
1986	Jan	193	759	–	–	112	275	–	–
	Feb	212	1,314	–	–	141	1,465	–	–
	Mar	380	1,801	481	27	145	4,259	–	–
	Apr	236	725	251	558	125	3,976	21	24
	May	118	505	273	675	123	2,162	77	308
	Jun	–	–	165	121	–	–	101	30
	Jul	–	–	–	–	71	28	122	112
	Aug	–	–	–	–	131	797	94	2,904
	Sep	–	–	365	156	114	157	93	3,097
	Oct	–	–	333	327	–	–	83	1,551
	Nov	465	271	185	27	–	–	88	758
	Dec	766	113	–	–	–	–	258	81

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

year-classes were difficult to trace and growth difficult to interpret. Norwegian size compositions showed that catches were dominated by shrimp of about 29-30 mm CL, similar to the findings of previous years.

iii) Shrimp discards

Information from one Norwegian trawler indicated a discard rates from 0% to 1.6% by weight with an average of 0.9%. The discarded shrimp consisted mostly of broken shrimp of relatively large size.

iv) By-catches

Data on by-catches of fish in the shrimp fishery were reported for nine Greenland vessels (logbook information) and for one Norwegian vessel (observer report). The reported by-catches in the Greenland fishery decreased from 9.1% in 1984 to 0.2% in 1985 but increased to 0.5% in 1986. The observed number of fish per kilogram of shrimp in the Norwegian fishery increased from 0.13 in 1985 to 0.26 in 1986. The total by-catch was still low in 1986, the major component being small redfish.

b) Research vessel surveys (SCR Doc. 87/2)

The Norwegian research cruise to Denmark Strait in September 1986 provided additional information on the biology of this stock. The distribution of catches by sex was similar to that in 1985. Males were found in highest proportion in the western and northern parts of the region and in lowest numbers around 66°N and 30°W. For the surveyed area as a whole, males constituted about 41% of the shrimp by number in 1986 compared to 43% in 1985. Most of the females were ovigerous, few had head roe and 26% were without roe. The incidence of females without roe was highest in the north and lowest around Dohrn Bank. Shrimp sizes increased from north to south, with the smallest males being found mainly in the north.

The largest catches during the survey were taken northeastward of the main fishing grounds in the spring. Biomass calculations, using the swept-area method, gave an estimate of 49,000 tons for the investigated area. This represents an increase of 17,000 tons for similar coverage during the 1985 survey. Part of this increase may be due to increased experience in trawling, but the use of a low-rise trawl and making no allowance for diel variation in availability during day and night fishing would result in lower average catch rates and a possible downward bias in the biomass estimate. Nevertheless, a time series of survey data is needed before the estimates can be used as indices of abundance.

3. Environmental Considerations (SCR Doc. 87/6)

In accordance with previous recommendations of STACFIS (NAFO Sci. Coun. Rep., 1986, page 20), the Chairman of the Environmental Subcommittee (M. Stein) presented a paper on the variability of water masses, currents and ice in Denmark Strait. During discussion of the paper, it was considered that more emphasis should be given to the Storfjord Deep region where the shrimp occur.

The question whether the dynamic regime of the Irminger Current system is responsible for maintaining the stock in this area can only be answered if biological and oceanographic sampling is carried out regularly on a grid where the stations are no more than 10 nautical miles apart. The Subcommittee Chairman offered to undertake further evaluation of the Dohrn Bank data in the computer files of the Federal Republic of Germany with regard to the baroclinic aspect of the current field and to interannual changes. The results of this analysis will be presented at the next meeting of STACFIS when the shrimp stocks are reviewed.

4. Prognoses

At the January 1986 Meeting, two scenarios were presented on the interpretation of catch rates and the continued presence of large shrimp. The inclusion of the 1986 CPUE data, together with the discussion on ice conditions, gear improvements, etc., made it impossible to draw realistic conclusions from the catch rates. However, data from trawl surveys in 1985 and 1986 showed no change in the size compositions of catches and the relative proportions of males and females were also similar. In addition, the biomass estimates for 1986 were higher than for 1985, but this may have resulted from non-biological factors, as noted previously. The surveys were carried out in September when most of the annual catch had already been taken. Thus, it seems that the catches in recent years have had no impact on stock abundance. Because of uncertainties in the catch-rate data and the short time series of data from the trawl surveys, STACFIS was unable to advise on a TAC for 1987.

5. Future Research Requirements

Data on biological characteristics of shrimp in Denmark Strait were available in reports from Greenland, Iceland and Norway, but their usefulness in assessing the stock was limited by the lack of full geographical coverage on a year-round basis. STACFIS noted that Norway had again carried out a research survey in 1986 and provided a biomass estimate for the stock. Thus, while some of the recommendations from the January 1986 Meeting were addressed, others were not dealt with and it was agreed that these be reiterated. STACFIS therefore recommends

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

ii) that research vessel surveys in the area be continued and intensified; and

iii) that plankton surveys be carried out to observe the distribution of shrimp larvae.

STACFIS welcomed the paper on environmental conditions in Denmark Strait (SCR Doc. 87/6), but noted that no data were available in the main area of shrimp distribution. STACFIS therefore recommends

that environmental studies be undertaken in the area of Storfjord Deep.

III. OTHER MATTERS

1. Proposal for a Working Group on Ageing Shrimp

At its meeting in June 1986 (NAFO Sci. Coun. Rep., 1986, page 85), STACFIS agreed that planning

for a second workshop on ageing shrimp should be discussed at its midterm meeting to assess the shrimp stocks in early 1987. After discussion, it was concluded that some experts on shrimp should meet at some time during 1987 to analyze data from the West Greenland shrimp samples, and that the results of this analysis and other contributions should be presented to a working group of STACFIS during the June 1988 Meeting. Participants of the 1981 Workshop should be invited to attend and the experts should consider the possibility of inviting others who might have relevant information to present.

2. Response to Canadian Request for Analysis of Research Activities in Subareas 0 and 1

Canada requested the Scientific Council, when reviewing the status of the shrimp stock overlapping Subareas 0 and 1, at its meeting in January 1987, to prepare an analysis of research activities that are necessary to allow estimation of (i) total biomass, (ii) distribution of that biomass between the two subareas, and (iii) advice on target level for removals.

With regard to part (i) of the request, it was agreed that an extensive survey of the shrimp grounds should be carried out, which would include the area of the Greenland trial fishery north of 71°N, Disko Bay, the previously stratified areas from 66°N to 69°30'N and areas south between 62°N and 66°N. Although it is not certain whether the shrimp concentrations in all of these areas are part of the same stock, it was agreed that coverage should include all exploited offshore grounds so that the necessary sampling data can be collected to determine relationships between the various concentrations and to establish stock boundaries.

Details of the topography and area of these grounds were not available at this meeting. However, from previous stratification schemes, it was estimated that approximately 100 strata would provide sufficient coverage of the above-mentioned areas. Allowing for an average of four sets per stratum and eight sets per day, 50 sea days would be needed for the survey, which should be carried out during the June-July period to avoid problems with ice and poor weather and to sample the prespawning shrimp before sternal spines are lost. A large offshore stern trawler would be necessary to undertake the work, and the shrimp trawl should be the most recently developed high-lift type. The lastest technology in navigation and monitoring fishing performance would also be essential. Nine scientific staff would be needed to sort the catches, obtain samples and collect data for both shrimp and other by-catch species. Additional resources would be needed for analysis of the collected data.

It was noted that part (ii) of the request could be answered quite readily when the results from part (i) are available by simple calculations for each subarea. Advice on target levels for removals (part iii of the request) would not be forthcoming until several years of trawl survey data become available.

3. Acknowledgements

There being no further business, the Chairman thanked the participants for their interest and cooperation throughout the course of the meeting and expressed the Committee's appreciation to the Secretariat for assistance.

APPENDIX II. AGENDA FOR SPECIAL MEETING IN JANUARY 1987

I. Opening (Chairman: J. Messtorff)

1. Appointment of rapporteur

2. Adoption of agenda

3. Plan of work

II. Fishery Science (STACFIS Chairman: W. R. Bowering)

1. Assessment of Shrimp Stocks

a) Shrimp in Subareas 0 and 1 (Annexes 1 and 2)

i) Review of fishery trends
ii) Distribution and biology
iii) Catch and effort
iv) By-catches in shrimp fishery
v) Biomass estimates
vi) Total allowable catch
vii) Review of previous recommendations and future research needs

b) Shrimp in East Greenland (Annex 2)

[Items (i) to (vii) as in 1(a) above]

2. Other Matters

a) Planning for the second Shrimp Ageing Workshop (SCS Doc. 86/24, page 64)

b) Quantitative description of research needed to allow estimation and distribution of biomass in Subareas 0 and 1 and target levels of removals (Annex 3)

III. Other Scientific Matters

IV. Adjournment

ANNEX 1. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1987

OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1986 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1987:

Cod (Div. 2J, 3K and 3L; Div. 3Ps)
Greenland halibut (Subarea 2 and Div. 3K and 3L)
Roundnose grenadier (Subareas 2 and 3)
Silver hake (Div. 4V, 4W and 4X)

It is further suggested that, subject to the concurrence of Denmark (Greenland), the Scientific Council, prior to the 1986 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1987 of the following stocks:

Shrimp (Subareas 0 and 1)
Greenland halibut (Subareas 0 and 1)
Roundnose grenadier (Subareas 0 and 1)

2. Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for those stocks listed above:

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As a general reference point, the implications of continuing to fish of $F_{0.1}$ in 1987 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those expected at the $F_{0.1}$ level. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1987 and the long term.

b) For those stocks subject to general production-type assessments, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference point should be the level of fishing effort (F) which is two-thirds that calculated to be required to take the MSY catch in the long term.

c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence on stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stocks.

L. S. Parsons
Assistant Deputy Minister (Science)
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 2. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON

MANAGEMENT OF CERTAIN STOCKS IN 1987

1. Denmark, on behalf of Greenland, requests the Scientific Council of NAFO at its June 1986 Meeting to provide advice on the status of the stocks and on the scientific basis for management in 1987 and as many years onward as the data allow for the following stocks:

   a) Stocks occurring in Subarea 1

      i) Atlantic cod
      ii) Redfish (by species, if possible)
      iii) Wolffish (by species (spotted and striped), if possible)

   b) Stocks overlapping Subareas 0 and 1 (subject to the concurrence of Canada)

      i) Greenland halibut
      ii) Roundnose grenadier
      iii) Northern shrimp (Pandalus borealis)

2. In the analyses on which management advice will be based, the following should be included:

   a) For cod in Subarea 1, the current stock size and its composition and distribution should be analyzed and form the basis for management options in which catch and catch composition (by age-groups) and the resultant stock size and spawning stock size are to be given, with the examples of options:

      i) F = F(0.1) from 1987 onward
      ii) F = F(max) from 1987 onward
      iii) F = F(1985) from 1987 onward
      iv) A steady catch level from 1987 onward with the annual catch level equal to (1) the TAC for 1985, and (2) the catch for 1986 calculated by the above options for F(1987).

      The maximum potential for rebuilding the spawning stock (i.e. complete stop of cod-fishing) should also be analyzed up to and including the stock size by January 1989.

      A graph should be produced illustrating the resulting spawning stock by 1 January 1988 for any given catch level between zero and that for F(max), assuming that the catch level in 1986 is equal to the above-mentioned TAC for that year.

      The report of the ICES Working Group on Cod Stocks off East Greenland, January 1986, indicates that year-classes 1984 and 1985 may be better than other year-classes in the present stock. The size of these year-classes should, if possible, be quantified and their expected spatial distribution in 1987 and 1988 described. The expected length and weight distribution of the catches calculated for 1987 and 1988 in the above-given options should be given, if possible by gear types.

   b) For redfish and wolffish in Subarea 1, options for management should, if possible, be expressed graphically in terms of catches in 1987 and the stock and spawning stock biomass by 1 January 1988 for a range of F-values covering at least for the wolffish one-half to two times that in 1985 and for redfish one-half to four times that in 1985.

   c) For Greenland halibut and roundnose grenadier in Subareas 0+1, the guidelines provided above for wolffish in Subarea 1, supplemented by any other guidelines provided by Canada, should form the basis for analyses and advice.

   d) For northern shrimp in Subareas 0+1, advice is requested on stock size and management options. As previously, it is further requested, in the possible extent, to include into the advice a statement on size composition of the actual catch in relation to the supposed composition of the stock.

   e) Furthermore, we request a separate assessment of the shrimp stock north of 70°52.5'N on the northwest coast of Greenland (i.e. only in Subarea 1).

3. As in the past, advice on status of stock and management options for shrimp at East Greenland should also be provided in cooperation with ICES.

4. The Scientific Council should feel free to report on such other invertebrate and finfish stocks in Subarea 1 and on such other scientifically-management options for the above-mentioned Subarea 1 stocks as it feels applicable.

Einar Lemche
Greenland Home Rule Authorities
Nuuk, Greenland

ANNEX 3. ADDENDUM TO CANADIAN REQUEST FOR ADVICE ON SHRIMP STOCK IN SUBAREAS 0 AND 1

1. "Canada requests the Scientific Council, when reviewing the status of the shrimp stock overlapping Subareas 0 and 1, at its meeting in January 1987, to preapre an analysis of research activities necessary to allow estimation of (a) total biomass, (b) distribution of that biomass between the two subareas, and (c) advice on target levels for removals. This analysis should include quantitative description of the activities deemed necessary (e.g. ship time, number of stations, etc.) and commentary on the time periods over which such activities should be carried out." (It is our understanding that this request will also be submitted by Denmark on behalf of Greenland.)

2. With respect to the assessment of the shrimp stocks in Subareas 0 and 1, Canada requests the Scientific Council to use the same terms of reference as requested by Canada in the past several years.

L. S. Parsons
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APPENDIX III. LIST OF PARTICIPANTS

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APPENDIX IV. LIST OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS

SCR No.	Ser. No.	
87/01	N1269	PARSON, D. G., P. J. VEITCH, and V. L. MERCER. Research and commercial fishing for shrimp (Pandalus borealis) in Division 0A, 1986.
87/02	N1270	SMEDSTAD, O. M. Preliminary report of a cruise with M/T "Masi" to East Greenland in September 1986.
87/03	N1271	SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (Pandalus borealis) in East Greenland waters in 1986.
87/04	N1272	SKÚLADÓTTIR, U., and I. HALLGRIMSSON. The Icelandic shrimp (Pandalus borealis) fishery in Denmark Strait in 1986.
87/05	N1273	CARLSSON, D. M., and P. KANNEWORFF. Problems with bottom photography as a method for estimating biomass of shrimp (Pandalus borealis) off West Greenland.
87/06	N1274	STEIN, M. On the variability of water masses, currents and ice in Denmark Strait.
87/07	N1275	LUND, H. Trial fishery for shrimp (Pandalus borealis Kr.) in West Greenland waters north of 70°52.5'N in 1986.
87/08	N1276	CARLSSON, D. M., and P. KANNEWORFF. The shrimp fishery in NAFO Subarea 1 in 1985 and 1986.
87/09	N1277	CARLSSON, D. M., and P. KANNEWORFF. The commercial shrimp fishery of Denmark Strait in 1985 and 1986.

SUMMARY DOCUMENTS

87/01	N1278	NAFO. Provisional report of Scientific Council Meeting, January 1987.