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SCIENTIFIC COUNCIL MEETING - NOVEMBER 1998

Report of Scientific Council, 6-10 November 1998

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REPORT OF SCIENTIFIC COUNCIL
6-10 November 1998

Chairman: H. P. Cornus

Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at Greenland Home Rule Government, Denmark Office, Pilestræde 52, Copenhagen K, Denmark, during 6-10 November 1998. Representatives attended from Canada, Denmark (in respect of Greenland), Estonia, European Union, Iceland and United States of America. The Assistant Executive Secretary was in attendance.

The opening session was called to order on 6 November 1998 at 1020 hours.

The Chairman, H. P. Cornus (EU-Germany), welcomed representatives to this meeting of the Scientific Council to conduct assessments on shrimp in Subareas 0 and 1, and Denmark Strait. The Assistant Executive Secretary was appointed rapporteur.

The Provisional Agenda was considered. It was noted that informal discussions among NAFO and ICES experts immediately after this Scientific Council Meeting will consider general problems in relation to the Precautionary Approach for shrimp stocks. The Council also agreed to consider the progress on the Pandalid Symposium of September 1999, and the time and venue of the November 1999 Meeting for shrimp assessments. The Agenda, modified accordingly was adopted.

The Council noted that STACFIS would undertake the assessments of the stocks (see Appendix I) while the prognoses and advice would be undertaken by the Council.

The session was adjourned at 1120 hours.

The Council met as needed through 6-10 November 1998, and the concluding session was convened at 1000 hours on 10 November 1998. The Council addressed the requests of the Coastal States and considering the results of the assessments, provided advice and recommendations. The Council addressed 'Other Matters' in the agenda.

The Council then considered and adopted the STACFIS report, and considered its own report and adopted the report of the meeting of 6-10 November 1998.

The meeting was adjourned at 1620 hours on 10 November 1998.

Summary reports of the assessments and other matters considered by the Scientific Council are given below in Sections II-IV. The Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Participants of this meeting are given in Appendix II, III and IV, respectively.

II. FISHERY SCIENCE

The adopted Report of Standing Committee on Fishery Science (STACFIS) is given at Appendix I. The Council's summary sheets and conclusions on shrimp in Subareas 0+1 and shrimp in Denmark Strait are presented in Section IIIa and b, respectively, of this report. The recommendations with respect to stock advice appear therein.

The recommendations made by STACFIS for the work of the Scientific Council as endorsed by the Council, are as follows:

At this meeting STACFIS recommended that, for shrimp in Subareas 0 and 1:

- *sampling of the commercial fishery be further improved to cover all components of the fishery by area and month,*
- *an analysis of the distribution of the shrimp stock in relation to environmental conditions be conducted,*
- *survey results 1994-97 (both biomass estimates and size composition data) be standardized to make them comparable to results from the other years,*
- *survey strategy and design be further optimized, and a study on the impact of the duration of trawl hauls on biomass estimates be undertaken, and*
- *an analysis of the abundance and spatial distribution over time of all by-catch species in trawl surveys be undertaken.*

At this meeting STACFIS recommended that, for shrimp in Denmark Strait:

- *a survey be conducted, to provide fishery independent data of the stock throughout its range,*
- *all available oceanographic data regarding the area be compiled for further investigation of the warming in northern Denmark Strait beginning in 1993,*
- *commercial catch sampling of the fishery be improved to fully cover seasonal and spatial variation , so that size and sex composition of the catch can be accurately described,*
- *methods for presenting length-at-age and length-at-sex reversal be coordinated, and*
- *all available logbook data be analyzed for trends in CPUE (both standardized and unstandardized).*

III. FORMULATION OF ADVICE

The Council reviewed the STACFIS assessments of shrimp in Subareas 0 and 1, and Denmark Strait and the agreed summaries are as follows:

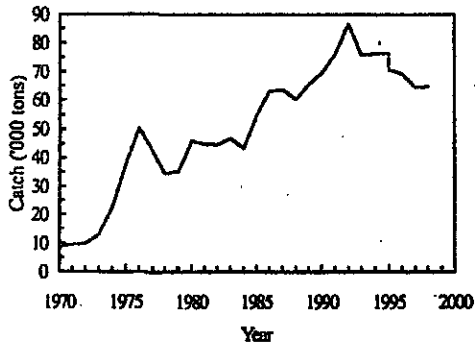
Shrimp (*Pandalus borealis*) in Subareas 0 and 1

Background: A small scale inshore fishery began in SA 1 during the 1930s. Since 1969 an offshore fishery has developed and the shrimp fishery is now the most important in Davis Strait.

Fishery and catches: The fishery is conducted mainly by Greenland and Canada. Recent catches from the stock are as follows:

Year	Catch ('000 tons)			TAC ('000 tons)
	Inshore	Offshore	Total	Recommended
1991	16.3	59.6	75.9	50.0 ¹
1992	20.6	66.2	86.8	50.0 ¹
1993	17.9	57.8	75.7	50.0 ¹
1994 ²	18.1	58.5	76.6	50.0 ¹
1995 ²	16.4	54.3	70.7	60.0
1996 ²	17.4	51.9	69.2	60.0
1997 ²	13.5	51.0	64.5	60.0
1998 ^{2,3}				55.0

¹ Only offshore.
² Provisional.
³ Projected total catch for 1998 is 65 000 tons.

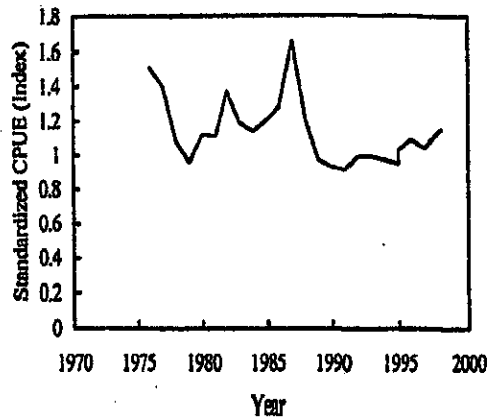


Data: Catch, effort and biological sampling data were available from the offshore fishery, and catch and effort data from the inshore fleet. Time series of biomass indices, and size and sex composition data were available from research surveys from both offshore and inshore areas.

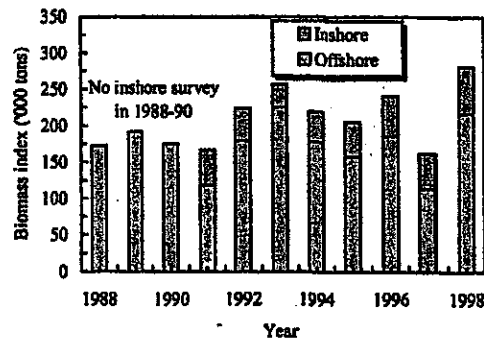
Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of the status of the stock is based on interpretation of commercial fishery data (catch, effort and standardized catch rates), time series of research biomass indices and biological data.

CPUE: A new combined standardized catch-rate index including all size groups of shrimp in the catch in the period 1976-98, indicate a stable or slightly increasing trend in the 1990s. The projected 1998 value is the highest value in the 1990s.

Recruitment: The 1998 survey shows an abundant year class of large males at 20 mm CL. Abundance of the female stock component appears stable in recent years. The males, which comprised the 20 mm group CL in 1998 are expected to contribute to the female biomass over the next two years.



Biomass: Given the range of variability exhibited in the survey indices, there appears to be no indication of a significant change in total stock biomass in the offshore area since 1988 and in the inshore area since 1991.



State of the Stock: The perception of the status of the stock is more optimistic than in 1997. Based on the available commercial and survey data on CPUE and recruitment, the stock appears to have remained stable or has possibly increased slightly in recent years.

Recommendation: Catches in 1997 and projected catches in 1998 average about 65 000 tons. Given the uncertainty of the absolute size of incoming recruitment, Scientific Council recommend that catches of shrimp in Subareas 0 and 1 in 1999 should not exceed this average.

Special Comments: There is now a change of the perception of the state of the stock. The CPUE index, previously believed to be declining, is now thought to be at least stable or increasing slightly. Given the range of variability survey biomass estimates there appears to be no evidence of a decline in biomass in recent years.

Sources of Information: SCR Doc. 98/111, 113, 114, 115, 116, 118, 119, 123.

Shrimp (Pandalus borealis) in Denmark Strait

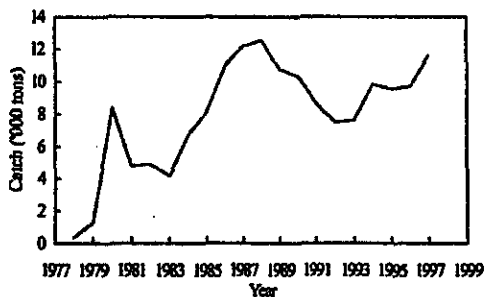
Background: The fishery for shrimp started in areas north of 65°N in Denmark Strait in 1978. The fishery started exploiting new areas south of 65°N after 1992.

Fishery and Catches: This fishery soon became a multinational fishery with recent catches and TACs as follows:

Year	Catch ('000 tons)	TAC ('000 tons)	
		Agreed ²	Recommended
1992	7.5	13.0	8
1993	7.6	9.6	5
1994 ¹	9.8	9.6	5
1995 ¹	9.5	9.6	5
1996 ¹	9.6	9.6	5
1997 ¹	11.6	9.6	5
1998 ¹ (to 1 Oct)	6.6	9.6	5

¹ Provisional.

² Only for Greenland EEZ



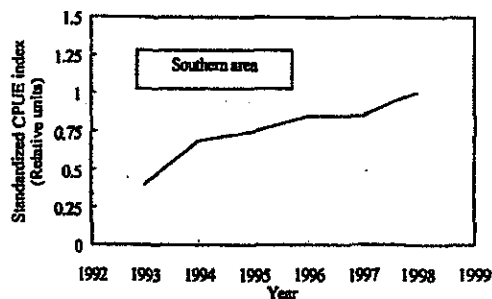
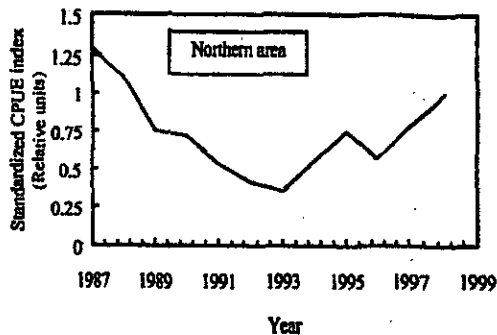
Data: Catch, effort and biological sampling data were available from the trawlers of several nations. No survey data were available in 1997 and 1998.

Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of the status of the stock is based on interpretation of commercial fishery data and biological data.

CPUE: In the northern area the standardized CPUE indices are now higher than the minimum values reached in 1989-93 approaching the level observed during the mid-1980s. Catch rates in the southern areas have increased since 1993.

Recruitment: Based on the available data there were no immediate concerns about recruitment.

Biomass: No direct biomass estimates were available.



State of the Stock: Standardized CPUE data from both the northern and the southern areas indicate a general increasing trend in fishable biomass since 1993. Several year-classes of male and female shrimp are evident in the sampling data in recent years.

Recommendation: Average catches for the years 1993 to 1997, a period coinciding with increasing catch-rates, were 9 600 tons. Scientific Council recommends that catches of shrimp in Denmark Strait in 1999 should not exceed this average.

Special Comments: The perception of the stock is now more optimistic than in the recent years. Scientific Council notes, however, that uncertainty on stock structure and lack of surveys in 1997 and 1998 make assessment of this stock difficult.

Sources of Information: SCR Doc. 98/112, 117, 120, 121, 122, 124.

IV. OTHER MATTERS

1. Progress Report of 1999 Symposium

The Council was presented with a brief report on the progress made in preparation for the Symposium on "Pandalid Shrimp Fisheries - Science and Management at the Millennium" of September 1999. The Council was informed that the co-convenor P. A. Koeller (Canada) had been in consultation with the other co-convenors and that plans for the joint NAFO, ICES and PICES Symposium were progressing well.

The co-convenors were currently polling scientists in their respective organizations to submit papers, and also provide ideas on the present program. Scientific Council members at this meeting were requested to indicate who would be submitting papers.

The Council extended its appreciation to the co-convenor P. A. Koeller (Canada), for his continued work in inviting speakers and structuring the Symposium, and wished him well in developing a successful Symposium.

2. Meeting of November 1999

Council considered the possible timing and venue of the next shrimp assessment meeting in November 1999. Noting the meeting will also include the assessment of shrimp in Div. 3M (see Scientific Council 6-18 September 1998 Meeting Report), the Council expects participation by additional experts. In this regard it was agreed that experts from ICES may be in a position to participate and provide valuable input to the assessments. The Council requested its members to look into possibilities of such participation.

The Council considered the possible participants, and the relative convenience and cost of traveling with respect to selecting the meeting venue, and Iceland was proposed. The Council requested the representative from Iceland to look into the possibility, and looks forward to hearing back from the representative.

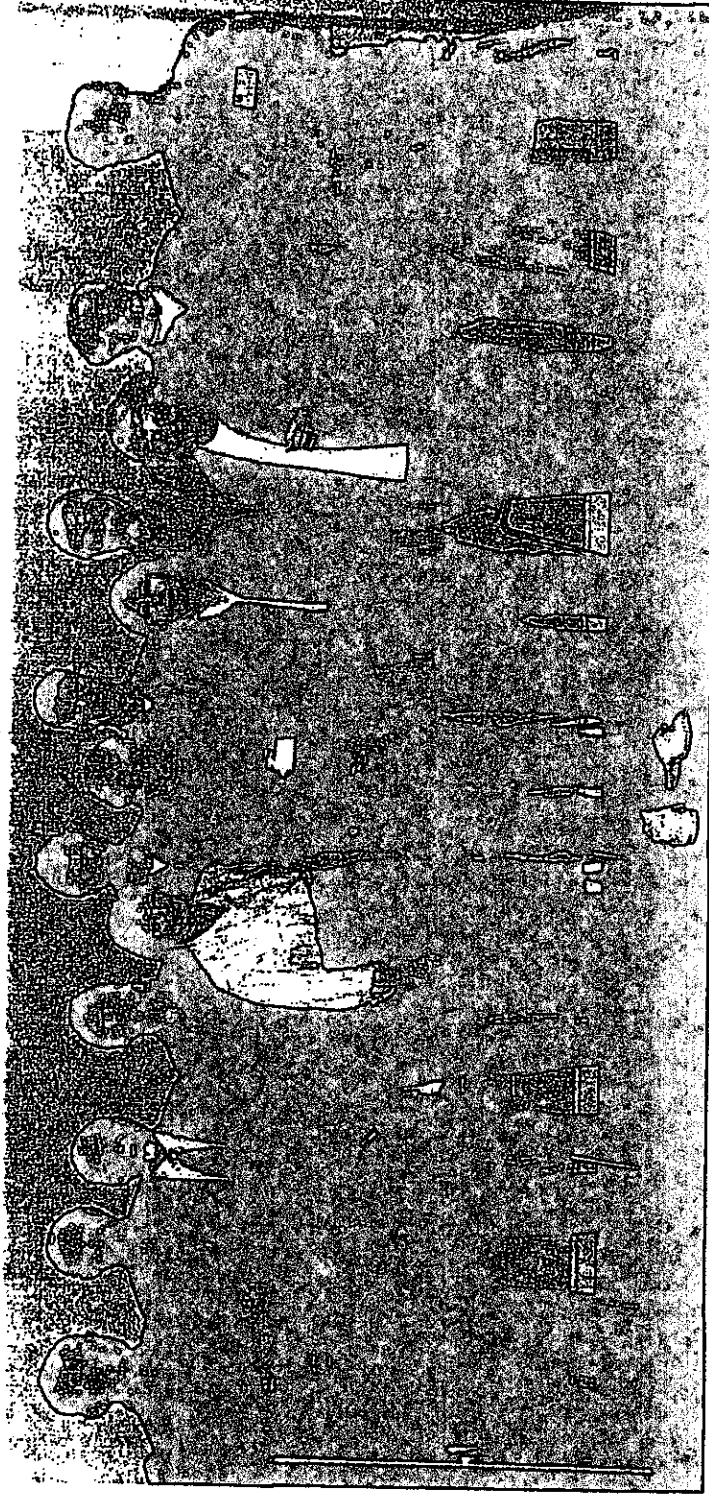
It was agreed the next meeting would require an additional 2 days for the assessment of shrimp in Div. 3M, and accordingly scheduled the meeting for 11 to 17 November 1999 (which includes Saturday, 13 November 1999 as a working day).

V. ADJOURNMENT

There being no further business, the Chairman expressed his sincere thanks to all participants for their cooperation and hard work done during the meeting. He especially thanked the Designated Experts and the STACFIS Chairman who had to contribute the most. He extended his thanks to the Secretariat and the Greenland Institute for providing excellent meeting facilities and hospitality.

He noted that this was the second time he chaired the November Meeting and his term would be finished before the November 1999 Meeting when a new Chairman takes over. He stated that he especially enjoyed chairing these meetings which provide advice on shrimp. He wished everyone a safe journey home and adjourned the meeting.

Participants of Scientific Council Meeting, 6-10 November 1998, Copenhagen, Denmark



Left to Right: D. M. Carlsson, P. Kannenworff, T. Amartunga, H. Siegstad, U. Skrifladottir, C. Hvingel, R. Mayo, O. Folmer, L. Savard, H.-P. Cornus, D. C. A. Auby, D. G. Parsons, M. C. S. Kingsley.

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

Chairman: R. K. Mayo

Rapporteur: Various

The Committee met at Greenland Home Rule Government, Denmark Office, Pilestræde 52, Copenhagen K, Denmark, at various times during 6-10 November 1998 to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on shrimp stocks in Subareas 0 and 1 and Denmark Strait. Representatives attended from Canada, Denmark (in respect of Greenland), Estonia, European Union, Iceland and United States of America. The Assistant Executive Secretary was in attendance.

I. STOCK ASSESSMENTS

1. Shrimp (*Pandalus borealis*) in Subareas 0 and 1 (SCR Doc. 98/111, 113, 114, 115, 116, 118, 119, 123)

a) Introduction

The shrimp stock off West Greenland is distributed in NAFO Div. 0A and Subarea 1 and the entire shrimp stock is assessed as a single population. The Greenland fishery exploits the stock in Subarea 1 (Div. 1A to 1F) in offshore and inshore areas (primarily Disko Bay). The Canadian fishery has been restricted to Div. 0A since 1981.

Two offshore fleet components, one from Canada and one from Greenland participated in the fishery. The offshore fleet has been restricted by areas and quotas since 1977. An inshore small-vessel Greenland fleet was unrestricted until January 1997, when quota regulation was imposed. The Canadian fishery in Div. 0A is regulated by a quota based on 17% of the advised TAC for the offshore area.

Overall catches increased until 1992, then decreased from 1993 to 1997. Catches in 1998 are projected to the same level as in 1997 (Fig. 1.1). Recent nominal catches and advised TAC (tons) for shrimp in Div. 0A and Subarea 1 are as follows:

	1988	1989	1990	1991	1992	1993	1994 ¹	1995 ¹	1996 ¹	1997 ¹	1998 ^{1,2}
Div. 0A Total	5 881	7 235	6 177	6 788	7 493	5 451	4 766	2 361	2 623	517	875
SA 1 Offshore	44 159	45 198	49 478	52 834	58 664	52 420	53 693	51 900	49 251	50 496	48 960
SA 1 Inshore	10 233	13 224	13 630	16 258	20 594	17 916	18 118	16 429	17 359	13 504	15 040
SA 1 Total	54 392	58 422	63 184	69 092	79 258	70 336	71 811	68 329	66 610	64 000	64 000
SA 0+1 Total	60 273	65 657	69 361	75 880	86 751	75 787	76 577	70 690	69 233	64 517	64 875
0+1 offshore catch	50 040	52 433	55 731	59 662	66 157	57 871	58 459	54 261	51 874	51 013	49 835
0+1 recomm. TAC	36 000	44 000	50 000	50 000	50 000	50 000	50 000	60 000	60 000	60 000	55 000

¹ Provisional data (STACFIC estimates from 1994-98).

² Projected to end of 1998.

³ Until 1994 the advised TAC was only for offshore south of 71°N. After 1994, the advised TAC includes offshore north of 71°N and inshore.

The nominal catch of shrimp in the offshore areas of Subarea 1 and the adjacent part of Subarea 0 (Div. 0A) increased from less than 1 000 tons before 1972 to almost 43 000 tons in 1976. Catches fluctuated thereafter and stabilised around a level of 54 000 tons during 1985-88, then increased to 66 000 tons in 1992 and decreased thereafter to 51 000 tons in 1997. Total catch in the offshore areas for 1998 is projected to be at the 1997 level. The Canadian fishery in Div. 0A amounted to about 2 500 tons in 1995 and 1996, declined to 500 tons in 1997 and 875 tons has been reported up to October 1998.

Historically, the fishing grounds in Div. 1B have been the most important. Since 1989, a gradual southward shift in the offshore fishery has taken place, and since 1990 catches in Div. 1C and 1D have exceeded those from Div. 1B. At the end of the 1980s, exploitation began in Div. 1E and 1F, and catches from these areas now account for about 20% of the total catch. The distribution of the fishery has not changed since 1996.

The West Greenland inshore shrimp fishery was relatively stable from 1972 to 1987 with estimated catches of 7 000-8 000 tons annually (except for 10 000 tons in 1974). Inshore catches in recent years have increased to over 20 500 tons in 1992, but decreased to 13 500 tons in 1997. During the 1990s inshore catches have accounted for about 25% of the total catch in Subarea 1. Preliminary data for 1998 (January-October) indicate inshore catches at the same level as in 1997.

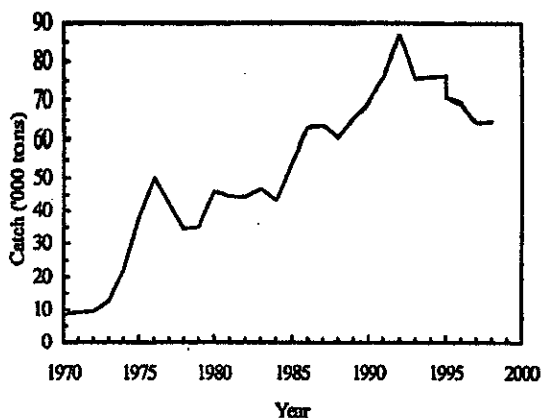


Fig. 1.1. Shrimp in Subareas 0 and 1: total catches (1998 projected to the end of the year).

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Catch and effort data from the shrimp fishery in 1998 were available from fishing records from Canadian vessels in Div. 0A and from Greenland logbooks for Subarea 1 (SCR Doc. 98/111, 123).

Two standardized CPUE indices (Fig. 1.2) were presented (SCR Doc. 98/111,113). The standardized CPUE series (Std. A) including mainly female shrimp in the 1990s showed a declining trend in that period. The new index (Std. B) represented the CPUE series of total catch and showed a stable or slightly increasing trend in the same period. The projected 1998 value is the highest in the 1990s. This discrepancy in the two CPUE series stems from the fact they largely represent two different size components of the stock. The divergence of the two CPUE trajectories therefore suggests that the biomass or the availability of shrimp larger than 8.5 g have been reduced throughout the 1990s fishery.

Although CPUE information including mainly female shrimp had been used previously as an indicator of stock size to avoid the influence of unreported discards, STACFIS agreed that CPUE information of total catch most likely reflects the overall trend in the fishable stock biomass of shrimp in Subareas 0 and 1.

Based on the new standardized CPUE index, a new standardized effort series was calculated (Fig. 1.3). Up to 1986, the new standardized effort showed a slight increasing trend. Effort more than doubled between 1987 and 1992, and decreased thereafter. Twin trawls introduced in 1995 on several Greenland trawlers have been omitted from the analyses of effort data.

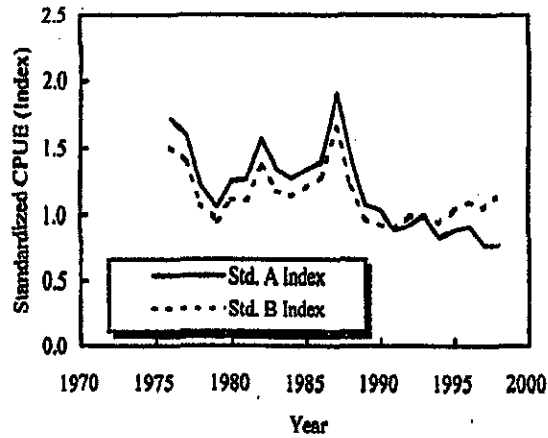


Fig. 1.2. Shrimp in Subareas 0 and 1: standardized CPUE index for female shrimp (Std. A) and for total catch (Std. B).

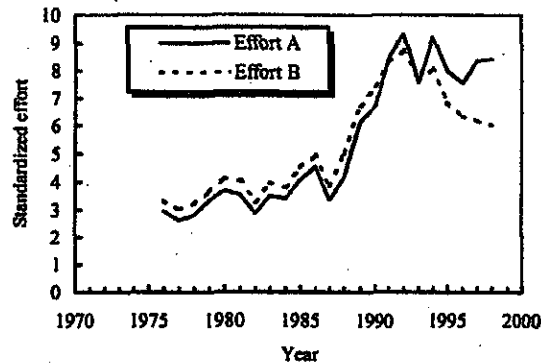


Fig. 1.3. Shrimp in Subareas 0 and 1: standardized effort index for female shrimp (Effort A) and for total catch (Effort B).

Length and age composition. Catch-at-length was calculated from length frequency data obtained by observers in the commercial fishery in Div. 0A from 1996 to 1998, and in Subarea 1 from 1991 to 1998 (SCR Doc. 98/111, 123). The proportion of female shrimp in the samples from the fishery has declined gradually since 1981. Also calculated mean shrimp size in catches has declined since 1991 corresponding to a mean individual reduction in weight of about 20%.

ii) **Research survey data**

Greenland trawl survey. Stratified-random trawl surveys have been conducted since 1988 in offshore areas (Subarea 1 and Div. 0A) and since 1991 in inshore Subarea 1 (SCR Doc. 98/115, 118). Since 1992, the survey has extended further south in Div. 1F compared to the coverage from 1988 to 1991. In 1994-97 the survey has been carried out as a two-phase survey allocating extra hauls to strata with high shrimp densities to reduce the variance of the biomass estimates.

In 1998, the survey was again carried out as a single-phase survey in agreement with results from a study group on evaluation of the design and efficiency of the survey (SCR Doc. 98/114). Also, following the recommendations from the study group, sampling effort was reduced in strata with shallow water (150-200 m) and increased in strata with deeper water. Further, tow duration was reduced from 60 minutes to 30 minutes in 25% of the hauls in certain strata.

Using the new interpretation, the stock composition data from the 1998 survey indicate the occurrence of a dominating size group of males at 17 mm in 1997 and at 20 mm in 1998. The female component is larger than in 1997 and of the same magnitude as in 1995 and 1996.

iii) Other studies

Evaluations of trawl survey (SCR Doc. 98/114). A study group was formed in 1998 to evaluate the design and efficiency of the survey. The group assessed the precision of the survey estimates, the effectiveness of the present stratification, the allocation of effort within the survey area, the appropriate tow duration and the suitability of two-stage sampling. The study group also recommended on future survey design and analysis. Following these recommendations the 1998 survey has reduced the tow duration to 30 minutes from the formerly used 60 minutes in about 25% of the offshore hauls in depths between 200 and 400 meters and the two-phase survey design used from 1994 to 1997 was discontinued.

Experimental survey (SCR Doc. 98/119). An experimental bottom-trawl survey for shrimp was carried out in 1997 to examine small-scale spatial structure of shrimp and fish population densities. This study showed that day-to-day variation was small, and there was a good correlation between days for all species, both overall and within transects. There was no serial correlation in catches along isobathic transects.

Production model (SCR Doc. 98/116). A logistic model of biomass dynamics was fitted to data on catch, standardized CPUE, and research survey biomass. The reliability of the conclusions was investigated by standard jackknife, omitting one year at a time from all the series of raw data. For most of the jackknife results F_{MSY} was estimated consistently, both MSY and B_{MSY} both ranged over a factor of about 170%. STACFIS concluded that further investigation of the behaviour of the model is required before it can be used as an assessment tool.

c) Assessment Results

CPUE. A new combined standardized catch-rates index including all size groups of shrimp in the catch in the period 1976-98, indicates a stable or slightly increasing trend in the 1990s. The projected 1998 value is the highest value in the 1990s.

Recruitment. The 1998 survey shows an abundant year-class of large males at 20 mm CL. Abundance of the female stock component appears stable in recent years. The males, which comprises the 20 mm CL group in 1998, are expected to contribute to the female biomass over the next two years.

Biomass. Given the range of variability exhibited in the survey indices, there appears to be no indication of a significant change in total stock biomass in the offshore area since 1988 and in the inshore area since 1991.

State of the Stock. The perception of the status of the stock is more optimistic than in 1997. Based on the available commercial and survey data on CPUE and recruitment, the stock appears to have remained stable or has possibly increased slightly in recent years.

d) Research Recommendations

For shrimp in Div. 0A and Subarea 1, STACFIS recommended that:

- *sampling of the commercial fishery be further improved to cover all components of the fishery by area and month,*
- *an analysis of the distribution of the shrimp stock in relation to environmental conditions be conducted,*
- *survey results 1994-97 (both biomass estimates and size composition data) be standardized to make them comparable to results from the other years.*

The estimates of trawlable biomass ('000 tons) are as follows:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Offshore (Div. 1A-1E, 0A)	172	192	175	119	179	225	178	158	186	113	217
Inshore (Div. 1A)	-	-	-	48	45	32	41	46	57	54	64
Offshore Div. 1F	-	-	-	-	1	20	24	2	4	26	23
Total	172	192	175	167	225	277	243	207	245	188	304

Biomass. In the offshore areas survey biomass estimates (Fig. 1.4) have fluctuated over the time series (SCR Doc. 98/118). The estimated biomass for 1998 was the largest in the time series. However, given the uncertainty of the 1998 estimate and the difference in conditions under which the 1994-97 surveys and the 1998 survey were conducted, STACFIS was unable to evaluate the significance of the apparent increase in the 1998 estimated biomass, until the 1994-97 survey results are re-analyzed.

The estimated biomass inshore for the period of surveys 1991-98 has exhibited a good stability with only minor fluctuations (Fig. 1.4). The estimate for 1998 is the largest in the time series (SCR Doc. 98/115) and results from the entire series is based on a consistent survey design.

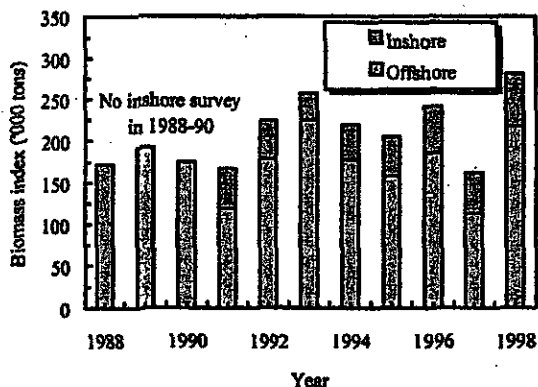


Fig. 1.4. Shrimp in Subareas 0 and 1: Combined biomass estimate from inshore and offshore surveys.

Demographic structure offshore. Overall length distribution and results from modal analysis of shrimp in the 1998 survey area show occurrence of a very abundant year-class of large males at 20 mm CL. Also, abundance of the female stock component appears high. Because the biomass estimate in the offshore area is not comparable between 1998 and 1994-97 abundance-at-age is not reported.

Demographic structure inshore. Survey samples from the Disko area from 1995 to 1998 were reanalysed by modal analysis, and a new age-at-length structure has been derived (SCR Doc. 98/104). The new interpretation indicated occurrence of only five year-classes of males or one year-class less than in the former interpretation.

- survey strategy and design be further optimized, and a study on the impact of the duration of trawl hauls on biomass estimates be undertaken, and
- an analysis of the abundance and spatial distribution over time of all by-catch species in trawl surveys be undertaken.

2. Shrimp (*Pandalus borealis*) in Denmark Strait (SCR Doc. 98/112, 117, 120, 121, 122, 124)

a) Introduction

The fishery started in 1978 and, up to 1993, occurred primarily in the area of Stredbank and Dohrbank as well as on the slopes of Storfjord Deep. However, since 1993 a fishery has also been conducted south of 65°N. The traditional northern area extends from approximately 65°N to 67°30'N and between 26°W and 34°W. The available fishing grounds at any given time depend heavily on the ice conditions.

Catches increased rapidly to about 12 000 tons in 1987 and 1988, declined thereafter to about 7 500 tons in 1992 and 1993 and increased again to about 12 000 tons in 1997. Since 1993 the nominal catches from the southern area have ranged from 1 500 tons to over 7 000 tons in 1997. The development of nominal catches (tons) are given in the following table and Fig. 2.1.

	1988	1989	1990	1991	1992	1993	1994 ¹	1995 ¹	1996 ¹	1997 ¹	1998 ^{1,2}
Nominal catches north of 65°N											
Iceland EEZ	1 431	1 326	281	465	1 750	2 553	1 514	1 151	566	2 856	1 403
Greenland EEZ	11 125	9 416	9 994	8 192	5 764	3 563	3 359	4 823	2 351	1 301	2 500
Sub-total	12 556	10 742	10 275	8 657	7 514	6 116	4 873	5 974	2 917	4 157	3 903
Nominal catches south of 65°N											
Greenland EEZ	-	-	-	-	-	1 532	4 939	3 532	6 796	7 442	2 722
Total	12 556	10 742	10 275	8 657	7 514	7 648	9 812	9 506	9 713	11 599	6 625
Recommended TAC		- 10 000	10 000	10 000	8 000	5 000	5 000	5 000	5 000	5 000	5 000

¹ Provisional catches as estimated by STACFIS.

² January-1 October.

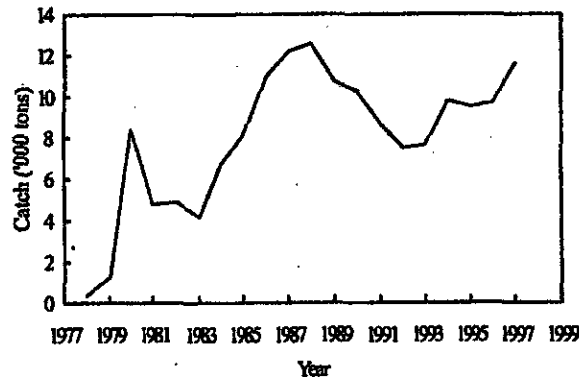


Fig. 2.1. Shrimp in Denmark Strait: nominal catches.

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Catch and effort (hours fished) from logbooks were available from Greenland, Norway, Iceland, Faroe Islands and EU-Denmark since 1980 and from EU-France for the years 1980 to 1991.

In the northern area, between 1980 and 1989, total unstandardized effort increased from about 35 000 hours to more than 100 000 hours, declining thereafter to about 23 700-47 800 hours in 1994-97. In the southern area, effort increased from 12 100 hours in 1993 to 26 600 in 1997. For the whole area effort has declined from 80 000 hours in 1993 to 50 300 in 1997.

Standardized catch-rates for Greenlandic vessels in the northern area (Fig. 2.2) showed a continuous decline from 1987 to 1993 (SCR Doc. 98/112), but there has been a general increasing trend since 1993. The standardized catch-rate series for the Greenlandic vessels in the southern area showed the same trend (Fig. 2.3).

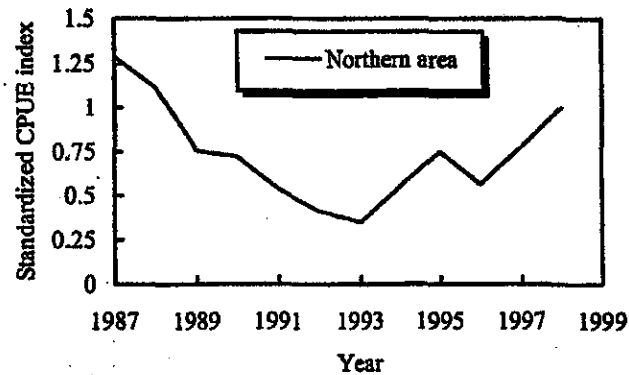


Fig. 2.2. Shrimp in Denmark Strait: annual standardized CPUE-indices (relative units) calculated for shrimp caught by Greenlandic vessels in the area north of 65°N.

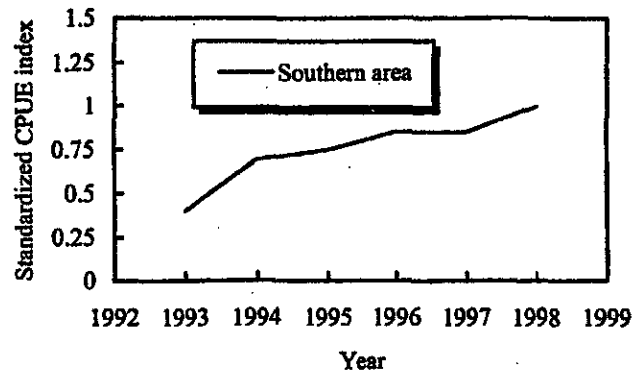


Fig. 2.3. Shrimp in Denmark Strait: annual standardized CPUE-indices (relative units) calculated for shrimp caught by Greenlandic vessels in the area south of 65°N.

In general the unstandardized catch-rates which include all fleets show trends similar to the standardized series.

Biological data. Commercial sampling of this fishery has generally been at a very low level but has however greatly improved in 1998. Samples from the Greenlandic and Icelandic fisheries in the late-1980s indicate that the catches were comprised mainly of females. Throughout most of the 1990s, males have dominated the catches in the north although there are indications of higher proportions of females in 1997 and 1998. Commercial samples from the Greenlandic fishery in the southern area showed a dominance of males in 1997 and 1998 (SCR Doc. 98/112, 121).

ii) **Research survey data**

No surveys were conducted in 1997 and 1998.

iii) **Other studies**

Hydrographical studies were undertaken (SCR Doc. 98/124) to see whether there were any changes in the hydrography of the areas north or south of 65°N, respectively, connected to the appearance of new concentrations of shrimp in the southern area in 1993. An advection of warm Atlantic water mass in the area north of 65°N led to increased temperatures in 1993 and thereafter. However, it is uncertain whether there is a linkage between the warming of the northern area and the shift of the fishery to the south since 1993.

A logistic surplus production model was fitted to landings, effort, unstandardized and standardized catch rates and survey indices of the northern area (SCR Doc. 98/117). Biomass trends were consistent with the catch-rate series. However, due to concerns about meeting model assumptions and the restriction of data to the northern area, the results are considered only as indicative and as auxiliary information for the evaluation of the state of the stock.

c) **Assessment Results**

Commercial CPUE. In the northern area the standardized CPUE indices are now higher than the minimum values reached in 1989-93 approaching the level observed during the mid-1980s. Catch rates in the southern area have increased since 1993.

Recruitment. Based on the available data there were no immediate concerns about recruitment.

Biomass. No direct biomass estimates were available.

State of the stock. Standardized CPUE data from both the northern and the southern areas indicate a general increasing trend in fishable biomass since 1993. Several year-classes of male and female shrimp are evident in the sampling data in recent years.

Uncertainty on stock structure, and lack of surveys in 1997 and 1998 make assessment of this stock difficult.

d) **Research Recommendations:**

For shrimp in Denmark Strait, STACFIS recommended that:

- *a survey be conducted, to provide fishery independent data of the stock throughout its range,*
- *all available oceanographic data regarding the area be compiled for further investigation of the warming in northern Denmark Strait beginning in 1993,*
- *commercial catch sampling of the fishery be improved to fully cover seasonal and spatial variation, so that size and sex composition of the catch can be accurately described,*
- *methods for presenting length-at-age and length-at-sex reversal be coordinated, and*
- *all available logbook data be analyzed for trends in CPUE (both standardized and unstandardized).*

II. OTHER BUSINESS

Designated Experts

TACFIS reviewed the list of Designated Experts for assessment of shrimp stocks. Noting that there was still no Designated Expert nominated for the assessment of shrimp in Denmark Strait, it was agreed that the Secretariat should submit an official request to the Contracting Parties. A decision will then be made during the intersessional period, in preparation for the June 1999 Meeting of the Scientific Council.

Acknowledgements

There being no other business, the Chairman thanked the participants, especially the Designated Experts for their contributions to the meeting. Expressing gratitude to the Secretariat for their continued support and assistance, the Chairman adjourned the meeting.



L to R: H. P. Cornus (Chairman, Scientific Council), U. Skuladottir (Designated Expert), H. Siegstad (Designated Expert) and R. Mayo (Chairman, STACFIS)



STACFIS at work on shrimp in Subareas 0 and 1 and Denmark Strait stock assessments

APPENDIX II. AGENDA SCIENTIFIC COUNCIL MEETING, 6-10 NOVEMBER 1998

Opening (Chairman: H.P. Cornus)

1. Appointment of rapportuer
2. Adoption of agenda
3. Plan of work

Fishery Science (STACFIS Chairman: R. Mayo)

1. Stock assessments (Annexes 1 and 2)
 - Northern shrimp (Subareas 0 and 1)
 - Northern shrimp (in Denmark Strait and off East Greenland)
2. Other business

III. Formulation of Advice

1. Northern shrimp (Subareas 0 and 1)
2. Northern shrimp (Denmark Strait and off East Greenland)

IV. Other Matters

1. Progress report on 1999 Symposium
2. Meeting of November 1999

V. Adoption of Reports

VI. Adjournment

ANNEX 1. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1999 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1998 Annual Meeting, provide advice on the scientific basis for the management of the Roundnose grenadier in Subareas 2 and 3 in 1999.

It is also suggested that, subject to the concurrence of Denmark (Greenland), the Scientific Council, prior to the 1998 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1999 of the following stocks:

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

The Scientific Council has noted previously there was no biological basis for making two separate assessments for the Greenland halibut throughout Subareas 0-3, but has advised that separate TACs be maintained for different areas of the distribution of Greenland halibut. The Council is asked therefore, subject to the concurrence of Denmark (Greenland) as regards Subarea 1, to provide an overall assessment of status and trends in the total stock throughout its range and comment on its management in Subareas 0+1 for 1999. In particular, the Council is asked to advise on appropriate TAC levels separately for SA 0+1, for SA 2 + Division 3K and for Divisions 3LMNO, and to make recommendations on the distribution of fishing effort within each of these three geographic areas. The Council is asked also to provide information on present harvest patterns in terms of yield per recruit and on distributional variation of the resource in recent years.

With respect to shrimp, it is recognized that the Council may, at its discretion, delay providing advice until later in the year, taking into account data availability, predictive capability, and the logistics of additional meetings.

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 implications of fishing at $F_{0.1}$ in 1999 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and those to be expected at the $F_{0.1}$ level in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be considered to rebuild the spawning stock. All results should be expressed in terms of stock sizes, catch rates and TACs implied for 1999 and the long term.
 - b) For those stocks subject to general production-type assessments, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference point should be the level of fishing effort (F) which is two-thirds that calculated to be required to take the MSY catch in the long term.
 - c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence on stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stock.

In addition to the above, the Scientific Council should also provide information on the application the Precautionary Approach for those stocks, as determined during the special March 1998 meeting of the Scientific Council.

3. The Scientific Council is requested to review the status of the cod stock in Divisions 2J+3KL and to provide estimates of the current size of the total and spawning biomass, together with a description of recent trends.
4. Subject to the concurrence of Denmark (Greenland), the Scientific Council is requested to address the following questions related to Greenland halibut in Subareas 0 and 1:
 - a) The Scientific Council is requested to describe the spawning times and locations as well as nursery areas for Greenland halibut in Subareas 0 and 1 and the relationships with the Greenland halibut resources in southern areas.
 - b) Concern has been expressed regarding the impact of shrimp fishing in Greenland halibut nursery areas with respect to discards of young Greenland halibut. The Scientific Council is therefore asked to quantify the by-catch of Greenland halibut (by size and age) from the shrimp fishery in the nursery areas of Davis Strait and describe the potential loss in both yield and contribution to the spawning stock. The Scientific Council is also asked to comment on the measures that could be taken to eliminate or reduce substantially these by-catches.
 - c) It is recognized that answers to these questions may be difficult to precisely quantify given the limitations of the existing database. Accordingly, the Scientific Council is asked to comment on the research required to adequately answer these and related questions regarding the status of the stock of Greenland halibut throughout the Davis Strait area.
5. For Roundnose grenadier in Subareas 0+1, the advice of the Scientific Council has been constrained by the lack of scientific information on this stock, as there are no recent estimates of biomass for the entire stock area. Subject to the concurrence of Denmark (Greenland), the Scientific Council is requested to comment on the research required to allow the Council to provide advice on TAC levels for that stock.

P. S. Chamut
 Assistant Deputy Minister
 Department of Fisheries and Oceans
 Ottawa, Canada

ANNEX 2. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT OF CERTAIN STOCKS IN 1999

1. Denmark, on behalf of Greenland, request the Scientific Council of NAFO in advance of the 1998 Annual Meeting, provide advice on the scientific basis for management of the following stocks in Subarea 1 in 1999 and as many years forward as data allow:
 - i) Redfish (by species, if possible)
 - ii) Any other stock of invertebrates and finfish of commercial interest, for which data allow a status report

It is also suggested that, subject to the concurrence of Canada, advice be given for the following stocks overlapping Subareas 0 and 1:

- i) Greenland halibut
- ii) Roundnose grenadier

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

In its 1993 report, the Scientific Council has noted that the offshore component of Greenland halibut, in Subareas 0 and 1, was distributed equally between these Subareas. Further in its 1995 report, the Scientific Council noted that the biomass of the inshore component in Subarea 1 was unknown. The Council is therefore asked to provide further information on following topics:

- a) allocation of TACs to appropriate Subareas (Subareas 0 and 1).
- b) allocation of TAC for Subarea 1 inshore areas.

3. Denmark, on behalf of Greenland, further requests that the Scientific Council of NAFO before December 1998, provide advice on the scientific basis for management of the Northern shrimp (*Pandalus borealis*) in Subareas 0 and 1 in 1999 and as many years forward as data allow.

Further, in cooperation with ICES, the Council is requested to advise on the scientific basis for management of the Northern shrimp (*Pandalus borealis*) in the Denmark Strait and adjacent areas east of southern Greenland.

Director
On behalf of
Ministry for Fisheries, Hunting & Agriculture



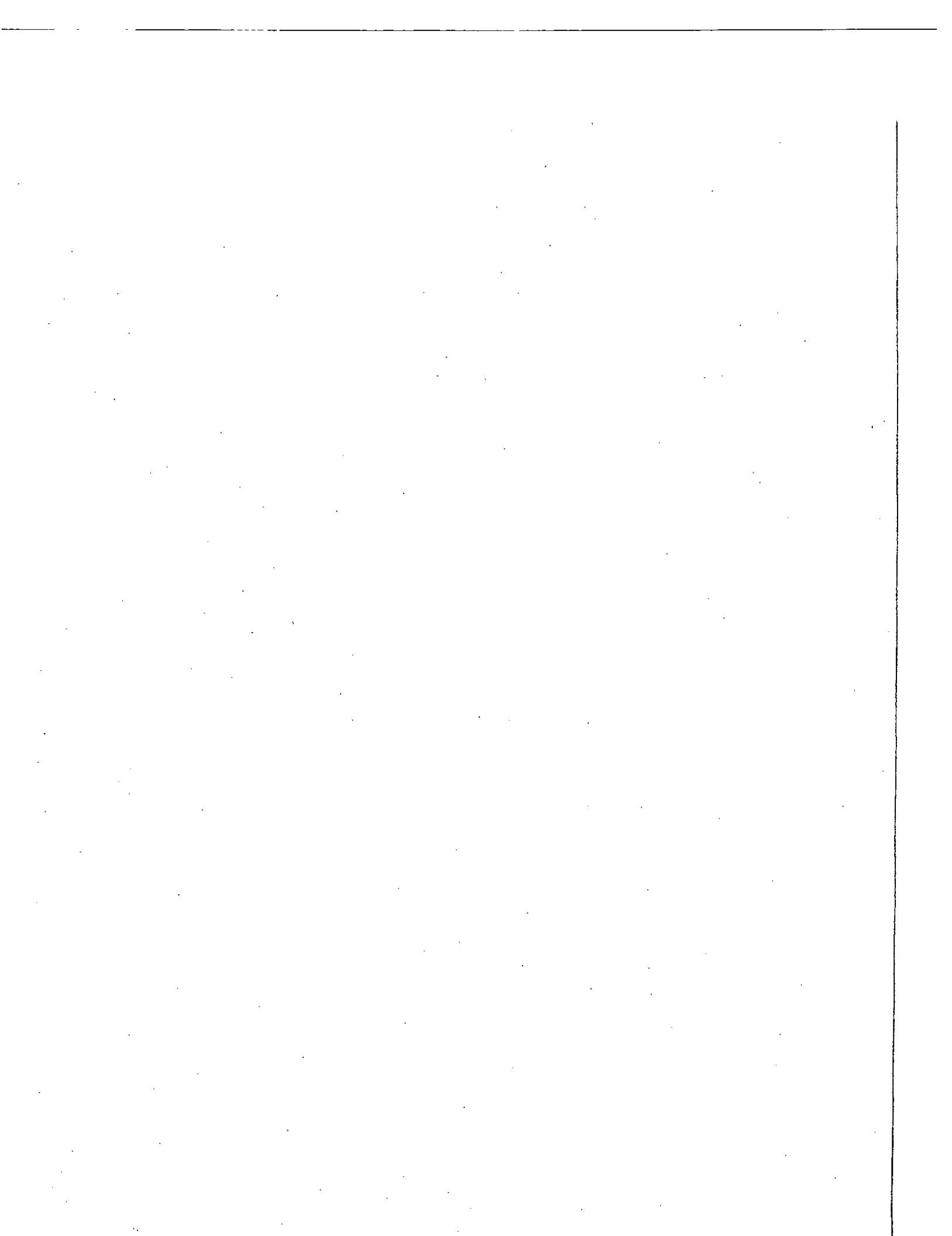
APPENDIX III. LIST OF DOCUMENTS, 6-10 NOVEMBER 1998

RESEARCH DOCUMENTS (SCR)

SCR No.	Serial No.	Name(s) and Title
98/111	N4020	HVINGEL, C., and O. FOLMER. The Greenlandic fishery for northern shrimp (<i>Pandalus borealis</i>) off West Greenland, 1970-1998.
98/112	N4021	HVINGEL, C., and O. FOLMER. The Greenlandic fishery for northern shrimp (<i>Pandalus borealis</i>) in Denmark Strait, 1997-September 1998.
98/113	N4022	HVINGEL, C., H. LASSEN, and D. G. PARSONS. A biomass index for northern shrimp (<i>Pandalus borealis</i>) in Davis Strait based on multiplicative modelling of commercial catch-per-unit-effort data.
98/114	N4023	CARLSSON, D., O. FOLMER, C. HVINGEL, P. KANNEWORFF, M. PENNINGTON, and H. SIEGSTAD. A review of the trawl survey of the shrimp stock off West Greenland.
98/115	N4024	CARLSSON, D. M., and P. KANNEWORFF. Stratified-random trawl survey for shrimp (<i>Pandalus borealis</i>) in Disko Bay and Vaigat, inshore West Greenland, 1998.
98/116	N4025	HVINGEL, C., and M. C. S. KINGSLEY. Jack-knifing a logistic model of biomass dynamics of the West Greenland shrimp stock.
98/117	N4026	CADRIN, S. X., and U. SKÚLADÓTTIR. Surplus production analysis in the Denmark Strait, 1977-1998 revised analysis incorporating 3 series including standardized CPUE.
98/118	N4027	CARLSSON, D. M., and P. KANNEWORFF. Offshore stratified-random trawl survey for shrimp (<i>Pandalus borealis</i>) in NAFO Subareas 0+1 in 1998.
98/119	N4028	KINGSLEY, M. C. S., and D. M. CARLSSON. An experimental investigation on spatial and depth variation in catch of shrimp, Greenland halibut and redfish.
98/120	N4029	SKÚLADÓTTIR, U. The Icelandic shrimp fishery (<i>Pandalus borealis</i>) in the Denmark Strait in 1997-1998 and some reflection on age groups in the years 1991-1997.
98/121	N4030	SKÚLADÓTTIR, U. Preliminary assessment of shrimp in the Denmark Strait in 1998.
98/122	N4031	SKÚLADÓTTIR, U. The catch statistics of the shrimp fishery (<i>Pandalus borealis</i>) in the Denmark Strait in the years 1980-1998.
98/123	N4032	SIEGSTAD, H. Preliminary assessment of shrimp (<i>Pandalus borealis</i>) in Davis Strait 1998 (Subareas 0+1).
98/124	N4033	STEIN, M. Do hydrographic conditions affect the distribution of shrimp (<i>Pandalus borealis</i>) off East Greenland?

SUMMARY DOCUMENTS (SCS)

SCS No.	Serial No.	Name(s) and Title
98/21	N4036	NAFO. Report of Scientific Council, 6-10 November 1998.



APPENDIX IV. LIST OF REPRESENTATIVES AND ADVISERS/EXPERTS, NOVEMBER 1998

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D. C. A. Auby, Word-Processing Secretary