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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL

January 1985 Meeting

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PROVISIONAL REPORT OF SCIENTIFIC COUNCIL*
January 1985 Meeting

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

The Council met at the Greenland Fisheries and Environmental Research Institute, Copenhagen, Denmark, during 16-22 January 1985, to provide scientific advice for 1985 on the management of the shrimp stocks in Subareas 0 and 1, as requested by Canada and the EEC (European Economic Community), and the shrimp stock in Denmark Strait at the request of the EEC. In addition, at the joint request of Canada and the EEC, the Council reviewed the status of the harp and hooded seal stocks in the Northwest Atlantic. Representatives attended from Canada, EEC (Denmark, France, Federal Republic of Germany, United Kingdom, and Commission of the European Communities), Iceland and Norway. In the absence of the Chairman (Dr. V. A. Rikhter) who could not attend this meeting, Dr. J. Messtorff acted as Chairman.

At the opening session, the Council participants were welcomed to Copenhagen by the Director of the Institute (Sv. As. Horsted). The Council regretfully noted the recent death of E. Poulsen, who served as Executive Secretary of ICNAF (International Commission for the Northwest Atlantic Fisheries) during 1952-63.

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

I. STOCK ASSESSMENTS

1. Assessment of Seal Stocks

a) Harp seals

As in 1983, the 1984 catch of 30,900 seals was substantially below the TAC (total allowable catch) of 186,000 due to poor market conditions. Large vessels from Canada and Norway did not participate in the harp seal harvest in 1984. There is a continuing trend of increasing harp seal catches at West Greenland. However, in the absence of effort data, it is not possible to evaluate whether this trend could be explained by changes in hunting methods or could be taken as evidence of increased abundance at Greenland.

From a mark-recapture study in March 1983, pup production in the Northwest Atlantic was estimated to be about 534,000 animals in 1983. This estimate was not significantly different from that derived from 1978-80 mark-recapture studies, although the 1983 estimate was based on recoveries in the year of marking rather than of age 1 and older seals. These new results support the conclusion that pup production has probably increased since the late 1960's.

Estimates of replacement yield in 1985 ranged from 210,000 to 510,000 animals. For a catch of 186,000 seals (TAC for 1984) plus 20,000 for Arctic Canada and West Greenland in 1985, the population will increase unless the actual replacement yield is close to the lowest value of the range.

b) Hooded seals

Due to poor market conditions and the absence of hunting by large vessels, the catches of hooded seals at Newfoundland in 1983 and 1984 (128 and 140 respectively) were only about 1% of the average annual yield from the area during 1975-82.

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* Only pages 3-6 are provisional, as the Report of the Standing Committee on Fishery Science (Appendix I) was adopted by the Council on 22 January 1985.

Pup production of hooded seals in the Northwest Atlantic was assessed by aerial surveys of the Front and Davis Strait areas in March 1984. The surveys were designed to estimate production in whelping patches and in areas outside the patches (scattered pups) to provide total production in each area. In Davis Strait, consolidated pack ice prevented seals from leaving the ice prior to 24 March, and the result of the helicopter survey of the only known whelping patch (18,600 pups) was considered to be a reliable estimate of production. At the Front, the total number of pups born in the single whelping patch was estimated to be about 54,700. In addition, about 7,400 pups were attributed to production by scattered seals outside the whelping patch. Thus, the total production at the Front was about 62,000 pups in 1984. If pup production in the late 1960's was about 30,000 animals (based on the survival index method), the hooded seal population in the Northwest Atlantic has probably increased in recent years.

Estimates of replacement yield in 1985 ranged from 15,500 to 64,700 animals, depending on the value of natural mortality. If the catch of hooded seals in 1985 is the same as that in 1983 (4,300), the population will increase for all values within the range of replacement yield estimates.

c) Future research on seals

The Council endorsed the recommendations of STACFIS regarding future research on the harp and hooded seal populations of the Northwest Atlantic.

2. Assessment of Shrimp Stock in Subareas 0 and 1

In 1979 and 1980, the offshore shrimp fishery in Davis Strait was regulated by an overall TAC of 29,500 tons, the nominal catches being 27,000 and 37,000 tons respectively in these years. The same TAC was advised for 1981-84 inclusive, but allowable catches of 35,000, 34,800, 34,625 and 34,925 tons respectively were set by the coastal states involved. Provisional statistics for 1984 indicate an offshore catch of about 37,000 tons (Table 1). The shrimp fishery in 1984 was severely hampered by ice in the first 5 months of the year. From May to November, Greenland vessels fished west and north of Store Hellefiske Bank (Div. 1B). However, more effort was expended in Div. 1C and 1D during this period than in the previous year. The distribution of fishing effort by Greenland vessels in 1984, as in the 2 previous years, did not exhibit the northward shift that was evident in 1980 and 1981.

Table 1. Nominal catches (metric tons) of shrimp in Subarea 0 and the offshore part of Subarea 1 in 1975-84, with the corresponding TACs for 1977-84.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Catch	29,190	42,766	34,300	26,869	27,087	36,652	37,300	36,827	38,115[1]	37,224[1]
Advised TAC	-	-	40,000	40,000	29,500	29,500	29,500	29,500	29,500	29,500
Effective TAC[2]	-	-	36,000	40,000	29,500	29,500	35,000[3]	34,800[3]	35,625[3]	34,925[3]

[1] Provisional data.
[2] Total of Canada and EEC TACs.
[3] Includes TAC of 5,000 tons in Subarea 0.

All available biological information on length distribution and sexual components of the catches and all data on trends in catch rates and biomass estimates were considered in advising on management of the fishery in 1985. After the decline in abundance which was observed during 1976-78, there was a general upward trend in overall catch rates during 1979-82 and stability since then. However, the catch rates for recent years may be biased upward due to increased efficiency of gear and the effects of ice conditions, but the effects of these factors cannot be estimated. Since these effects could account for the observed increase in catch rates, it is quite possible that the stock did not increase in the early 1980's.

A TAC of 40,000 tons was advised for 1977 and 1978. The advised TAC for 1979 was reduced by about 26% to 29,500 to reflect the decrease in abundance from 1976 to 1978. Since 1979, an increase in the TAC was not advised because of interpretation of the catch-rate series and because of concerns about recruitment prospects for the stock. Despite the concerns about recruitment, catch rates have not decreased. However, quantitative estimates of recruitment for 1985 were not available. Because of the apparent stability of the stock and the fact that higher-than-advised yields have been realized during this period of stability, the Council advises that the overall TAC for the offshore grounds of Subarea 1 and adjacent parts of Subarea 0 in 1985 should not exceed 36,000 tons, which corresponds to the average catch during 1979-84.

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

3. Assessment of the Shrimp Stock in Denmark Strait

The shrimp fishery in this area expanded rapidly from 1977 to 1980. The total catch on both sides of the midline between Greenland and Iceland was about 8,300 tons in 1980 (Table 2) and declined sharply to 4,800 tons in 1981 when the fishery was regulated by a TAC of 8,000 tons which was set by the EEC for the area west of the midline. TACs of 4,500, 5,725 and 5,245 tons were set by the EEC for 1982, 1983 and 1984 respectively. Catches in Denmark Strait in these years were 4,900, 4,200 and 6,400 tons.

Table 2. Nominal catches (metric tons) of shrimp in Denmark Strait in 1978-84, with corresponding TACs for 1981-84.

	1978	1979	1980	1981	1982	1983	1984
Catch	363	1,285	8,260	4,792	4,902	4,175	6,353[1]
Advised TAC	-	-	-	-	4,200	4,200	4,200
Effective TAC[2]	-	-	-	8,000	4,500	5,725	5,245

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

The fishery in 1984 took place in the area of Strede and Dohrn Banks and on the slopes of Storfyord Dyb. Ice conditions in the early part of the fishing season were variable, hindering access to the northern and eastern parts of the fishing grounds, but the ice cover later in the season did not influence the distribution of the fishing fleet as in previous years. Ice conditions varied considerably from month to month throughout the years, thereby affecting the distribution of fishing effort and making the evaluation of catch-per-unit-effort data difficult. Although it was not possible in previous assessments to reach a conclusion on the reasons for the trends in catch rates, the inclusion of data for 1984 indicates stability of the stock.

Shrimp less than 20 mm (carapace length) were scarce in all of the length frequencies of samples in 1984, supporting the earlier conclusion that young shrimp are not abundant on the fishing grounds.

In view of the apparent stability of the stock, the Council advises that the overall TAC for 1985 should not exceed 5,000 tons, which corresponds to the average level of catch during 1981-84.

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

II. COLLABORATION WITH OTHER ORGANIZATIONS

1. Coordination of Research on North Atlantic Seal Stocks

The Council was informed, through a letter from the General Secretary of ICES, about the establishment of an ICES Working Group on Harp and Hooded Seals in the Greenland Sea, which will hold its first meeting during 9-13 September 1985 (Chairman: F. O. Kapel), with the following terms of reference:

a) Assess the stock size and pup production of harp and hooded seals;
b) Consider sustainable yields at present stock sizes and in the long term under varying options of age compositions of the catches;
c) Consider effects of recent changes in the food supply and the possible interaction with other marine living resources in the area;
d) Review the available data to assess the state of the stocks and give proposals for future research programs;
e) Give advice on catch options for the 1986 sealing season.

Since the terms of reference of this ICES Working Group have much in common with corresponding work on harp and hooded seals in the Northwest Atlantic, the Council considered it advantageous that both organizations coordinate their work. In this respect, the Council agreed that the feasibility of joint meetings of the respective working groups or the establishment of a joint ICES/NAFO working group should be considered and a firm proposal developed at the June 1985 Meeting for consideration by ICES at its Statutory Meeting in October 1985.

III. FUTURE SCIENTIFIC MEETINGS

1. Scientific Council Meeting, June 1985

The Council confirmed that its next meeting will be held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 5-20 June 1985, to deal with its regular business, involving the work of the three standing committees (STACFIS, STACREC and STACPUB) and associated sub-committees and working groups.

2. Annual Meeting, September 1985

The Council noted that arrangements are being made to hold the Seventh Annual Meeting in Cuba during 16-20 September 1985. As agreed by the Council in September 1984 (NAFO Sci. Coun. Rep., 1984, page 86), the Special Session on "Design and Evaluation of Biological Surveys in Relation to Stock Assessments" will be held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, in the week preceding the Annual Meeting, namely, during 10-12 September 1985.

IV. ADJOURNMENT

On behalf of the Council, the Acting Chairman expressed his thanks to the Director and Staff of the Greenland Fisheries and Environmental Research Institute for the excellent meeting facilities. He also thanked the participants for their cooperation and support during the course of the meeting and acknowledged the indispensible assistance of the NAFO Secretariat and the secretarial staff assigned to the Secretariat by the Institute. The participants expressed their appreciation to the Vice-chairman (Dr. J. Messtorff) for chairing the Council sessions in the absence of the Chairman. The meeting was adjourned at 1600 hr on 22 January 1985.

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

Chairman: J. E. Carscadden   Rapporteurs: Various

The Committee met at the Greenland Fisheries and Environmental Research Institute, Copenhagen, Denmark, during 16-22 January 1985 to review the status of the shrimp stock in Subareas 0 and 1, as referred to it by the Scientific Council, based on the requests of Canada and the European Economic Community (EEC) (Appendix II, Annexes 1 and 2). As requested by the EEC, the Committee reviewed the status of the shrimp stock in Denmark Strait (Appendix II, Annex 2). In addition, as requested by Canada and the EEC (Appendix II, Annex 3), the Committee reviewed the status of the harp and hooded seal stocks in Subareas 0, 1, 2, 3 and 4. Scientists attended from Canada, EEC (Denmark, France, Federal Republic of Germany, United Kingdom and the Commission of the European Communities), Iceland and Norway.

Meetings of the ad hoc Working Group on Shrimp (convened by J. E. Carscadden) and the Working Group on Seals (convened by W. D. Bowen) were held concurrently, and the results of the assessments are given in Sections I and II below.

I. ASSESSMENT OF SEAL STOCKS

1. Introduction

The ad hoc Working Group on Seals met during 16-21 January 1985 at the request of STACFIS, with W. D. Bowen (Canada) as Convener, to consider the joint request by Canada and EEC for advice on management in 1985 of the seal stocks in the Northwest Atlantic. Scientists attended from Canada (W. D. Bowen, K. Hay and R. A. Myers), EEC (J. Harwood, W. Wijnstekers and F. Kapel), and Norway (T. Øritsland and N. Øien). K. Hay was appointed rapporteur.

2. Harp Seals

a) Review of fishery trends (SCR Doc. 85/I/9; SCS Doc. 85/I/1)

Recent catches of harp seals in the Northwest Atlatnic are given in Table 1, including updated catch statistics for West Greenland during 1978-83. As in 1983, the 1984 catch of 30,900 was substantially below the TAC (186,000) due to reduced effort at Newfoundland and in the Canadian Arctic. The number of hunters producing sealskins in the Canadian Arctic has declined from 2,129 in 1980 to 730 in 1982. Effort statistics for 1983 are not yet available.

Table 1. Harp seal catches (numbers of animals) in the Northwest Atlantic, 1977-84. (... indicates data not available.)

Year	West Greenland	Northwest Territories	Labrador N. of 54°	Northern Quebec	Regulated Catch	Total Catch
1977	9,938	1,508	254	-	155,143	166,843
1978	10,540	2,129	1,263	-	161,723	175,655
1979	12,774	3,620	619	87	160,541	177,641
1980	12,270	6,350	3,335	109	171,929	193,993
1981	13,605	4,672	10,863	...	189,731	218,871[1]
1982	17,244	4,268	...	...	169,484	190,996[1]
1983	18,739	1,287	...	...	57,889[2]	77,915[1]
1984	...	...	...	...	30,900[2]	30,900[1]

1 Partial statistics
2 Norway did not participate in the seal hunt in 1983 and 1984.

Large vessels from Canada and Norway did not participate in the harp seal harvest at Newfoundland in 1984. However, 627 harp seals were taken by large chartered vessels in March and April for scientific study.

The available statistical information for West Greenland (SCR Doc. 85/I/9) indicates that the total catch decreased from a level of 20,000-25,000 in the early 1940's to 5,000-7,000 annually in the late 1960's and early 1970's. Since 1975, the catch of harp seals at West Greenland has increased, reaching a level of 17,000-19,000 in 1982-83. The causes for this development were discussed, and it was agreed that the data presented in SCR Doc. 85/I/9 did not allow an unambiguous interpretation of the increasing trend observed for the most recent decade. It was not possible to evaluate whether this trend could be explained solely by changes in hunting methods or could be taken as evidence of increased abundance of harp seals at Greenland. However, interviews with hunters and unsolicited comments from residents in Greenland leave the impression of increased abundance of harp seals in recent years. For example, the phenomenan known as "amissut" (i.e. mass occurrence of schooling harp seals) was rarely observed during the 1960's and early 1970's, but is now seen frequently.

b) Research conducted in 1984

A Canadian study of the relationships between pup size, growth rate and female condition was concluded in 1984. Morphometric measurements were sampled from 24 mother-pup pairs throughout the lactation period. In addition, daily weight gain of 44 harp seal pups of known age was determined and milk consumption was estimated for 8 pups using labelled water (D_2O) methods. Studies were also conducted on changes in milk composition and energy content throughout lactation. In April 1984, 545 seals (age 1 and older) were sampled from molting concentrations at the Front for studies on growth, reproduction and population dynamics. A sample of 49 beaters was taken during April and May for studies on growth and feeding.

c) Tag recoveries at Greenland (SCR Doc. 85/I/13)

Between 1981 and 1984, a total of 195 harp seals tagged at Newfoundland have been recaptured in Greenland: 8 in East Greenland and 187 along the west coast of Greenland. Although these 195 new recoveries constitute a significiant addition to previous material, they do not alter the general pattern of seasonal and regional distribution described in previous analyses.

d) Estimation of parameters (SCR Doc. 85/I/1)

i) Pup production

A mark-recapture study was conducted in March 1983 to estimate harp seal pup production in the Northwest Atlantic. As in similar studies between 1978 and 1980 (Bowen and Sergeant, 1983)[1], a Petersen model modified to correct for tag loss and reporting rate of recovered tags was used to estimate production. The experimental design followed the same procedure with two important differences: (1) the absence of an offshore hunt for whitecoats in the Gulf and Front areas enabled researchers to distribute tags more uniformly throughout the whelping concentrations; and (2) the numbers of seals tagged in the Gulf and Front areas were similar to estimates of historical production in these areas, resulting in more uniform tagging density throughout the population than in previous investigations.

Two types of estimates were considered: those derived from recoveries in the year of marking (short-term estimates), and those based on recoveries of seals aged 1 and older (long-term estimates).

ii) Stock size and replacement yield

Harp seal population size and replacement yield in 1985 were calculated by using the population model described in Roff and Bowen (1983)[2]. The catch-at-age matrix was up-

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

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

dated to include regulated Canadian catches during 1983 and 1984 and estimated catches at West Greenland from the most recent data available prior to this meeting.

e) Assessment results (SCR Doc. 85/I/1, 2)

i) Vital rates

No new information on harp seal vital rates was presented at this meeting.

ii) Pup production

Over 12,000 harp seal whitecoats were tagged in the Gulf of St. Lawrence and at the Front in March 1983 (Table 2). To estimate tag loss, 1,282 pups were double-tagged. Estimated tag loss at 1 to 3 months of age (the period of short-term estimates) was 1% based on 145 returns. Tag loss up to about 1 year of age was estimated at 4% based on 14 recoveries (SCR Doc. 85/I/1).

Table 2. Numbers of harp seal pups (whitecoats) tagged in the Gulf and Front areas in March 1983.

Date	Area	Tagged		
		Single	Double	Total
March 6-17	Gulf	3,369	493	3,862
March 10-25	Front	7,612	789	8,401
	Total	10,981	1,282	12,263

An estimate of the reporting rate of recovered harp seal tags from pups marked in March 1983 was obtained from a stratified-random survey of 51 Newfoundland communities in September 1983 after the hunting season had ended (SCR Doc. 85/I/2). About 53% of 1,894 licensed sealers were interviewed and were paid a reward for each harp seal tag which they held. An estimated 295 ± 49 (1 SD) tags from Front-marked pups had not been returned for reward in the 211 Newfoundland communities in which licensed sealers were known to reside. Prior to the survey, a total of 665 tags from beaters had been returned for the reward. Thus, the reporting rate was estimated at 0.693 ± 0.034 (1 SD). This value, similar to that found by Bowen and Sergeant (1983), was used to correct the Petersen estimate of pup production.

The estimate of pup production in 1983, based on short-term recoveries, was 534,000 ± 33,000 (1 SE). The estimate of 136,000 pups based on recoveries at age 1 was considered to be unreliable because of changes in the structure of the hunt in 1984 which resulted in a substantially greater proportion of the catch being taken by landsmen. In addition, the estimate was believed to be negatively biased because 34 of the 75 recoveries of Front-tagged animals were made in mid-April from a small area of Bonavista Bay, Newfoundland, implying that hunters had selectively hunted for tagged animals. The unusual ice conditons in Bonavista Bay at this time made such selection possible.

The Committee considered three types of estimates of pup production in the last 20 years: the cumulative catch from the 1967 cohort (ICES, 1983)[3]; modified survival index estiamtes for the 1968-77 and 1960-72 periods (ICES, 1983); and mark-recapture estimates for 1978, 1979 and 1980 (Bowen and Sergeant, 1983) and 1983 (SCR Doc. 85/I/1). The estimates for the late 1960's and early 1970's are as follows:

[3] ICES. 1983. Report on the meeting of an ad hoc working group on assessment of harp and hooded seals in the Northwest Atlantic. ICES Coop. Res. Rep., No. 121, 16 p.

Period	Estimated pup production	95% confidence limits
1967	302,000	-
1968-77	293,000-374,000	270,000-410,000
1960-72	400,000	372,000-428,000

The Committee noted that the 1983 mark-recapture estimate was entirely consistent with, and not significantly different from, the value for 1978-80, although it was based on recaptures in the year of marking rather than on age 1 and older animals. This adds weight to the conclusion of the ICES Working Group (ICES, 1983) that pup production had probably increased since the late 1960's. However, the Committee noted that the calculated confidence intervals for the estimates from the late 1960's and early 1970's were almost certainly underestimated, and that the cumulative catch and survival index estimates could be biased downward whereas the mark-recapture estimates could be biased upward. Thus, unequivocal evidence for an increase in pup production could come from a mark-recapture experiment in 1986 or later, when the predicted increase in pup production is sufficient to be detected, given the precision of the estimation technique.

iii) Stock size and replacement yield

Replacement yield in 1985 and corresponding stock size of seals (age 1 and older) were calculated using the probable range of pup production for the late 1960's (320,000-420,000) (ICES, 1983) and a range corresponding to the calculated 95% confidence limits for pup production in 1983 derived from the 1983 mark-recapture experiment (SCR Doc. 85/I/1). The range of replacement yield in 1985, with a catch of 80% young of the year and consistent with the above ranges of pup production, is shown in Table 3.

Table 3. Estimates of harp seal population size (age 1 and older) and replacement yield in 1985 for different values of M and 1967 pup production that are consistent with pup production in 1983 from mark-recapture studies. (Initial age distribution and other parameters from Roff and Bowen, 1983.)

Pup production (000)		Natural mortality[1]		1985 estimates (000)	
1967	1983	M_0	M_{1+}	Population age 1 & older	Replacement yield
320	600	0.1575	0.0525	3,300	510
370	590	0.0750	0.0750	3,200	430
380	590	0.2175	0.0725	3,100	400
390	540	0.0850	0.0850	2,800	355
430	470	0.2850	0.0950	2,200	225
430	450	0.2000	0.1000	2,200	225
420	440	0.2850	0.0950	2,000	210

[1] M_0 = pup mortality; M_{1+} = mortality (age 1 and older).

The 1983 catch statistics indicate that the proportion of seals (age 1 and older) in the catch has not changed significantly. Final catch statistics were not available for 1984.

With a catch of about 78,000 animals in 1983 (Table 1) and the approximate catch of about 50,000 animals (including 20,000 for Arctic Canada and Greenland) in 1984, the harp seal population will increase from 1984 to 1985. With a catch of 186,000 animals (total allowable regulated catch in 1984) plus about 20,000 for Arctic Canada and Greenland in 1985, the population would increase unless the true replacement yield was close to the lowest value of the range, in which case the population will likely remain at the 1985 level.

The Committee was not able to provide reliable estimates of sustainable yield in 1985 because of uncertainty in the relationship between vital rates and population size.

f) Future research requirements

STACFIS recommends

i) that a mark-recapture experiment to estimate pup production be repeated at the Front and in the Gulf of St. Lawrence during 1986;

ii) that a large number of female harp seals (at least 250) be sampled to determine near-term age-specific pregnancy rates;

iii) that the analysis of the 1983 aerial survey of two harp seal patches at the Front be completed; and

iv) that the mark-recapture data be reanalyzed to determine the effects of hunting method and catch location on the estimate of pup production.

3. Hooded Seals

a) Review of the fishery (SCR Doc. 85/I/9; SCS Doc. 85/I/1)

Hooded seal catches in the Northwest Atlantic during 1975-84 are summarized in Table 4. Due to poor markets for pelts, catches at Newfoundland declined greatly after 1982. The total catch of hooded seals by Canadian vessels in the Northwest Atlantic during 1984 was 444, comprising 202 bluebacks (pups) and 242 animals age 1 and older. Of this catch, 388 animals (202 bluebacks, 186 older seals) were taken primarily in Davis Strait for research purposes. Landsmen took 56 seals. No hooded seals were taken at the Front by large vessels during 1984. Catch statistics for hooded seals at Greenland during 1984 are not yet available, but the total catch at West and East Greenland during 1983 was 5,485 (SCR Doc. 85/I/9).

Table 4. Hooded seal catches (number of animals) in the Northwest Atlantic, 1975-84. (... indicates data not available.)

Year	Newfoundland Pups	Newfoundland Age 1+	Newfoundland Total	Davis Strait Total	W. Greenland Total	Northwest Atlantic Pups	Northwest Atlantic Age 1+	Northwest Atlantic Total
1975	7,646	7,965	15,611	-	3,679	7,646	11,644	19,290
1976	6,540	5,845	12,385	-	4,230	6,540	10,075	16,615
1977	8,970	3,123	12,093	-	3,751	8,970	6,874	15,844
1978	7,966	2,538	10,504	-	3,635	7,966	6,173	14,139
1979	11,948	3,177	15,125	-	3,612	11,948	6,789	18,737
1980	10,661	1,963	13,116	-	3,779	11,153	5,742	16,895
1981	10,661	3,015	13,676	-	3,745	10,661	6,760	17,421
1982	7,757	2,636	10,393	-	4,398	7,757	7,034	14,791
1983	-	128	128	-	4,155	-	4,283	4,283
1984	68	72	140	304	...	...	...	...[1]

[1] Partial statistics.

Prior to 1939, Greenland hunting statistics did not specify individual seal species, but the available evidence indicates that the catch of hooded seals at West Greenland decreased from 10,000-15,000 annually at the turn of the century to 500-1,000 around 1960. In the mid-1960's, the catch statistics show a sudden increase to a level of 1,400-2,200 for West Greenland, and between 1971 and 1975 the catch increased to around 4,000 and has remained at this level. Annual catches at East Greenland were 200-700 in the 1950's and 1960's, but increased rapidly during the 1970's to a level of 2,500 in 1980. Catches in East Greenland have been lower in the most recent years (average of 2,000 annually).

The significant increase in catches at West and East Greenland may in part be due to changes in hunting methods. However, evidence from local residents indicates that hooded seals have become more abundant at Greenland in recent years.

b) Research in 1984

During March 1984, a tagging program was carried out at the Front and in Davis Strait to elucidate the interrelationship between these two whelping groups. The program involved tagging of 414 hooded seal pups at the Front, 1,465 in Davis Strait, and 394 in the Gulf. Growth, duration of lactation, pup growth rates, milk consumption, energetics, and changes in female condition during lactation were studied at the Front during March-April 1984. Biological samples were obtained from 304 hooded seals taken in Davis Strait as part of a cooperative Canadian-Danish research project. Data and material collected were standard morphometrics and weights, lower jaws for age determination, reproductive organs, stomach contents, blood for haematological analyses, and tissues for analyses of heavy metals and chlorinated hydrocarbons.

c) Survey methods (SCR Doc. 85/I/14)

Pup production of hooded seals in the Northwest Atlantic was assessed by aerial survey (visual and photographic), with simultaneous collection of ground-truth data. Surveys were carried out both at the Front and in Davis Strait. Because of a short lactation period (4 days) compared to a protracted pupping season (about 10 March to 5 April), instantaneous pup abundance estimates must be corrected for those pups which have left the ice and those which are yet to be born. These corrections require estimates of the durations of the following pup developmental stages: newborn, thin blueback, fat blueback, and solitary (weaned). Stage durations were determined at the Front by direct observation of tagged pups of known age from birth to weaning.

Historical data for the Front allowed definition of three survey strata: (i) the region where pups occur in relatively high densities (51°-53°N) but excluding the whelping patches, (ii) the whelping patches, and (iii) the regions where pups occur in very low densities (south of 51°N and north of 53°N). There were insufficient data to define survey strata for Davis Strait.

At the Front, a fixed-wing aircraft flew along transects at an altitude of 1,000 ft (305 m) from near the coast to the seaward edge of heavy pack ice (that preferred by whelping hooded seals), with a transect spacing of 10 nm (18.5 km) in Stratum 3 and an interval of 5 nm (9.3 km) in Stratum 1. Transect spacing was about 15 nm (28 km) in Davis Strait. On transects flown at the Front from 19-26 March, vertical photographs (23 cm × 23 cm) were taken at intervals of about 2 nm (3.7 km), whereas, on the transects flown in Davis Strait during 26-27 March, photographs were taken at intervals of about 4 nm (7.4 km). Counts of hooded seals on these spot-photographs were used to determine the density of pups in strata outside the whelping concentrations (i.e. scattered pups).

A single large whelping patch was located in each region. Both fixed-wing photographic and helicopter sighting surveys were used to determine the number of pups present in the whelping patches (SCR Doc. 85/I/14). Fixed-wing photographic surveys consisted of a series of parallel transects flown systematically across the whelping patches with 20% overlap between successive frames. Transect width was about 450 m. Whelping concentrations were relocated by using radio transmitters placed on the ice. Pup abundance for each whelping patch was also determined by helicopter sighting surveys flown at an altitude of 100 ft (31 m), using a total strip width of 200 m. Transects were spaced systematically at an interval of 1 nm (1.85 km). Loran-C navigation was used for helicopter surveys at the Front, whereas dead-reckoning navigation, with allowance for wind direction and speed, was used in helicopter surveys in Davis Strait. Observers counted all pups seen within their respective 100-m wide strips and classified each pup into one of the four developmental stages (defined above). The number of pups present in each whelping patch was calculated by using Jolly's strip survey method for unequal-sized sampling units (Caughley, 1977)[4].

d) Estimation of pup production (SCR Doc. 85/I/14)

i) Scattered seals

Abundance of scattered seals was estimated by multiplying the area surveyed by the average density of seals in the spot-photographs. Confidence limits were obtained by a bootstrap estimator (Effron, 1979)[5].

ii) Whelping patches

A maximum likelihood method was used to combine estimates of abundance from several surveys with estimates of the number of pups in each developmental stage to obtain an estimate of total pup production. The maximum likelihood method weighted each survey point estimate of pup abundance by the estimated sampling variance and each estimate of the proportion of pups in each stage by the sample size corrected for loss of degrees of freedom associated with the sampling design. Adequacy of the model fit was investigated by examining the pattern of residuals and the covariance matrix of the estimated parameters.

The newborn stage was estimated to last 3 hours. The thin blueback stage was estimated to last 1.5 days. The fat blueback stage was assumed to be variable in the model and was estimated to last 1.5 days, 2.5 days and 3.5 days for 11%, 66% and 23% of the pups respectively. The duration of the solitary stage could not be determined from observations of pups of known age and was therefore estimated in the model.

e) Assessment results (SCR Doc. 85/I/14)

i) Vital rates

Using the method of Chapman and Robson (1960)[6], total mortality rate was calculated from an age distribution of 147 adult females sampled in Davis Strait during March 1984. The result was $Z = 0.142$ with a 95% confidence interval of 0.115-0.166.

ii) Scattered pups

At the Front, 12 hooded seal pups were seen on the 472 spot-photographs in Stratum 1. This provided an estimate of 7,400 scattered pups on the ice (density = 0.12 pups/km^2) with 95% confidence interval of 2,700-14,400. There was insufficient information to correct this estimate for the number of pups which had already left the ice or were yet to be born. No pups which could unambiguously be attributed to production outside the whelping patch were seen in Davis Strait, but the spot-photographs were taken only on 26-27 March when most pups in this area had left the ice.

iii) Whelping patches

For the Front herd, four parameters were estimated simultaneously in the model: total pup production, mean birth date, variance in the birth date, and duration of the solitary stage. Due to weather and logistical constraints, all fixed-wing surveys of the Front patch were incomplete, and, therefore, the results were not used in the final assessments. Pup abundance estimates from complete helicopter sighting surveys were 35,300

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[4] CAUGHLEY, G. 1977. Analysis of vertebrate populations. John Wiley and Sons, London.

[5] EFFRON, B. 1979. Computing and theory of statistics: thinking the unthinkable. Soc. Ind. Appl. Math. Reivew, 21: 460-80.

[6] CHAPMAN, D. G., and D. S. ROBSON, 1960. The analysis of a catch curve. Biometrics, 16: 354-369.

on 21 March (95% confidence interval of 24,900-45,600) and 24,000 on 25 March (95% confidence interval of 18,900-29,200).

Estimates of total pup production at the Front were calculated by assuming that births were normally distributed throughout the season. The resulting estimate of total pup production (54,700) indicated that a significant correction was needed to account for pups that had already left the ice or were yet to be born. The 95% confidence limits for total pup production were ± 17,500, if the other three parameters are correctly estimated. Uncertainty in the estimate of the other three parameters will not alter each 95% confidence limit by more than 2,500 pups. To investigate the effect of asymmetry in the distribution of births on the estimate of total pup production, births were alternatively assumed to follow a gamma distribution, the resulting estimate of pup production being 48,700. However, there was insufficient information to independently estimate all of the necessary parameters of this alternative model, and, therefore, this result must be considered less reliable than that based on the normal distribution.

In Davis Strait, consolidated pack ice prevented seals from leaving the ice prior to 24 March. Therefore, the result of the complete helicopter survey of 24 March (18,600 pups, with 95% confidence interval of 13,800-23,400) was considered to be a reliable estimate of pup production in this area. Although this estimate is probably biased downwards, it is unlikely that many pups were born after 24 March.

The total pup production estimates for the Front and Davis Strait areas are probably underestimates for three reasons: whelping patches within the survey area could have been missed because of the wide interval between search transects, ice suitable for pupping was available outside the area surveyed, and no correction was made for the scattered pups that had left the ice or were yet to be born.

iv) Trends in pup production

The estimates of hooded seal pup production in the Northwest Atlantic from the 1984 aerial surveys are substantially higher than those which were previously assumed (NAFO Sci. Coun. Rep., 1983, pages 60-61). It is difficult to compare results from the 1984 survey of Davis Strait with previous surveys, which did not provide an estimate of abundance of pups outside the patches and did not account for those pups which had left the ice or were yet to be born. The difference between the estimate of 18,600 (with 95% confidence interval of 13,800-23,400) and previous estimates of around 10,000 might easily be accounted for by differences in survey design. Thus, it is not possible to determine recent trends in pup production in Davis Strait from the available data. The 1984 estimate of 62,000 pups (95% confidence interval of 40,000-87,000) at the Front is the only reliable estimate of total production for this area in recent years.

Earlier estimates of hooded seal pup production in the Northwest Atlantic (about 30,000 during the late 1960's) have all been based on the survival index method and depend heavily on the 1966 data point (SCR Doc. 85/I/14). If it is accepted that pup production in the late 1960's was in the neighbourhood of 30,000, the hooded seal population has probably increased in recent years, whether the value of 30,000 represents total Northwest Atlantic production or Front production alone.

v) Replacement yield

Projections to 1990 were calculated for hooded seals at the Front, involving three hunting scenarios: with a Greenland catch of 6,000 (32% females), catches at the Front were assumed to be zero, 3,000 and 12,000 seals. The age and sex composition of these catches were taken from average levels at Greenland and at the Front in recent years. The projections began in 1979 by using the age structure which was calculated from the sample of females collected at the Front in that year, corrected for the proportion of whelping animals and assuming constant pup production in 1976-79.

Using the estimated catch history of the population for 1979-83 and two levels of natural mortality (0.07 and 0.13), which were previously considered to be a feasible range of M (NAFO Sci. Coun. Rep., 1983, pages 60-61), population trajectories consistent with the point estimate and 95% confidence limits on Front production in 1984 were calculated. These trajectories were carried forward to 1990 by using the estimated structure of the 1984 catch and the three hunting scenarios described above. These projections (Table 5) and replacement yields (Table 6) are conservative because they assume that Greenland catches are derived only from seals born at the Front. However, six new recaptures of tagged hooded seals in Greenland were reported at the meeting, five of these being

Table 5. Projected pup production for hooded seals at the Front, 1985-90, for three different levels of 1984 production, two levels of M, and three different hunting scenarios (numbers in thousands)[1].

Pup production (1984)	Year	M = 0.07			M = 0.13		
		G	12+G	3+G	G	12+G	3+G
39.9	1985	43.4	43.4	43.4	41.0	41.0	41.0
	1986	48.5	48.0	48.4	43.2	42.7	43.1
	1987	55.4	54.4	55.1	46.2	45.3	46.0
	1988	63.3	61.0	62.7	49.6	47.6	49.1
	1989	72.1	67.2	70.9	52.9	48.9	51.9
	1990	82.1	73.8	80.0	56.5	50.0	54.9
62.1	1985	68.9	68.9	68.9	65.1	65.1	65.1
	1986	78.0	77.5	77.8	69.3	68.8	69.2
	1987	89.3	88.3	89.1	74.5	73.6	74.3
	1988	102.4	100.1	101.8	80.3	78.3	79.8
	1989	117.1	112.2	115.9	86.3	82.2	85.2
	1990	133.9	125.6	131.8	92.6	86.1	91.0
86.6	1985	97.1	97.1	97.1	91.7	91.7	91.7
	1986	110.5	110.0	110.3	98.1	97.6	97.9
	1987	126.7	125.8	126.5	105.8	104.9	105.6
	1988	145.5	143.2	144.9	114.2	112.2	113.7
	1989	166.7	161.8	165.5	123.0	118.9	122.0
	1990	191.0	182.8	188.9	132.5	126.0	130.9

[1] G = Greenland catch of 6,000 only; 12+G = Front catch of 12,000 plus Greenland catch; 3+G = Front catch of 3,000 plus Greenland catch.

Table 6. Estimates of replacement yield of hooded seals at the Front in 1985 for three levels of 1984 pup production and two levels of M. (These replacement yields assume a catch with same age structure as that at Greenland; variation in catch age structure is unlikely to affect replacement yield by more than ±5%.)

Pup production (1984)	Replacement yield	
	M = 0.07	M = 0.13
39,900	28,800	15,500
62,100	45,900	24,700
86,600	64,700	34,900

bluebacks which were tagged in Davis Strait during March 1984. Previously, five hooded seals tagged at the Front and nine in the Gulf of St. Lawrence were recovered in West and East Greenland (Kapel, 1982)[7]. Thus, pups born in Davis Strait must contribute to catches at Greenland.

vi) Stock identity

Comparison of the age distribution of 140 females (age 6 and older) from Davis Strait in 1984 with that of 174 females from the Front in 1982 (Table 7) indicates that the two groups have experienced substantially different mortality patterns over at least the past 10 years. Future recoveries, in the whelping areas, of seals tagged at Newfoundland and in Davis Strait may clarify further the relationship between these two breeding herds.

Table 7. Percentage age composition of female hooded seals (age 6 and older) from the Front and Davis Strait areas.

Area	Age (years)											Z	95% confid. interval
	6	7	8	9	10	11	12	13	14	15	16+		
Front (1982)	14.9	16.1	13.2	8.6	10.9	11.5	5.2	4.0	4.0	2.3	9.2	0.221	0.188-0.254
Davis Strait (1984)	13.6	7.1	9.3	5.7	5.7	7.1	5.7	10.0	7.9	5.0	22.9	0.142	0.115-0.166

f) Future research requirements

STACFIS recommends

i) that additional research be carried out to estimate the seasonal distribution of births within patches and to quantify the variability of pup developmental stages;

ii) that simultaneous aerial (fixed-wing aircraft and helicopter) surveys of the Front and Davis Strait regions be carried out to provide additional estimates of pup production for both regions, with increased effort to assess pup production outside the whelping patches and to study effects of variation in strip width and inter-observer variability for helicopter surveys;

iii) that biological sampling of hooded seal catches at Greenland should be continued, with particular emphasis on age composition; and

iv) that attempts be made to collect detailed hunting effort statistics for Greenland to aid in the interpretation of trends in the catch data.

4. Coordination with the ICES Working Group on Harp and Hooded Seals in the Greenland Sea

STACFIS noted that a permanent ICES Working Group on harp and hooded seals in the Greenland Sea has been established, and agreed that liaison and cooperation with this Working Group would be of benefit to seal stock assessments and the planning of coordinated research within the NAFO Scientific Council. In order to achieve this, STACFIS proposes that a procedure should be established to exchange reports of special NAFO Scientific Council meetings on seals and reports of ICES Working Group meetings on a regular basis through the Secretariats of the two organizations. STACFIS also proposes that joint meetings should be considered in order to further improve coordination of future assessments and research related to harp and hooded seals in the North Atlantic.

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[7] KAPEL, F. O. 1982. Studies on the hooded seal, Cystophora cristata, in Greenland, 1970-80. NAFO Sci. Coun. Studies, 3: 67-75.

II. ASSESSMENT OF SHRIMP STOCKS

1. Introduction

The ad hoc Working Group on Shrimp met during 16-21 January 1985 at the request of STACFIS, with J. E. Carscadden as Convener, to consider the requests of the coastal states involved for advice on management in 1985 of the shrimp stocks in Davis Strait and Denmark Strait. Scientists attended from Canada (J. E. Carscadden and D. G. Parsons), EEC (D. M. Carlsson, P. Kanneworff, J. C. Poulard and R. Noé), Iceland (I. Halgrimsson), and Norway (O. M. Smedstad).

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

a) Fishery trends (SCR Doc. 85/I/3, 4, 6).

The nominal catch of shrimp in Subareas 0 and 1 increased from less than 10,000 tons prior to 1973 to almost 50,000 tons in 1976, decreased to about 35,000 tons in 1978 and 1979 and increased to about 45,000 tons annually in 1981-83 (Table 8). Preliminary statistics for 1984 indicate a total catch of about 45,000 tons, of which 38,000 tons were taken on the offshore grounds. The West Greenland inshore fishery has been relatively stable with estimated catches of 7,000-8,000 tons annually since 1972 (except 10,000 tons in 1974).

The offshore fishery has been regulated by TAC (total allowable catch) since 1977. In 1977 and 1978, the total offshore catches in the Davis Strait region were about 34,000 and 27,000 tons, compared with TACs of 36,000 and 40,000 tons respectively. In 1979 and 1980, the offshore fishery was regulated by a TAC of 29,500 tons, with the nominal catch being 27,000 and 37,000 tons respectively. Since 1981, Canada and the EEC have set separate TACs for Subareas 0 and 1 respectively. The TAC for Subarea 0 was 5,000 tons annually during 1981-84, whereas the TACs in Subarea 1 were in the range of 29,625-30,000 tons during 1981-84 (Table 8). For the same period, the Scientific Council advised that the TAC for Subarea 1 and adjacent parts of Subarea 0 should not exceed 29,500 tons.

Severe ice conditions in the spring of 1982, 1983 and 1984 caused delayed achievement of the allowable catch and a change in the distribution of the shrimp fishery, compared to the situation in the years preceding 1982. Ice severely hampered the fishery in the first 5 months of 1984, but, from May to October, Greenland vessels fished west and north of Store Hellefiske Bank (Div. 1B). More effort was expended in Div. 1C and 1D during this period than in 1983. The distribution of fishing effort by Greenland vessels in 1984, as in the previous 2 years, did not exhibit the northward shift that was evident in 1980 and 1981. Danish, Faroese, French and Norwegian vessels also fished in Subarea 1 in 1984, with slightly less effort than in 1983. Canadian vessels fished mainly between 58°W and 59°W and 67°N and 68°N in Div. 0A, as in previous years. Norwegian vessels expended some effort in Div. 1C and 1D, but most activity occurred in Div. 1B. There was no information available on the distribution of fishing effort by the other countries.

In Subarea 1, a total of 47 vessels (>80 GRT) participated in the fishery in 1984, compared to 48 in 1983 and 56 in 1982. In Subarea 0, a total of 8 vessels participated in the fishery in 1984 compared to 9 in 1983.

b) Input data

i) Commercial fishery data (SCR Doc. 85/I/ 3, 4, 6)

CPUE. Catch and effort information about the shrimp fishery in 1984 included Canadian data based on logbook records and observer reports for Subarea 0, Norwegian data based on logbook records for Subarea 1, and Greenland data based on logbook records and corresponding landings for Subarea 1.

Table 8. Nominal catches and TACs (metric tons) of shrimp (Pandalus borealis) in Subareas 0 and 1, 1975-1984.

		1975	1976	1977	1978	1979	1980	1981	1982	1983[1]	1984[1]
SA 0	Canada	-	-	-	-	-	59	1,590	858	2,030	420
	Denmark	-	-	68	86	67	-	1,923	946	1,359	223
	Faroes	-	-	239	-	115	-	1,686	-	757	555
	France	-	-	-	21	7	-	-	-	-	417
	Greenland	-	-	-	-	149	815	85	8	-	477
	Norway	-	65	150	15	791	-	-	-	-	-
	Spain	-	327	-	-	-	-	-	-	-	-
	Total	-	392	457	122	1,129	874	5,284	1,812	4,146	2,092
SA 1	Canada	-	-	-	-	245	590	-	-	-	-
	Denmark	1,142	2,717	5,842	3,382	1,327	872	995	959	451	390
	Faroes	5,300	11,179	12,612	8,070	6,867	3,554	1,234	530	475	383
	France	-	803	924	805	353	247	535	672	418	405
	F. R. Germany	-	-	31	-	-	-	-	-	-	-
	Greenland(a)[2]	8,700	7,300	7,800	7,600	7,500	7,500	7,500	7,500	7,500	7,500
	Greenland(b)[2]	1,089	2,478	7,081	5,531	12,527	27,501	28,197	32,016	32,108	33,500[3]
	Japan	-	146	-	-	-	-	-	-	-	-
	Norway	8,678	11,658	7,353	8,959	4,639	3,014	1,055	838	517	454
	Spain	6,948	6,925	-	-	-	-	-	-	-	-
	USSR	6,033	6,468	-	-	-	-	-	-	-	-
	Total	37,890	49,674	41,643	34,347	33,458	43,278	39,516	42,515	41,469	42,632
	Offshore	29,190	42,374	33,843	26,747	25,958	35,778	32,016	35,015	33,969	35,132
SA 0+1	Offshore catch	29,190	42,766	34,300	26,869	27,087	36,652	37,300	36,827	38,115	37,224
SA 0+1	Advised TAC	-	-	40,000	40,000	29,500[4]	29,500	29,500	29,500	29,500	29,500
SA 0+1	Effective TAC	-	-	36,000	40,000	29,500	29,500	35,000[5]	34,800[5]	34,625[5]	34,925[5]

[1] Provisional data.
[2] a = inshore (estimated from the total for Greenland), and b = offshore catches.
[3] Based on reporting to Greenland authorities of vessels greater than 80 GRT plus an estimate of 3,200 for vessels less than 80 GRT.
[4] Based on advice for a reduction in TAC of 20-32% of the 1978 TAC (ICNAF Redbook, 1979, p. 19).
[5] Includes TAC of 5,000 tons in Subarea 0.

Canadian logbook data showed a decrease in the July-September catch rate from 1983 to 1984. However, the data for 1984 covered only a small portion of the total catch in Subarea 0. Observer reports, which covered a greater part of the fishery in the area, showed similar catch rates in both years. Norwegian logbook data for Div. 1B showed a small increase in CPUE for the same period from 1983 to 1984, but, because of ice, no fishing occurred in Div. 1B during January-March and ice still hindered access to the fishing grounds in the northern part of the area during April-June. The catch rates of Greenland trawlers (630-722 GRT) were about the same level in April, May and June, but showed a typical seasonal decline from June to September. Spring catch rates were not as high as in earlier years. The Greenland data showed that more fishing occurred in Div. 1C in 1984 than in previous years, and catch rates in this division increased from 1983 to 1984 (SCR Doc. 85/I/3).

Indices of mean catch rates in the July-September period of 1976-84 for the different national fisheries in Div. 1B (standardized to 1976) and for the Canadian fishery in Div. 0A (standardized to the average of the other indices in 1980) are given in Table 9 and the Greenland data are illustrated in Fig. 1. In general, 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 CPUE index was available for 1983 and 1984) and the stabilization of the Norwegian index from 1982 to 1983. For both countries, however, the indices were derived from relatively small catches.

Table 9. CPUE indices (July-September) for Greenland, Norwegian and French fisheries for shrimp in Div. 1B and the Canadian fishery in Div. 0A, 1976-1984.

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

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

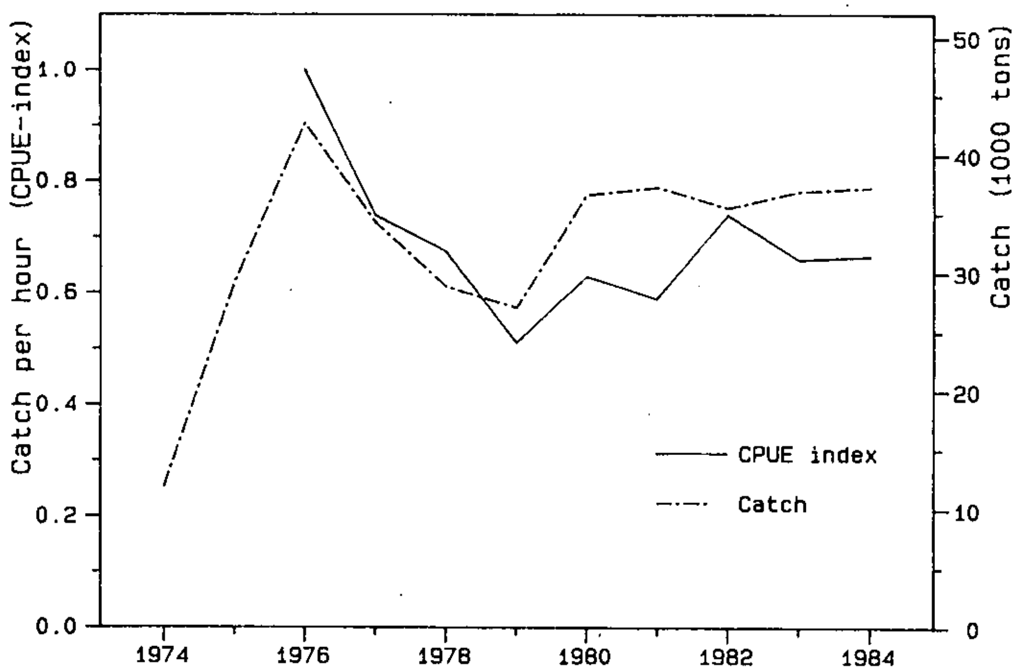

Fig. 1. Indices for mean CPUE for the period July-September, 1976-84 in Div. 1B compared to total offshore catches in Subareas 0 and 1. (Mean catch rates are based on logbook information for seven trawlers (630-722 GRT) of the Royal Greenland Trade Department. Offshore catch in 1984 is provisional).

No new information was available on the influence of the introduction by some countries of more efficient gears in the shrimp fishery around 1980 and their effect on CPUE indices. The late opening of the fishery in 1982, 1983 and 1984 due to ice resulted in a reduction of fishing pressure on spring concentrations of berried females. This might have resulted in higher than normal abundance later in the season. Therefore, it was agreed that the CPUE indices for July-September 1982-84 may be biased upwards, but it was not possible to quantify either of these factors.

Biological data. Shrimp samples from the Canadian fishery in Div. 0A in 1984 were analyzed for sex, maturity and age interpretation. The data showed that 9% of females in the sample would not have spawned in 1984. This value was higher than that observed in samples of previous years (SCR Doc. 85/I/4), when less than 5% failed to spawn. Four age groups were identified in the commercial sample, two of males and two of females, with more than 40% belonging to the oldest male group. It was agreed that further ageing of shrimp should be continued to determine the age composition of the yearly catches. However, before this can be done, the present interpretation of ages should be verified.

Length frequencies from the Canadian (SCR Doc. 85/I/4) and Norwegian (SCR Doc. 85/I/6) fisheries in Subarea 0 and 1 respectively showed that shrimp greater than 18 mm dominated in the catches. The Canadian data from Div. 0A showed that the smaller of the two male age groups was more abundant in October and November 1984 than in previous years.

Shrimp discards. The observed discarding of shrimp in Div. 0A during 1984 was higher in most months than in the previous 3 years. More than 5% of the total shrimp catch was discarded in most months. Size distributions of discarded shrimp showed two modal groups around 19 mm and 21-22 mm. No change in size of discards was noted between months or at different depths. The size range of discards (18-24 mm) was similar to the size range of males in the catches.

The observed discarding of shrimp by one Norwegian trawler in Div. 1B varied from haul to haul (2.1 to 16.7%), with an average of about 6% of the total shrimp catch being discarded. The size distribution of discarded shrimp from catches at Holsteinsborg Dyb showed the same bimodality as the discards in Div. 0A, whereas the discards from catches at Sukkertoppen Dyb showed unimodality at 20 mm. However, there was no information on the level of discarding and the reasons for discarding by the majority of the fleet.

By-catches. Generally, by-catches in the shrimp fishery of Subarea 0 and 1 do not appear to be a problem. Logbook records from eight Greenland trawlers showed a by-catch of 2% in 1984, compared to about 1% in the previous 3 years. The dominant species in the by-catch was redfish. Small redfish also dominated in the Nowegian by-catch, but the by-catch rate was lower than in the last 2 years. In the 1984 Canadian fishery in Div. 0A, the by-catch increased from about 6% in July to 36% in November. Most of this increase was attributed to increased incidence of Greenland sharks. The dominant commercial species in the catches was redfish which comprised less than 5% of the total catch in most months.

ii) Research vessel surveys (SCR Doc. 85/I/3, 8)

Abundance estimates from photographic surveys. Data from photographic surveys have been incorporated into a shrimp distribution model to derive biomass estimates for 1981-84 in the region from 66°00'N to 69°30'N (SCR Doc. 85/I/8). STACFIS considered that the results of the present version of the model were more reliable than those of earlier versions, but suggested that these results should be treated with caution because only half of the data that are included in the model have been reassigned to new size groups.

The trends in biomass estimates are in good agreement with CPUE indices for the seven trawlers of the Royal Greenland Trade Department (Fig. 2), except for the 1984 biomass estimate which shows a decline from the previous year. However, the analysis of the photographic data indicates that this decline is caused by a lower abundance of the smallest size group of shrimp in the southern part of the surveyed area. Because this group is not fully recruited to the fishable stock, a change in its abundance will not be reflected in the CPUE indices from the commercial fishery. In addition, data from the commercial fishery indicate that the biomass which was estimated for the area around Holsteinsborg Dyb (Div. 1B and 1C) may be underestimated. STACFIS noted that

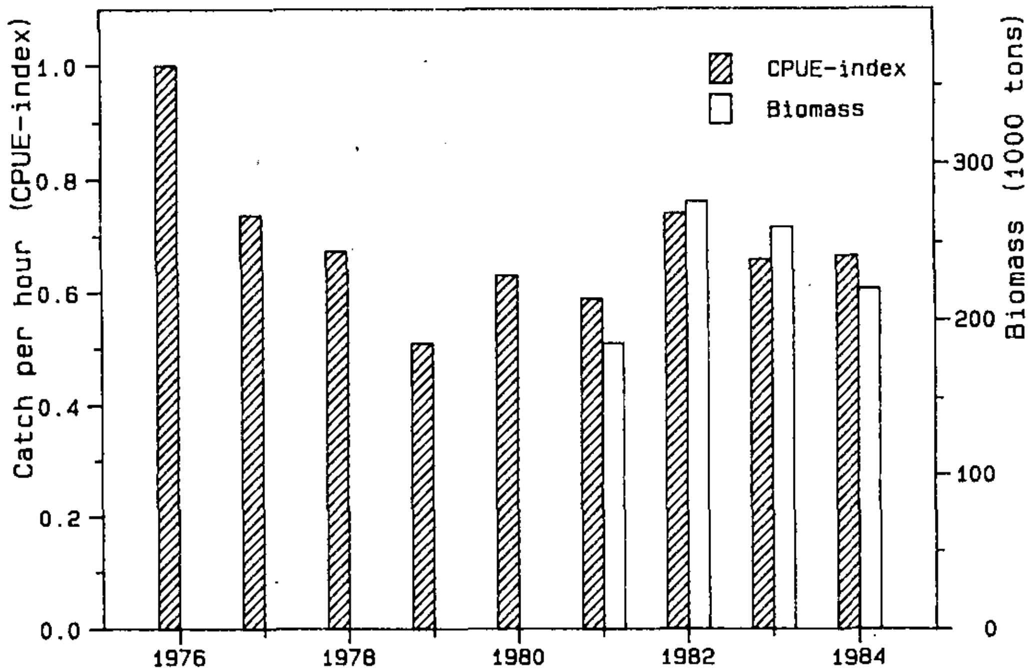

Fig. 2. Estimates of total biomass from photographic surveys in the area of 66°00'N-69°30'N, in depths 100-600 m, and average CPUE indices for commercial trawlers (July-September) in Div. 1B.

improvement of the input to the model has been achieved and that a good agreement now exists between the estimates from the model and the CPUE indices.

Bottom temperature has been regarded as one of the most important factors governing the distribution of shrimp. The photographic model indicates that there is a relationship between abundance and observed bottom temperature in the area 2 and 3 years earlier. It was noted that bottom temperatures in the area have been declining in recent years, which may affect the productivity of the stock, but STACFIS was unable to evaluate this possibility.

Biological data. Length compositions of shrimp samples from a Danish research survey in July-August were analyzed for sex and maturity (SCR Doc. 85/I/3). Trawling was carried out on the photographic stations wherever bottom conditions permitted. The data showed that males generally dominated in areas south and west of Store Hellefiske Bank (Div. 1B) and in Godhavn Rende (Div. 1A) to the northeast. In these areas, females were noticeably lacking. At some stations on the northern slope of Store Hellefiske Bank (Div. 1B), higher proportions of large shrimp (transitionals and females) were found. An examination of a small number of samples from 1983 and 1984 showed that, in the northern and southern areas, the proportion of non-spawning females was similar in the 2 years. At one offshore station on western Store Hellefiske Bank (Div. 1B), where there was a high proportion of females, an increase in non-spawners was observed, similar to observations from the Canadian fishery in the adjacent Div. 0A (SCR Doc. 85/I/4). It was noted that the available samples were difficult to interpret because of the lack of a time series. STACFIS proposed that similar samples over a series of years be examined to detect changes in distributional patterns and that an attempt should be made to relate such changes to abundance estimates.

c) Prognoses

Catch rates from the Canadian fishery in Div. 0A (observer data) for the July-September period were approximately the same in 1983 and 1984. The same pattern was evident in catch-rate data for the Greenland and Norwegian fisheries in Div. 1B. Although the CPUE indices indicate that the stock showed an increasing trend from 1979 to 1982 and stability since then, these indices may be biased upwards in recent years because of possible influences of improved trawl design since 1980 and unfavorable ice conditions in 1982, 1983 and 1984 (see CPUE section). Although the effects of these factors cannot be estimated, it is quite possible that they could account for the observed increase and subsequent stability of the stock, and that the stock may not have increased since 1979 (Fig. 1).

In 1976, STACRES advised a TAC of 40,000 tons for 1977, based on a strategy to maintain the spawning stock level at 50% of the virgin spawning stock size (ICNAF Redbook, 1977, page 15). However, in 1978, it was advised that the 1979 TAC be set at a level in the range of 20-32% below the advised 1978 TAC of 40,000 tons to reflect decreases in abundance between 1976 and 1978 (ICNAF Redbook, 1979, page 19). STACFIS has not advised increases in the TAC of 29,500 tons since 1979 because of the interpretation of the catch-rate series, as discussed above, and because of concerns over the recruitment prospects for the stock. Although concerns about recruitment have been expressed by STACFIS in recent years, catch rates have not declined. From the data available at this meeting, it was not possible to provide quantitative estimates of recruitment for 1985. Because of the apparent stability of the stock and the fact that higher-than-advised yields have been realized during this period of stability, STACFIS advises that the overall TAC for the offshore grounds in Subarea 1 and the adjacent parts of Subarea 0 in 1985 should not exceed 36,000 tons which corresponds to the average catch during 1979-84.

STACFIS emphasizes that this advice to increase the TAC is not based on evidence of an increase in the stock since 1979 but rather on a reevaluation of a longer data series. Furthermore, because little is known about the effects of the environment on growth, survival, recruitment and distribution of shrimp, STACFIS is concerned about the possibility of poor recruitment due to adverse environmental conditions, as evident by declining bottom temperatures. Although this shrimp stock appears to have been stable in recent years, other P. borealis stocks (e.g. Alaska, Gulf of Maine) have collapsed due to the combined effects of overfishing and changes in environmental parameters.

d) Future research requirements

STACFIS noted that some of the recommendations from the January 1984 Meeting (NAFO Sci. Coun. Rep., 1984, page 15) were addressed during the year. Danish scientists redefined size categories of shrimp in the photographic model for most years, with the remainder to be completed in 1985. Also, observer programs were continued in 1984, providing length frequencies, biological samples and estimates of by-catch and discards. However, some other recommendations were not addressed, and it was agreed that these be reiterated. Special note was made of the inability to initiate a time series of stratified-random trawl surveys. It was agreed that such a series is essential to compare with the other abundance indices from the photographic surveys and CPUE data, as well as provide more quantitative information on recruitment. Concern was expressed that estimates of discards have not been representative of the fishery and that catches have been underestimated. STACFIS therefore recommends

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

ii) *that the annual photographic survey be continued;*

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

iv) *that reporting of discards be closely monitored to ensure reliability and consistency with observer reports;*

v) *that countries participating in the shrimp fishery ensure that fishing vessel logbooks are completed and copies made available to scientists as soon as possible;*

vi) *that a study be undertaken to determine the relative efficiency of gear types used in the Davis Strait shrimp fishery in an attempt to quantify the effects of recent changes in gear on CPUE indices;*

vii) *that the present interpretation of age and growth of shrimp be verified and an attempt made to separate shrimp catches into year-classes.*

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

a) Fishery trends (SCR Doc. 85/I/7, 10, 11, 12)

The shrimp fishery in Denmark Strait began in 1978 by an Icelandic vessel on the eastern side of the midline between Greenland and Iceland (Table 10). Nominal catches increased to 1,300 tons in 1979 when Norwegian trawlers participated in the fishery, and exceeded 8,200 tons in 1980 with the additional involvement of Danish, Faroese, French and Greenland vessels. In 1981, the total catch on both sides of the midline declined to 4,800 tons, well below the level of 8,000 tons aimed at by the EEC for regulation of the fishery in the area west of the midline. For 1982, a TAC of 4,500 tons was set by the EEC for the western side of the midline, whereas the Scientific Council advised an overall TAC of 4,200 tons; the reported catch in 1982 totalled 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 totalled 4,200 tons. In 1984, the EEC set a TAC of 5,245 tons, the Scientific Council advised an overall TAC of 4,200 tons as previously, and the reported catch totalled 6,400 tons.

Table 10. Nominal catches and TAC (metric tons) of shrimp (*Pandalus borealis*) in Denmark Strait, 1978-84.

Country	1978	1979	1980	1981	1982	1983	1984[1]
Denmark	-	-	702	581	740	204	443
Faroes	-	-	4,233	713	737	443	668
France	-	-	50	353	414	291	500
Greenland	-	-	200	1,004	1,115	1,467	2,250
Iceland	363	485	614	125	-	43	363
Norway	-	800	2,461	2,016	1,896	1,727	2,128
Total	363	1,285	8,260	4,792	4,902	4,175	6,352
Advised NAFO TAC	-	-	-	-	4,200	4,200	4,200
Effective EEC TAC[2]	-	-	-	8,000	4,500	5,725	5,245

[1] Provisional data

[2] On the western side of the midline

The shrimp fishery in Denmark Strait in 1984 took place in the area of Strede and Dohrn Banks as well as on the slopes of the Storfjord Dyb. Ice conditions early in the fishing season were variable, hindering the access to more northern and eastern areas, but, later in the season, the ice cover did not influence the distribution of the fishing fleet as in previous years. For 1983, available information indicated that the bulk of the catch was coming from south of 66°N, whereas the main fishery in 1984 was conducted north of 66°N at depths ranging from 300 to 500 m.

In 1983, the overall fishing period (except for one vessel) extended from March to November, with the main fishing period from March to June when about 80% of the catch was taken. In 1984, the fishing periods west and east of the Greenland-Iceland midline differed considerably. West of the midline, the fishing period extended from January to May, when about 5,800 tons (approximately 92% of the total catch) were taken, and in November-December when Faroese vessels caught about 90 tons. East of the midline, on the other hand, the fishing period extended from June to December, the main fishing period being in September and October when about 70% of the total catch east of the midline was taken. As in 1983, 41 vessels (excluding Icelandic vessels) participated in the fishery.

b) Input data

i) Commercial fishery data (SCR Doc. 85/I/7, 10, 11, 12)

CPUE. Monthly catch rates and corresponding fishing effort, based on logbook data for the Danish, French, Greenland, Icelandic and Norwegian fisheries in 1980-84, are listed in Table 11. In 1980 and 1981, catch rates were highest during March-April, whereas in 1982 catch rates were highest in May. In 1983 and 1984, the highest catch rates were from the Greenland fishery in March and January respectively. The January 1984 catch rate for Greenland vessels was almost as high as the highest catch rate observed for Danish and Greenland vessels (April 1980), but then declined through February and March. The catch rates for the French vessels were considerably higher in April and May in 1981 and 1984, compared to the same months in 1982 and 1983. The Norwegian catch rates in 1982 and 1983 were lower than the catch rates in 1980 and 1981. In April 1984, Norwegian catch rates showed an increase compared to April 1983, whereas the catch rates in May were considerably lower in 1984 compared to the year before. The Icelandic catch rates were stable in June from 1980 to 1983 (except 1982, when no fishing took place), but declined in 1984. The October and November catch rates also declined from 1983 to 1984.

Ice conditions differed considerably from month to month throughout the years and thereby affected the distribution of the fishery, making the evaluation of CPUE data difficult. This difficulty was compounded by incomplete data on catch location and fishing effort for a substantial portion of the fleet. Although it was not possible in previous assessments to reach a conclusion on the reasons for the trends observed in catch rates in recent years, the inclusion of the data for 1984 indicates stability in the stock. Despite this indication of stability from the CPUE series, it was agreed that a more detailed analysis of the existing data was needed. Such an analysis might include standardization by gear, tonnage class and season to obtain a representative abundance index for the stock.

Biological data. Data on the biology of shrimp in Denmark Strait were available from Greenland, Norwegian, French and Icelandic trawlers in 1984. Length distributions of catches from trawlers of the four countries were similar, the size range of shrimp being 20-35 mm with the dominant mode in all samples at approximately 29 mm. The sample from the French trawler, however, had proportionately fewer shrimp between 20 and 25 mm.

Samples obtained from Greenland vessels in February north of 66°N were comprised mostly of 25-33 mm females, with the males being mainly 20-28 mm. Females dominated in two samples taken in March south of 66°N, but the more westerly sample contained a higher proportion of males than that from further east. The size ranges of shrimp in these

Table 11. Monthly catch rates (kg per hour trawling) and corresponding effort (hours trawling) from the logbooks available from the shrimp fishery off East Greenland, 1980-84.

		Denmark and Greenland[1]		France		Iceland[2]		Norway	
Year	Month	CPUE	Effort	CPUE	Effort	CPUE	Effort	CPUE	Effort
1980	Mar	-	-	-	-	-	-	904	398
	Apr	672	35	-	-	-	-	704	793
	May	392	1,295	-	-	125	1,425	378	1,071
	Jun	139	315	-	-	90	1,478	98	714
	Jul	71	60	62	40	104	1,176	-	-
	Aug	17	32	-	-	123	851	95	874
	Sep	181	482	-	-	96	806	145	2,883
	Oct	107	1,165	-	-	-	-	99	3,071
	Nov	145	465	-	-	-	-	160	1,181
1981	Mar	-	-	-	-	-	-	364	137
	Apr	486	1,343	433	157	-	-	296	3,848
	May	263	914	261	522	-	-	161	4,057
	Jun	123	6	144	257	99	688	119	1,101
	Jul	-	-	-	-	78	603	-	-
	Aug	-	-	-	-	39	245	42	167
	Sep	-	-	-	-	-	-	46	65
1982	Mar	160	763	-	-	-	-	197	1,548
	Apr	195	1,570	216	331	-	-	171	4,450
	May	280	1,394	264	563	-	-	248	3,339
	Jun	-	-	185	238	-	-	-	-
1983	Mar	345	484	-	-	-	-	-	-
	Apr	160	457	165	248	-	-	128	2,734
	May	-	-	254	245	50	2	255	1,439
	Jun	-	-	162	206	99	52	143	1,797
	Jul	-	-	-	-	-	-	133	45
	Aug	-	-	-	-	-	-	98	622
	Sep	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	172	80	-	-
	Nov	-	-	-	-	155	158	-	-
1984	Jan	600	105	-	-	-	-	-	-
	Feb	356	312	-	-	-	-	208	183
	Mar	224	281	316	132	-	-	229	2,104
	Apr	-	-	487	723	-	-	184	3,701
	May	-	-	304	349	-	-	161	2,699
	Jun	-	-	-	-	42	59	-	-
	Jul	-	-	-	-	68	283	-	-
	Aug	-	-	-	-	75	62	-	-
	Sep	-	-	-	-	99	1,280	-	-
	Oct	-	-	-	-	125	1,000	-	-
	Nov	-	-	-	-	70	952	-	-
	Dec	-	-	-	-	100	273	-	-

[1] Data based on logbooks from Danish and Greenland trawlers in 1980, 1981 and 1982. Since 1983 only Greenland logbooks have been available.

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

samples were similar to those in the February samples, and the proportion of transitionals was low in both months.

Norwegian samples in April south of 66°N showed that all shrimp were females, 92% of which were ovigerous. North of 66°N, 37% of the sample were males, 15% transitionals and 48% females. French samples showed a predominance of females (93%) around the same time of year in the area of 66°N. Males ranged in size from 20 to 29 mm. Transitionals and females with sternal spines ranged from 25 to 32 mm, and females with no spines from 22 to 34 mm.

Icelandic samples in October-November indicated slow development of ovaries of females in this region where bottom temperatures were just over 0°C. A separation of a November sample by sex indicated three year-classes of males, a single mode of females with spines and possibly two year-classes of older females without spines.

Shrimp less than 20 mm were scarce in all the 1984 samples, including the Norwegian discard data. This supports the conclusion that young shrimp are not abundant on the fishing grounds and likely inhabit other areas, some of which may not be accessible to fishing. It was noted, however, that both the Greenland (February-March) and Icelandic (November) samples contained a higher proportion of male shrimp than observed in samples of the catches in former years.

Shrimp discards. Observations on one Norwegian trawler indicated discarding rates of 0.7% to 5.9%. On an average, 3.4% of the total catch was discarded in 1984, compared to 0.8% in 1983, 3.7% in 1982 and 11.5% in 1981. For one French trawler, discarding was reported to be 0.7%, and an observer on board a Greenland trawler reported that discarding was minimal. The Norwegian data showed a size range of discards of 17-29 mm with a mode at 24 mm. It was noted that information on discarding of shrimp was very minimal, making year-to-year comparisons difficult.

By-catches. Data on by-catches of fish in the shrimp fishery were reported for French, Greenland and Norwegian vessels. The by-catch of French vessels were comprised mainly of redfish and Greenland halibut and was less than 1% of the total catch. The by-catch of a Greenland vessel was 9.1% by weight in 1984, compared to 2.0% in 1983, the increase being mainly due to small redfish. On the Norwegian vessel, the by-catch increased from 1983 to 1984, the mean numbers of fish caught per kg of shrimp being 0.18 and 0.24 respectively. The increase was mainly due to Greenland halibut which was the dominant species in the by-catch.

ii) Data from research surveys (SCR Doc. 85/I/5)

Biological data. The Norwegian research cruise to Denmark Strait in September 1984 provided additional information on the biology of this shrimp stock. Males dominated in the outer part of the survey area, whereas females were more abundant near Dohrn Bank (around 66°N, 30°W) where they comprised 90% of the catches. Fifty percent of females in the outer part of the area lacked roe, whereas 90% of the shrimp in the area around Dohrn Bank had roe. Shrimp were smallest in the north and west and largest around Dohrn Bank.

c) Estimation of parameters

i) General production model (SCR Doc. 85/I/15)

A general production model (Fox, 1970)[8] was used to calculate maximum sustainable yield. Data for all countries involved in the fishery were used, except for the first

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

2 years (1978 and 1979) when only the Icelandic catch and effort data were available. Monthly effort for each country was calculated by dividing catch by catch rate, and the monthly estimates for all countries were combined to yield an annual catch rate. The 1978 and 1979 catch rates from Icelandic data were adjusted by a constant (2.22), which was calculated by dividing the catch rate of all countries in 1980 and 1981 by the Icelandic catch rate for the same years. Moving averages of 2 and 3 years were used in the model.

d) Assessment results

i) General production model (SCR Doc. 85/I/15)

The maximum sustainable yields calculated from the general production model were 4,900 tons (3-year moving average) and 5,400 tons (2-year moving average), but the fit was slightly better for the 3-year moving average.

STACFIS noted that a similar analysis had been presented several years earlier and had been used, in the absence of other information, as a guide in assessing the yield from the stock. However, even with additional data, this model provided only a very approximate estimate of the maximum sustainable yield of the stock, because of the short time-series and the adjustments that were made in the data from the early years.

e) Prognoses

Sampling from the Norwegian survey of Denmark Strait in September 1984 was insufficient to estimate biomass. Catch-per-unit-effort data for Greenland and Norwegian trawlers indicated some stability in abundance since 1981, but data from two French trawlers showed a substantial increase in 1984. The catch rates of these vessels for 15-30 April were the highest reported during the 1981-1984 period. Icelandic catch-rate data were inconclusive.

Observations on aspects of the biology of shrimp in the Denmark Strait that had been considered in previous years were again discussed. The Committee noted that there is at least 5 years of growth from the larval stage to the spawning female, and the effects of exploiting the spawning stock on future recruitment are not yet measurable. It was also noted that this stock may be living under extreme and unstable environmental conditions.

Although the general production analysis indicated a sustainable yield of approximately 5,000 tons, STACFIS agreed that such an analysis should be used only to provide an approximate estimate of the maximum sustainable yield. STACFIS noted that the catch-rate data indicate stability in the stock, and therefore advises that the overall TAC for 1985 should not exceed 5,000 tons, which corresponds to the average catch during the 1981-84 period. It was further noted that allowing the catches to exceed the advised TAC (as has occurred since 1981) would add further pressure on the stock in 1985, which in turn may adversely affect the stock in future years.

f) Future research requirements

More information on biological characteristics of shrimp in Denmark Strait was contained in the Greenland, Norwegian, French and Icelandic data, but its usefulness in assessing the stock was limited by the lack of information on a year-round basis. STACFIS noted that there was a Norwegian research vessel survey in September 1984 but was concerned that few data were available on the environmental and biological questions outlined at the Janaury 1983 Meeting (NAFO Sci. Coun. Rep., 1983, page 16). STACFIS therefore

recommends

i) that catch-rate data and biological samples be obtained from all components of the fishery in Denmark Strait;

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

iii) that a study on environmental conditions be undertaken, including ice and currents in the area;

iv) that the Icelandic samples collected from 1976 to 1984 be analyzed in greater detail to determine seasonal changes in maturity; and

v) that countries participating in the shrimp fishery ensure that fishing vessel logbooks are completed and copies made available to scientists as soon as possible.

III. OTHER MATTERS

1. Acknowledgements

There being no further business, the Chairman thanked the participants for their interest and cooperation in making this meeting a successful one, and especially W. D. Bowen for his involvement as Convener of the *ad hoc* Working Group on Seals. He expressed his appreciation to the NAFO Secretariat and the staff of the Greenland Fisheries and Environmental Research Institute for their support during the course of the meeting.

APPENDIX II. AGENDA FOR JANUARY 1985 MEETING

I. Opening (Vice-chairman: J. Messtorff)

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

II. Fishery Science (STACFIS Chairman: J. E. Carscadden)

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 catches
vii) Future research needs

b) Shrimp at East Greenland (Annex 2)

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

2. Assessment of Seal Stocks (Annex 3)

a) Northwest Atlantic harp seals

i) Review of fishery trends
ii) Population assessment
iii) Distribution and biology
iv) Future research requirements

b) Northwest Atlantic hooded seals

(Items (i) to (iv) as in 2(a) above)

III. Other Matters

1. Review of Future Meeting Arrangements (if needed)

2. Adjournment

ANNEX I. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1985

OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 1984 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks in 1985:

   Cod (Div. 2J, 3K and 3L; Div. 3N and 3O, Div. 3Ps)
   Redfish (Div. 3L and 3N)
   American plaice (Div. 3L, 3N and 3O)
   Witch flounder (Div. 3N and 3O)
   Yellowtail flounder (Div. 3L, 3N and 3O)
   Greenland halibut (Subarea 2 and Div. 3K and 3L)
   Roundnose grenadier (Subareas 2 and 3)
   Silver hake (Div. 4V, 4W and 4X)
   Capelin (Div. 3L, Div. 3N and 3O)
   Squid (Subareas 3 and 4)

   It is further suggested that, subject to the concurrence of the other coastal states concerned, the Scientific Council, prior to the 1984 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1985 of the following stocks:

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

2. Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for those stocks listed above and for the Flemish Cap (Div. 3M) stocks:

   a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As a general reference point, the implications of continuing to fish at $F_{0.1}$ in 1985 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 1985 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 biomasss at levels of about two-thirds that of the virgin stock.

L. S. Parsons
Assistant Deputy Minister
for Atlantic Fisheries
Dept. of Fisheries and Oceans
Ottawa, Canada

ANNEX 2. EEC REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 1985 OF CERTAIN STOCKS IN SUBAREAS 0 AND 1

1. The EEC requests the Scientific Council of NAFO to provide advice for the following stocks:

   a) Stocks occurring in Subareas 0 and 1:

      Greenland halibut
      Roundnose grenadier
      Northern shrimp

   b) Stocks occurring in Subarea 1:

      Atlantic cod
      Atlantic redfish
      Wolffish (catfish)

2. For the above mentioned stocks, the present state of exploitation should be reviewed and options for management in 1985 given. Where possible, these should be expressed graphically in terms of catch in 1985 and the size of the spawning stock biomass on 1 January 1986 for a range of values of F which covers at least -50% to +25% of F in 1983.

3. For cod in Subarea 1, it is requested that catches for each year up to and including 1987 and spawning stock biomasses for each year up to and including 1988 are calculated for maintaining F at the following levels from 1985 onwards: $F = F_{0.1}$, $F = F_{max}$ and F_{1982}. All values of F refer to that on the most heavily exploited age groups.

   Catches should also be calculated for the option of maintaining the spawning stock biomass at 175,000 tons and the resultant F estimated.

   It is also requested that F in each year up to and including 1987 and spawning stock biomasses for each year up to and including 1988 and calculated for:

   - maintaining until 1987 a constant catch equal to that in 1983;
   - maintaining until 1987 a constant catch equal to that in 1984 if the stock were fished at $F_{0.1}$ in 1984;
   - maintaining until 1987 a constant catch of 68,500 tons

   The agreed TAC for 1984 is 68,500 tons.

   Advice is requested on the effects of increasing the mesh size from the existing regulation 130 mm to 140 mm, 150 mm and 160 mm respectively. From September 1984, the fishery by Greenland fishermen will use 140 mm mesh size.

4. Management options for shrimp at East Greenland should also be given in coordination with ICES.

E. Gallagher, Director General
Directorate General for the Fisheries
Commission for the European Communities
Brussels, Belgium

ANNEX 3. JOINT CANADA-EEC REQUEST FOR ADVICE ON HARP AND HOODED SEALS

1. The Government of Canada and the European Economic Community request advice, before February 15, 1985, of the NAFO Scientific Council on the scientific basis for management in 1985 of harp seals and hooded seals within national fishery limits in NAFO Subarea 0, 1, 2, 3 and 4. Specifically the Scientific Council is requested to review the results of recently completed programs and advise on the following:

a) Northwest Atlantic Harp Seals

i) Current stock size and pup population and recent trends in these parameters.

ii) Current replacement yield and substainable yield at present stock size and in long term and under varying options of age compositions in the catch, including that recently occurring, specifically, how has the replacement yield changed with the changes in the age composition of the catch recently observed?

iii) Trends in population size based upon differing levels of catch assuming quota regulations of all removals except that by traditional hunting in the Canadian Arctic and at Greenland.

iv) Trends in catches in Canada, North of 60°N latitude and at Greenland.

v) Future research requirements and need for coordination with ICES.

b) Northwest Atlantic Hooded Seals

i) Interrelationships between Davis Strait and Front herds.

ii) Current stock size and pup population.

iii) Current replacement yield and substainable yield at present stock size and in long term.

iv) Trends in population size over the next five years, assuming a continuation of the current harvesting regime at Greenland and differing levels of catches in Canadian waters, including those occurring in the recent past.

v) Future research requirements.

L. S. Parsons
Assistant Deputy-Minister
for Atlantic Fisheries
Dept. of Fisheries and Oceans
Ottawa, Canada

E. Gallagher, Director General
Directorate General for the Fisheries
Commission for the European Communities
Brussels, Belgium

APPENDIX III. LIST OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS

SCR No.	Serial #	Title
85/I/1	N935	BOWEN, W. D., and D. E. SERGEANT. A mark-recapture estimate of 1983 harp seal pup production in the Northwest Atlantic.
85/I/2	N936	BOWEN, W. D. An estimate of the proportion of recovered harp seal tags not returned for reward: the 1983 mark-recapture experiment.
85/I/3	N937	CARLSSON, D. M. Data on the shrimp fishery in NAFO Subarea 1 in 1983 and 1984.
85/I/4	N938	PARSONS, D. G., P. J. VEITCH, and G. E. TUCKER. Catch, effort, CPUE and biological data from the Canadian fishery for shrimp (*Pandalus borealis*) in Division 0A, 1984.
85/I/5	N939	SMEDSTAD, O. M. Preliminary report of a cruise with M/T *Masi* to East Greenland waters in September 1984.
86/I/6	N940	SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (*Pandalus borealis*) off West Greenland in 1984.
85/I/7	N941	SMEDSTAD, O. M., and S. TORHEIM. Norwegian investigations on shrimp (*Pandalus borealis*) in East Greenland waters in 1984.
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85/I/14	N948	HAY, K., R. A. MYERS, and W. D. BOWEN. Estimation of pup production of hooded seals (*Cystophora cristata*) in the Northwest Atlantic during March 1984.
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85/I/2	N951	NAFO. Provisional report of Scientific Council Meeting, January 1985.

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