

Northwest Atlantic



Fisheries Organization

Serial No. N026

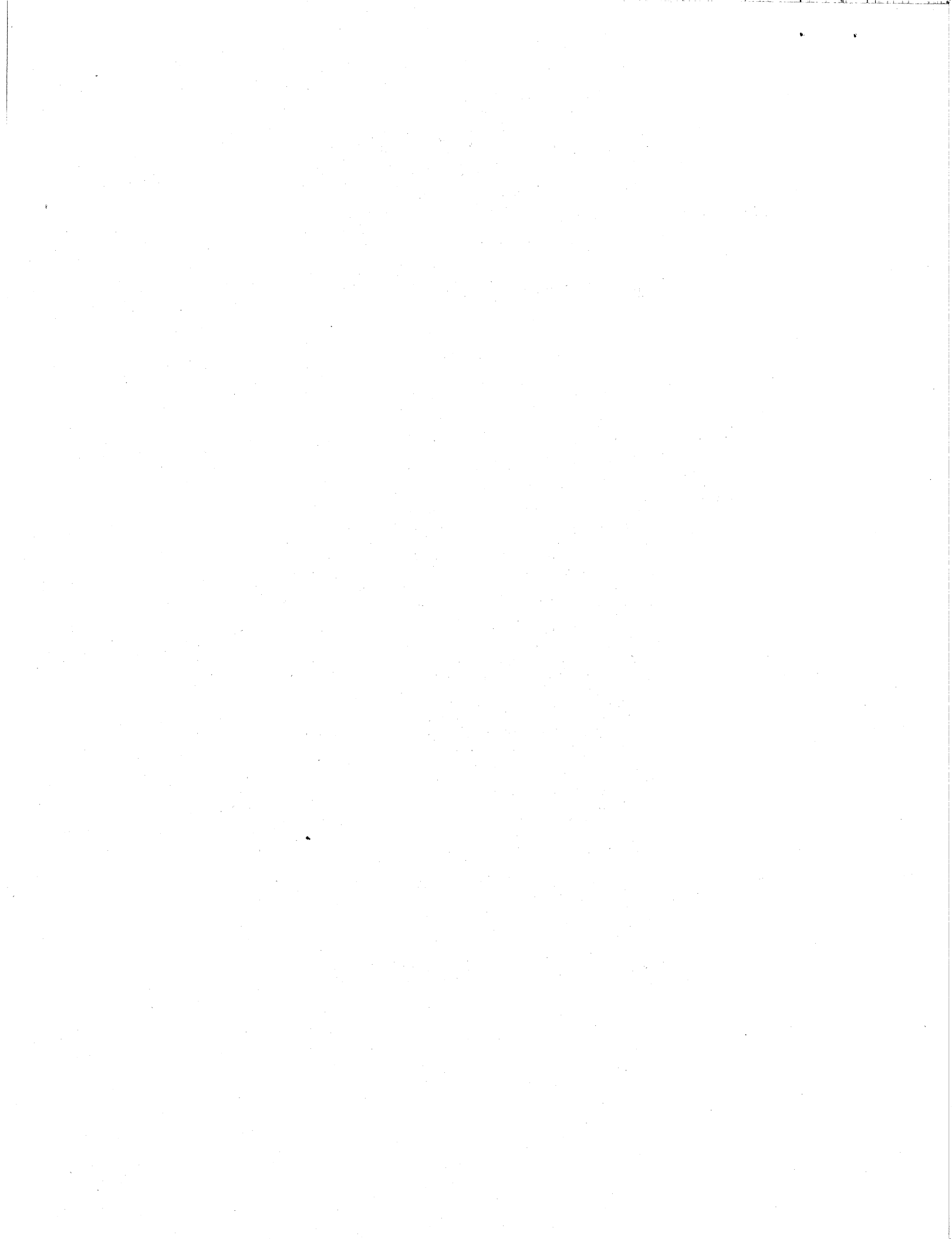
NAFO SCS Doc. 79/XI/2

SPECIAL MEETING OF SCIENTIFIC COUNCIL - NOVEMBER 1979

Report of Scientific Council on Shrimp and Seals
(Dartmouth, Canada, 13-16 November 1979)

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REPORT OF THE SCIENTIFIC COUNCIL OF NAFO

Special Meeting on Shrimp and Seals, November 1979

Chairman: R. H. Letaconnoux

Rapporteur: V. M. Hodder

The Scientific Council met at NAFO Headquarters, Dartmouth, Canada, during 13-16 November 1979, to provide advice for 1980 on the conservation of the shrimp stocks in Subareas 0 and 1 and the harp and hooded seal stocks in the Convention Area. The stock assessments were undertaken by the Standing Committee on Fisheries Science (STACFIS), whose report, as approved by the Scientific Council, is given in Appendix I. The agenda for the meeting is given in Appendix II, the list of participants in Appendix III, and the list of research and summary documents in Appendix IV. Brief summaries of the shrimp and seal assessments, together with other matters considered by the Scientific Council, are given below.

1. Assessment of Shrimp Stocks in Subareas 0 and 1

In 1978, the offshore shrimp fishery in Subareas 0 and 1 was regulated by an overall TAC of 40,000 tons of which only about 27,000 tons were taken. The offshore fishery in 1979 was regulated by an overall TAC of 29,500 tons. Preliminary catch statistics for January-October 1979 indicate that the total catch in the management areas was about 22,300 tons. The information presented at the meeting confirms that the major part of the biomass in Div. 1B from July to October 1979 was found at the northwestern slopes of Store Hellefiske Bank, with a dominance of small shrimp (immature and males) on the shallower (150-200 m) parts of the Bank.

New information on the biology of shrimp relates to variation by depth and area in the distribution of various size groups, to diurnal variation in catch per effort due to vertical migration, to studies of modes in length frequencies as representing age-groups, and to studies of variation by area of the spawning/hatching rate of females.

For advising on the total allowable catch for 1980, all information available on biomass estimates, trends in catch rates, and composition of the stock was taken into consideration. There was good correspondence between the biomass estimates based on data from the two trawl surveys in 1979. The 1979 biomass estimates for the area between 66°N and 69°N were not very different from the estimates based on trawl survey data for the same area in 1976. However, the 1979 surveys used trawls with smaller meshes and thus caught relatively more small and medium-sized shrimp. Consequently, biomass in this area seems to be somewhat lower in 1979 than in 1976. It was generally agreed that a decrease in biomass had occurred over the period 1976 to 1978 as reported at the November 1978 Meeting. Catch rates also decreased over the same period. It is more difficult to compare catch rates in 1978 with those available for part of 1979, but the overall level of catch rates between the two years does not seem to differ significantly. At the same time, some changes seem to have occurred in the size composition of the stock with an increase (relatively as well as absolutely) in the number of small and medium-sized shrimp. Taking all of these factors into consideration, the Scientific Council advises that the overall TAC for the offshore shrimp grounds in Subarea 1 and adjacent parts of Subarea 0 in 1980 should remain at the same level as in 1979 (29,500 tons).

In view of the relatively low biomass of shrimp estimated for Div. 0B off Baffin Island and the very low catch rates, it was decided that advice on total allowable catch for this area was not necessary.

Although more information is gradually becoming available on the distribution and abundance of pre-recruit shrimp, knowledge about recruitment is still not good enough to allow more detailed forecasts of stock size and distribution. However, a review of the situation at the May-June 1980 meeting of the Scientific Council could be made if desired.

The Scientific Council endorsed the recommendations of STACFIS regarding future research on shrimp (see Appendix I, page 10).

2. Assessment of Seal Stocks

a) Harp seals

A re-analysis of all available information shows that mean age of sexual maturity has declined from 6.2 years in the early 1950's to 4.3 years in 1979, while fertility rate has shown a corresponding increase from 0.85 to 0.94 during the same period. Since no new estimate of natural mortality was available, the previously estimated value of 0.10 has been used in this assessment.

A 1979 tag-recapture study provides a reliable estimate of 203,000 for the pup production at the Front, with 95% confidence limits of 174,000 and 239,000. An additional 20,000 pups may be added to account for a smaller southern patch, the size of which was estimated by eye. Since previous aerial survey data show that, on the average Gulf production is 0.375 of total production, the total Gulf and Front production for 1979 is estimated at 352,000 pups. Other estimates

of pup production from both 1978 and 1979 tag-recapture studies are considered unreliable owing to various biases in the data.

The survival index method gives an estimate of pup production for mid-year 1973 of 342,000 pups, with 95% confidence limits of 267,000 and 625,000. This simple and reliable method of estimation, which depends on a wide spread of catch figures, will soon become inapplicable owing to the low variability of recent pup kills.

Recoveries of tagged harp seals show that homing increases with age. For animals aged 5 years and up, 12 of 16 recoveries (75%) have come from the area of birth.

Cohort analyses, based on the mean estimate of pup production from the 1979 tagging experiment (352,000) and on its lower confidence limit (304,000), give estimated age 1+ population size in 1979 of 1.38 and 1.26 million respectively. The mean value of 352,000 is considered to be the best estimate of 1979 pup production, since it agrees well with updated estimates derived from the aerial survey (320,000 for 1977) and from the survival index method (342,000 for 1973).

Population projections to 1985, based on an annual catch of 180,000 seals, indicate an instantaneous rate of increase for age 1+ seals of 0.02 per year for a 1979 pup production of 352,000 and 0.01 per year for a 1979 pup production of 304,000. Pup production in 1985 is estimated at 397,500 in the first case and 339,400 in the second.

With a mean whelping age of 5.3 years and fertility rate of 0.94, and assuming a continuing catch of 180,000 per year (80% pups, 20% age 1+ seals), sustainable yields are estimated to be 237,000 and 205,000 respectively for 1979 pup productions of 352,000 and 304,000. Replacement yields, based on the best estimate of pup production (352,000), is estimated at 205,400.

The catch in West Greenland attained a level near 10,000 seals in 1978 and appears to be increasing. Since a further catch of about 2,000 per year is taken in Arctic Canada, consideration should be given to increasing the exemption for arctic catches from 10,000 to 15,000 seals in 1980.

b) Hooded seals

No new analyses of age and reproductive samples were available, the most recent being those presented at the November 1978 meeting. Analysis of catch/effort data for the Front in 1979 was unsuccessful due to rapid changes in catchability of pups which enter the water at an early age compared to harp seals.

There is no new basis for revising the assessment presented to the November 1978 meeting. STACFIS therefore advises that the TAC for hooded seals at the Front should remain at 15,000 for 1980, with the kill of adult females limited to 5% of the TAC.

c) Future research

The Scientific Council endorsed the recommendations of STACFIS regarding future research on harp and hooded seals (see Appendix I, pages 12-13). The Council also noted the interest of STACFIS in obtaining information on biological responses of the White Sea population of harp seals to protection, requested the Secretariat to seek permission from the Northeast Atlantic Sealing Commission for the use of any relevant information in the national research reports submitted to the Commission by its members.

3. Future Meetings

The Scientific Council reviewed the scheduling of meetings for the first half of 1980 and confirmed the following:

- a) Special Meeting of the Scientific Council to be held in Lisbon, Portugal, during 5-13 February 1980, to provide advice for management in 1980 of the cod stocks in Div. 3M and 3NO, the capelin stocks in Div. 2J+3K and 3LNO, the silver hake stock in Div. 4VWX, and the squid stocks in Subareas 3 and 4.
- b) The Annual Meeting of the Scientific Council to be held at NAFO Headquarters, Dartmouth, Canada, during 3-13 June 1980, in conjunction with meetings of its three standing committees: Fisheries Science (STACFIS), Research Coordination (STACREC), and Publications (STACPUB).

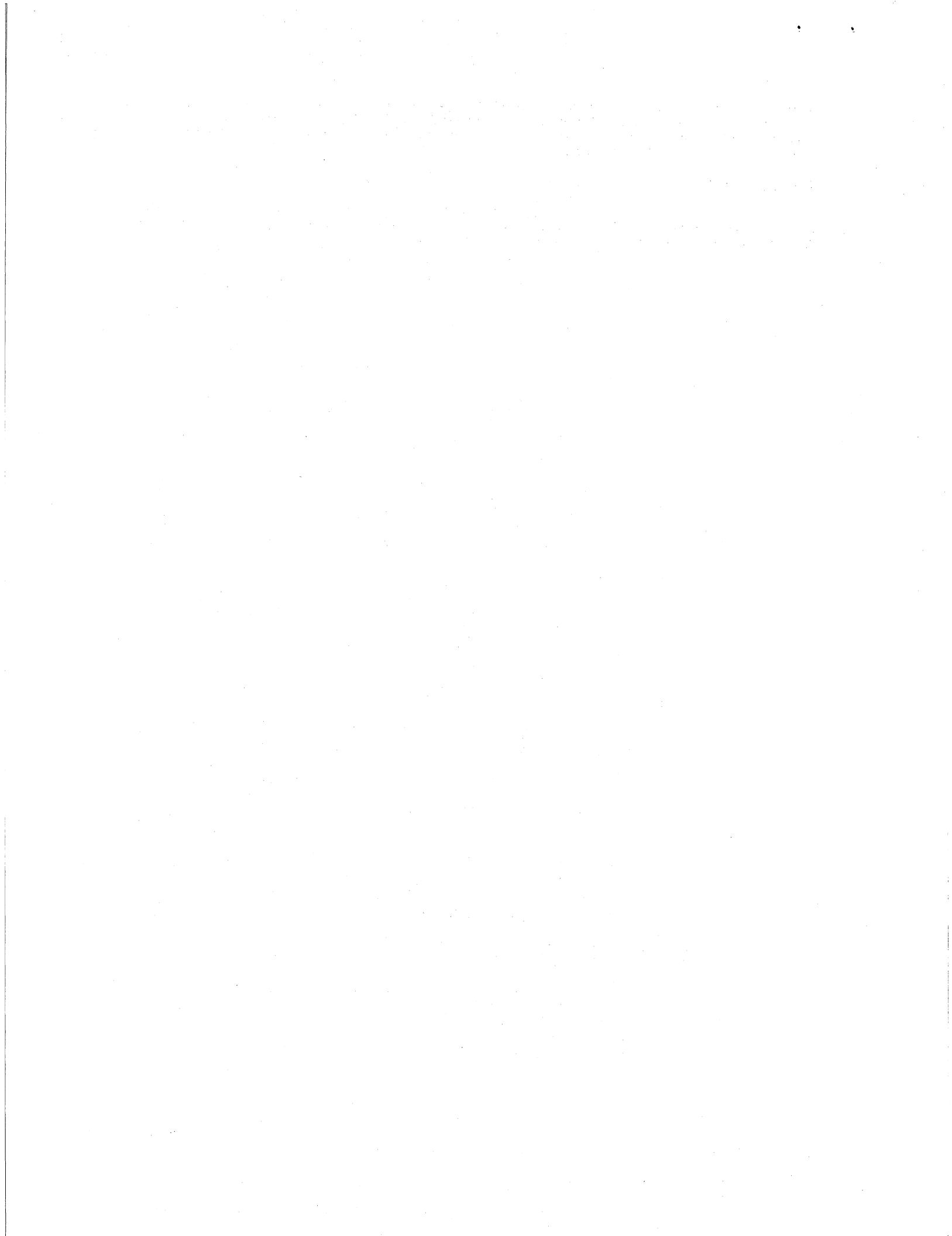
4. Other Matters

The Assistant Executive Secretary briefly reviewed SCS Doc. 79/XI/1, which outlined the problems encountered by the Secretariat in documenting fishery statistics for 1977 and 1978 due to confusion regarding the reporting of statistics from cooperative arrangements between coastal states and other

countries. He indicated that arrangements were being made with the Secretary of the CWP (Coordinating Working Party on Atlantic Fishery Statistics) to have specific instructions for the reporting of such statistics included in the "Notes for the Completion of STATLANT 21A and 21B Forms" to facilitate the reporting of 1979 fishery statistics.

5. Acknowledgements

The Chairman thanked the participants for their cooperation during the course of this Special Meeting, and expressed his appreciation to the Secretariat staff for their hospitality and efficient work. The meeting was adjourned at 1200 hrs on 16 November 1979.



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

Special Meeting on Shrimp and Seals, November 1979

Chairman: G. H. Winters

At the request of the Scientific Council, STACFIS met during 13-16 November 1979 to (a) assess the status of the shrimp (*Pandalus borealis*) stocks in Subareas 0 and 1, as requested by Canada and the European Economic Community (EEC) (NAFO Meet. Proc. 1979, page 115), and (b) review the status of the harp and hooded seal stocks in the Northwest Atlantic, at the request of Canada (NAFO Circ. Letter 79/12, Addendum). Scientists attended from Canada, Denmark (Greenland Fisheries Laboratory), Faroe Islands, France, Norway, and United States of America.

In considering the provisional agenda of the Scientific Council, STACFIS agreed that the assessments of shrimp and seals be carried out in two working groups which would meet concurrently. Consequently, meetings of the *ad hoc* Working Groups on Shrimp (convened by Ø. Ulltang with Sv. Aa. Horsted as Rapporteur) and on Seals (convened by A. W. Mansfield with D. E. Sergeant as Rapporteur) were held during 13-15 November and their reports as approved by STACFIS are given in Sections I and II below.

I. SHRIMP IN SUBAREAS 0 and 1

1. Fishery Trends

The nominal catch of shrimp in Subareas 0 and 1 (Table 1) increased rapidly from less than 10,000 tons prior to 1973 to 50,000 tons in 1976 and declined to 34,500 tons in 1978. The offshore shrimp fishery has been regulated by total allowable catches since 1977. The total nominal catch for Subarea 1 in 1977 was 41,600 tons, of which 33,800 tons were taken in the offshore fishery against a total allowable catch (TAC) of 36,000 tons. In 1978, the offshore fishery in Subareas 0 and 1 was regulated by an overall TAC of 40,000 tons of shrimp, of which only about 27,000 tons were reported from the offshore grounds in both areas. In addition, about 7,600 tons of shrimp were taken in the inshore fishery in Subarea 1. The offshore fishery in 1979 was regulated by an overall TAC of 29,500 tons for Subareas 0 and 1. Preliminary catch statistics for January-October 1979 indicate that the total catch in the management areas (Subarea 0 and offshore grounds in Subarea 1) was about 23,200 tons, with the inshore catch in Subarea 1 being about 7,500 tons.

Table 1. Nominal catches (metric tons) of shrimp (*Pandalus borealis*) in Subareas 0 and 1¹.

Area	Country	1971	1972	1973	1974	1975	1976	1977	1978	1979(Oct) ²
SA 0	CANADA	-	-	-	-	-	-	-	-	198 ³
	DEN-G	-	-	-	-	-	-	-	-	329
	DEN-M	-	-	-	-	-	-	68	86	35
	FAROES	-	-	-	-	-	-	239	-	183
	FRA-M	-	-	-	-	-	-	-	21	42
	NORWAY	-	-	-	-	-	65	150	15	154
	SPAIN	-	-	-	-	-	327	-	-	-
	TOTAL	-	-	-	-	-	392	457	122	941
SA 1	CANADA	-	-	-	-	-	-	-	-	910 ³
	DEN-G (a) ⁴	8,741	7,342	7,950	10,064	8,700	7,300	7,800	7,600	7,500
	(b)	200	150	185	180	1,089	2,478	7,081	5,531	12,161
	DEN-M	-	-	196	308	1,142	2,717	5,842	3,382	1,314
	FAROES	496	755	1,371	2,023	5,300	11,179	12,612	8,070	3,841
	FRA-M	-	-	-	-	-	803	924	805	303
	FRG	-	-	-	-	-	-	31	-	-
	JAPAN	-	-	-	-	-	146	-	-	-
	NORWAY	-	1,409	2,940	5,917	8,678	11,658	7,353	8,959	3,767
	SPAIN	-	-	-	-	6,948	6,925	-	-	-
	USSR	-	-	-	3,517	6,033	6,468	-	-	-
TOTAL	9,437	9,656	12,642	22,009	37,890	49,674	41,643	34,347	29,796	
OFFSHORE	696	2,314	4,692	11,945	29,190	42,374	33,843	26,747	22,296	

¹ Statistics for 1971-78 pertain to ICNAF Statistical Area 0 and Subarea 1, and for 1979 to the new NAFO Subareas 0 and 1 (see Appendix V).

² Preliminary statistics to end of month indicated.

³ Canadian data include catches from cooperative arrangements with other countries.

⁴ a = inshore, b = offshore catches.

2. Distribution (SCR Doc. 79/XI/5, 6, 7, 8, 9)

The papers presented at this meeting generally did not consider possible distribution of shrimp in areas other than those already known to be shrimp grounds. However, more detailed information on variation of shrimp density and size composition by depth and by fluctuations in temperature was reported.

Information from the two surveys carried out by Canada (SCR Doc. 79/XI/7) and France (SCR Doc. 79/XI/6 and 8), as well as analysis of data from the commercial fisheries, again showed a seasonal northward shift of the fishery but also a continuation of the between-years northward displacement of the areas of the heaviest concentrations of shrimp. It was noted that the quota of 3,000 tons set aside for the area north of 68°N latitude in the Greenland fishing zone was taken by the beginning of June, so that no commercial data were available for that area after that time. However, most fishing took place just south of 68°N latitude, indicating that the best concentrations occurred in this area. The surveys confirm that the major part of the biomass in Div. 1B was found at the northwestern slopes of Store Hellefiske Bank at depths between 200 and 400 m. The results of the Canadian survey indicate that, at the time of the survey, approximately 25% of the shrimp biomass observed between 66°N and 68°30'N occurred in Subarea 0 (as shown in Appendix V). The distribution of shrimp seems, to a great extent, to be determined by hydrographic conditions. Both surveys show the major concentrations in 2° to 4°C temperatures with maximum concentrations in 3° to 4°C temperatures.

Earlier investigations have not shown any pronounced tendency to a variation of size distribution of shrimp with depth in the offshore area. However, the surveys in 1979 clearly show a dominance of small shrimp (immatures and males) on the shallower part (150-200 m) of the slopes of Store Hellefiske Bank, where males dominated in some of the samples down to a depth of 300 m. The photographic surveys showed the occurrence of small shrimp in both shallow and deep water. As was the case (for the first time) in 1978, small shrimp were again observed at some of the stations north of Store Hellefiske Bank and in Div. 1A. Also, some variation in the ovigerous/non-ovigerous ratio of females occurs from area to area.

3. Biology (SCR Doc. 79/XI/6, 7, 8)

New information on the biology of shrimp relates to variation by depth and area in the distribution of size groups (see preceding paragraph), to diurnal variation in catch per effort due to vertical migration, to studies of modes in length frequencies as representing age-groups, and to studies on variation by area of the female spawning/hatching rate.

Diurnal variation of shrimp is well documented (e.g. see *ICNAF Selected Papers* No. 4) and has to be taken into account when using catch per unit effort as stock abundance indices. A specific study during the Canadian survey (SCR Doc. 79/XI/7) indicates that catch per unit effort may vary by a factor as high as 9 and that the optimum catches may be in the early afternoon rather than centered around noon. However, the estimates of conversion factors are variable and they should be applied with caution.

A cooperative study by Canadian and French scientists (SCR Doc. 79/XI/8) indicates that grouping of carapace length, measured by tenths of a millimeter, into 0.3-mm classes with running average of three leads to modes in the length frequency diagram that may be interpreted as age-groups. From these data and those presented in SCR Doc. 79/XI/7, at least three age-classes of juveniles and males are well defined, while there is only one group of females which represents an age-class accumulation.

The 1979 surveys indicate that the period of spawning extended into October which is later than formerly observed for the inshore stocks. This phenomenon may be ascribed to different environmental (temperature) conditions. However, a striking difference was observed between the Div. 0B and Div. 1B samples, the former containing many more large non-spawning females than the latter in which almost all females were spawning.

4. Catch and Effort (SCR Doc. 79/XI/2, 5, 7)

Catch and effort data were available for Canadian, French, Greenland and Norwegian vessels based on logbook information (haul-by-haul) and limited data on catches for Faroese vessels. In addition, part of the information presented by Canada and Norway was obtained by observers on commercial vessels.

The Norwegian data (SCR Doc. 79/XI/2) indicate some increase in catch rate in Div. 1C and 1D from 1978 to 1979, whereas in Div. 1B there was a slight peak in catch rate during the early months of 1979 in contrast to no peak in the early months of 1978. The lack of a peak in 1978 may be attributed to ice conditions in that year, making direct comparison of catch rates in the two years difficult. However, the data up to August 1979 indicates no significant change in overall catch rate between the two years.

The French data (SCR Doc. 79/XI/5) provided details on monthly distribution of effort and catch for two trips by one vessel in 1979, but comparison with 1978 data was not possible due to the different distribution of fishing in the two years.

Data for the Greenland trawlers show their catch rate in the first part of 1979 to be higher than in 1978, when fishing operations were hampered by ice. The annually observed decrease in catches in the last part of the year occurred somewhat earlier in 1979 than in 1978, but data so far available do not indicate any significant change in overall catch rate from 1978 to 1979. However, when comparing only the July-August-September period, when ice is no hindrance and when shrimp may be more evenly distributed than earlier in the year, the Greenland data indicate a decrease in catch rate of about 20% from 1978 to 1979.

5. Biomass Estimates (SCR Doc. 79/XI/5, 6, 7, 9)

Biomass estimates were arrived at on the basis of the results of the Canadian and French surveys (SCR Doc. 79/XI/7 and 6 respectively) and of the Danish photographic survey (SCR Doc. 79/XI/9). Also, French commercial data were used to assess biomass in the same areas as those covered by the French survey.

Data from the 1979 photographic survey in Div. 1B and the adjacent part of Div. 1A are very limited due to bad weather conditions during the survey and due to a malfunction of the equipment. The data generally show higher densities of shrimp than in 1978, but it is not possible to draw firm conclusions from the 1979 photographic survey, because of the limited number of photographs, the large difference in density at two stations within one of the most important strata, and the difference in coverage between the two years. However, the photographic surveys seem to indicate a change in size composition of shrimp during the 1977-79 period. Small and medium-sized shrimp are more numerous (relatively as well as absolutely) on the 1979 photographs than on those for 1978 and 1977.

In discussing the results of the trawl surveys, some new information was presented (SCR Doc. 79/XI/7) indicating that the opening of the trawl used was over-estimated in previous calculations of the area swept. Investigations based on acoustic instrumentation show that the width of a Sputnik 1,600 mesh trawl is approximately 22 m. However, the effect of the trawl doors and bridles on fishing for shrimp is not well known, so that the path effectively fished may be somewhat wider than the width of the trawl. The new information indicates that previous biomass estimates may have been underestimated.

There is a good correspondence between the shrimp biomass estimates based on the data from the two trawl surveys in 1979. Using a 30-m trawl opening, the biomass between 66°N and 69°N is estimated to be about 45,000 tons, whereas the estimate is about 62,000 tons for a trawl opening of 22 m. This is not very different from the trawl survey estimate for the same area in 1976 (55,000 tons). It was noted, however, that the 1979 surveys used trawls with smaller meshes which caught relatively more small and medium-sized shrimp than in 1976. Therefore, biomass in this area may be somewhat lower in 1979 than in 1976. It was again pointed out that the biomass estimates are minimum estimates due to the assumption that all shrimp over the swept area are being caught. It should be noted that the area north of 69°N and east of 55°W, which was fished extensively in early 1979, was not covered by either of the trawl surveys or by the photographic survey.

For the shrimp grounds in Div. 0B off Baffin Island, the biomass estimated from the French survey is about 3,000 tons in 1979, which is about the same level as the estimate for 1977.

6. Total Allowable Catch

In advising on the total allowable catch for 1980, all information available on biomass estimates, trends in catch rates, and composition of the stock was taken into consideration. It was generally agreed that a decrease in biomass had occurred over the period from 1976 to 1978, as was indicated at the November 1978 Meeting (*ICNAF Redbook 1979*, pages 15-20). Catch rates also decreased over the same period. It is more difficult to compare catch rates in 1978 with those available for part of 1979 due largely to the effect of severe ice conditions in 1978, but the overall level of catch rate between the two years does not seem to differ significantly. However, some changes seem to have occurred in the size composition of the stock, this was reflected in the size composition of the landings of Greenland trawlers but not to the same extent in Norwegian catches. There are indications that the change in size composition is not only a relative change, as the photographic and trawl surveys point to some increase in the number of small and medium-size shrimp. Temperatures and the absence of cod as a predator on the main shrimp grounds seemed to provide optimum conditions for shrimp in 1979. Taking all of these factors into consideration, STACFIS advises that the overall TAC for the offshore shrimp grounds in Subarea 1 and adjacent parts of Subarea 0 in 1980 could be at the same level as in 1979 (29,500).

STACFIS noted that nearly all of the information presented at this meeting related to the area between 66°N and 69°N. The limited Norwegian catch and effort data from Div. 1D and 1C indicate a

stable or possibly somewhat improved fisheries situation on the grounds in these divisions from 1978 to 1979. It is considered likely that a proportion of the overall TAC will be caught in these divisions, but, as formerly, advice for a breakdown of the TAC by areas could not be provided.

As indicated in previous reports, it is likely that some interrelationships, probably varying between years, exist between the shrimp stock in Disko Bay and that in the offshore waters adjacent to Disko Bay. It was noted that this has led to protective measures by allowing only a small part of the overall TAC for the offshore grounds to be taken in the Greenland fishing zone in an area north of 68°N latitude. It was pointed out that, if the observed northward displacement of the best concentrations continues, a relatively higher proportion than previously of the overall catch would likely occur around 68°N latitude, if fishing were freely distributed. If the protective measures are maintained, it is therefore likely that the greater part of the fishery may occur as close to the border line as possible.

In its consideration of the advice, STACFIS noted that, although more information is gradually becoming available on distribution and abundance of pre-recruit shrimp, knowledge about recruitment is still not good enough to allow more detailed forecasts of stock size and distribution. However, since much of the important data are collected and the data base updated continuously, STACFIS agreed that it would be possible to review the situation at the June 1980 Meeting of the Scientific Council, if this was desired by the regulatory authorities.

In view of the relatively low biomass estimated for Division OB off Baffin Island and the very low catch rates evident from the French survey, it was decided that advice on total allowable catch for this area was not necessary.

7. Discarding of Shrimp (SCR Doc. 79/XI/2, 7)

Reports on discards of shrimp by observers on Norwegian vessels and vessels chartered by Canada were presented. The Norwegian observations indicated a discard rate of 6.5% for 1979, while the Canadian observations indicated low rates of discard varying between 2% and 10%. It was discussed whether the price differential between small and large shrimp influences the discard rate. If individual vessels have a limited quota, these vessels may search for those parts of the grounds where catches are composed mainly of large shrimp. This would result in a very low discard rate. On the other hand, in a situation where very high catch rates occur on a stock of a more mixed structure, fishing may take place there with a high discard rate if large shrimp are caught in sufficient numbers to occupy the vessel's capacity of daily production. The discard problem seems to be negligible for those trawlers landing iced shrimp for land-based production.

8. By-Catch in the Shrimp Fishery (SCR Doc. 79/XI/2, 6, 7)

The major by-catch in the shrimp fishery continues to be small redfish and, to a lesser extent, Greenland halibut and American plaice, while very few cod are observed in the shrimp catches north of 66°N. Norwegian data for the years 1976-79 show a mean by-catch of between 0.8 and 1.8 fish per kg of shrimp caught. The French survey (SCR Doc. 79/XI/6) shows high variation in by-catch between hauls and areas, the by-catch of redfish in Subarea 0 being much less than in Subarea 1. Canadian observations also show large haul-to-haul variation with by-catches, mainly small redfish ranging from 12% to 21% of the total catches.

9. Future Research Requirements

The value of having trawl surveys with good coverage of the total area was clearly demonstrated at this meeting. Also, the value of photographic surveys was stressed, especially if carried out in conjunction with trawl surveys. STACFIS, therefore,

recommends

- i) *that extensive stratified trawl surveys be carried out in the whole area of shrimp distribution in Subarea 1 and the adjacent parts of Subarea 0, in order to establish a time series of comparable observations;*
- ii) *that stratified photographic surveys be continued and intensified and, as far as possible, be combined with trawl hauls; and*
- iii) *that the observer program to closely monitor the shrimp fishery on a year-round basis be continued.*

STACFIS discussed whether the use of more than one survey vessel would result in better coverage simultaneously or whether vessels obtained better information by observing at various times of the year. The latter was thought to provide the most useful information but requires coordination between the laboratories engaged. Coordination is also needed to standardize gear and methods.

II. HARP AND HOODED SEALS

1. Conservation of Harp Seals (SCR Doc. 79/XI/1, 3, 4, 10, 12, 13)

a) Research in 1979

Canada reported on estimates of pup production from tagging and recapture and from survival indices and catch and effort analysis (SCR Doc. 79/XI/3, 4), on maturation and fecundity rates at different population sizes (SCR Doc. 79/XI/1), on population size and sustainable yield (SCR Doc. 79/XI/12), and on differential migrations and mixing of Gulf and Front herds (SCR Doc. 79/XI/3). Denmark presented catch statistics and age composition data for Greenland in recent years (SCR Doc. 79/XI/10), and a synopsis of tag recoveries in Greenland from 1949 to date (SCR Doc. 79/XI/13). Norway presented statistics for the 1979 Norwegian catch at the Front and recorded its participation in Canadian field studies at the Front in 1979.

b) Population assessment

i) Vital rates

Mean age at sexual maturity was recalculated using the method of DeMaster (1978)¹ to be 4.3 years. After reviewing a re-analysis of all available information (SCR Doc. 79/XI/1), it was agreed that mean age of sexual maturity has declined significantly from 6.2 to 4.3 years during a period of overall population decrease from 1951 to 1979. Although there are no empirical data to substantiate density-dependence, this relationship is supported by the existence of an increase in age at sexual maturity in the increasing White Sea population (Nazarenko, 1975)².

Fertility rate has also now been shown to have increased from 0.85 to 0.94 parallel with population decline, using data from late pregnancy. Ovulation rates have remained constant, as measured early in the reproductive cycle, so that the reproductive potential of the stock has not been impaired.

There were no new analyses of natural mortality (M), and it was therefore agreed to accept the previously calculated value of 0.10 (*ICNAF Redbook* 1979, page 11).

ii) Pup production

Only one reliable estimate emerged from a mark-recapture experiment at the Front in 1979 (SCR Doc. 79/XI/4). The result gave an estimated pup production on the Front of 203,000, with 95% confidence limits of 174,000 and 239,000. An additional 20,000 pups were added to account for a small southern patch, the size of which was estimated by eye. The total production on the Front in 1979 was therefore approximately 220,000 pups. If, as indicated from past aerial survey data, that Gulf production remains at 0.375 of the total, total production in 1979 is estimated at 352,000 pups (SCR Doc. 79/XI/3, 12).

Re-analysis of the 1978 mark-recapture experiment (SCR Doc. 79/XI/3) indicated that estimates of pup production were likely to be biased and therefore unreliable, due to non-random mixing of tagged and untagged pups in the landmen's catch. An estimate of Gulf production in 1979 was not possible because of the low number of tag recoveries from the beater hunt. An estimate of production was also presented using tag recoveries from one-year-olds in 1979. This estimate of 589,000 pups may be optimistic and is thought to be biased due to incomplete sampling of age 1 animals in the landmen's catch.

The survival index method, based on a predictive regression for the 1970-77 year-classes, gave an estimate of production for mid-year 1973 of 342,000 pups, with 95% confidence limits of 267,000 and 625,000 (SCR Doc. 79/XI/3). Since catch figures for this period are precise, a predictive regression is appropriate. This method assumes that both production and population are stable, but the use of a narrow range of years reduces potential bias. It was noted that this method of estimation, depending on a wide spread of catch figures, will soon become inapplicable due to low variability of recent pup kills.

iii) Stock relationships

Tag recoveries by area were analyzed for harp seals marked in the Gulf of St. Lawrence from

¹ DeMaster, D. P. 1978. Calculation of the average age of sexual maturity in marine mammals. *J. Fish. Res. Board Can.*, 35: 912-915.

² Nazarenko, Y. I. 1975. Sexual maturation, reproductive rate, and missed pregnancy in female harp seals. *Rapp. P.-v. Réun. Cons. int. Explor. Mer*, 169: 413-415.

1966 to 1978 (SCR Doc. 79/XI/3). Homing was found to increase with age. For animals aged 5 years and up, there are 16 recoveries, of which 12 (75%) came from the area of birth.

iv) Population size and sustainable yield in 1979

Utilizing an updated catch-at-age matrix and a selectivity curve based on the 1979 moulting sample, cohort analyses for the period 1960-79 were carried out under two assumptions of the size of the 1979 pup production: (a) the mean (352,000), and (b) the lower confidence limit (304,000) of the 1979 tagging experiment. The mean value of 352,000 is considered to provide the best estimate of 1979 pup production, since it agrees well with previous estimates, which were derived from the 1977 aerial survey at the Front adjusted by the Front/Gulf production ratio (320,000), and from the survival index for mid-year 1973 (342,000), updated for trends in pup production based on cohort analysis. The age 1+ population size in 1979 ranged from 1.23 to 1.38 million for assumption (b) and (a) respectively.

The estimated age composition of the population in 1979 depended on the 1979 sample of moulting seals. Two methods were used to check the accuracy of this age composition: the first recalculated the age composition, using information from survival indices for each of the first nine year-classes; and the second compared the relative age composition from cohort analysis in 1974 with a moulting sample obtained in that year and found no great selectivity except in age-group 1. Neither method showed gross differences in age composition from that obtained for 1979.

Populations were projected to 1985, using the two levels of pup production in 1979 referred to above. The projections assume the following: (a) $M = 0.10$; (b) fertility rate = 0.94; (c) most recent maturity ogive; (d) no density-dependence in parameters; (e) hunting mortality is distributed over the age-groups as in 1979; and (f) a yearly catch of 180,000 animals of which 80% are pups and 20% are age 1+ seals. Under these conditions and using the population age structure from a cohort analysis that produces 352,000 pups in 1979, the age 1+ population increases at an instantaneous rate of 0.02 per year. If pup production in 1979 is about 304,000, the age 1+ population increases at an instantaneous rate of only 0.01 per year. Pup production increases from 352,000 in 1979 to 397,500 in 1985 in the first case and from 304,000 to 339,400 pups in the second case.

With mean whelping age of 5.3 years and fertility rate of 0.94, the equilibrium sustainable yields were calculated to be 237,000 animals (80% pups) and 205,000 animals (80% pups) for 1979 pup productions of 352,000 and 304,000 respectively. These sustainable yield estimates assume a stable age distribution and a population in equilibrium. Since all evidence indicates that the population is increasing, these estimates are low. The replacement yield based on the best estimate of pup production (352,000) was estimated to be 205,400.

In considering TACs, it should be noted that arctic catches of harp seals have been assumed to be stable and less than 10,000 animals in recent years. However, estimates of catch for West Greenland in 1975-1978, adjusted for incomplete reporting, show that the catch is increasing and has reached a level of nearly 10,000. To this catch must be added about 2,000 animals caught annually in Arctic Canada. STACFIS therefore

recommends

that the exemption for arctic catches should be increased to a level of 15,000 harp seals in 1980.

c) Future research

In order to improve the basis for assessment of the harp seal stocks, STACFIS

recommends

- i) that another large-scale tagging experiment should be carried out, with efforts made to tag in all major whelping patches;*
- ii) that arctic catch statistics be improved and that data be collected on sinking losses in arctic hunting; and*
- iii) that further studies of food and feeding, and a wider study of animal condition throughout the annual migratory cycle be carried out.*

STACFIS considered that a review of information on biological responses of the White Sea population of harp seals to protection would be extremely valuable. It was agreed that a scientist be

designated to review the Norwegian and USSR literature and that permission be obtained from the Northeast Atlantic Sealing Commission to make use of relevant national reports submitted to the Commission by its members.

2. Conservation of Hooded Seals

a) Research in 1979

Although considerable collections of jaws have been made of whelping, moulting and migrating animals, analyses have not been completed. Canada reported an attempt at daily catch/effort analysis at the Front by Leslie's method, which proved unsuccessful due to rapid changes in catchability of hooded seal pups which here enter the water at an early age compared to harp seal pups.

b) Stock assessment

Since no new data were available, there was no basis for revising the assessments made at the November 1978 Meeting (*ICNAF Redbook 1979*, pages 11-14). STACFIS, therefore, advises that the TAC for hooded seals should remain at 15,000 for 1980. It was also noted that in 1979 the target figure for kill of adult females (5% of total kill) was achieved and advises that this conservation measure be maintained.

c) Future research

In order to improve the basis for assessment of the hooded seal population, STACFIS

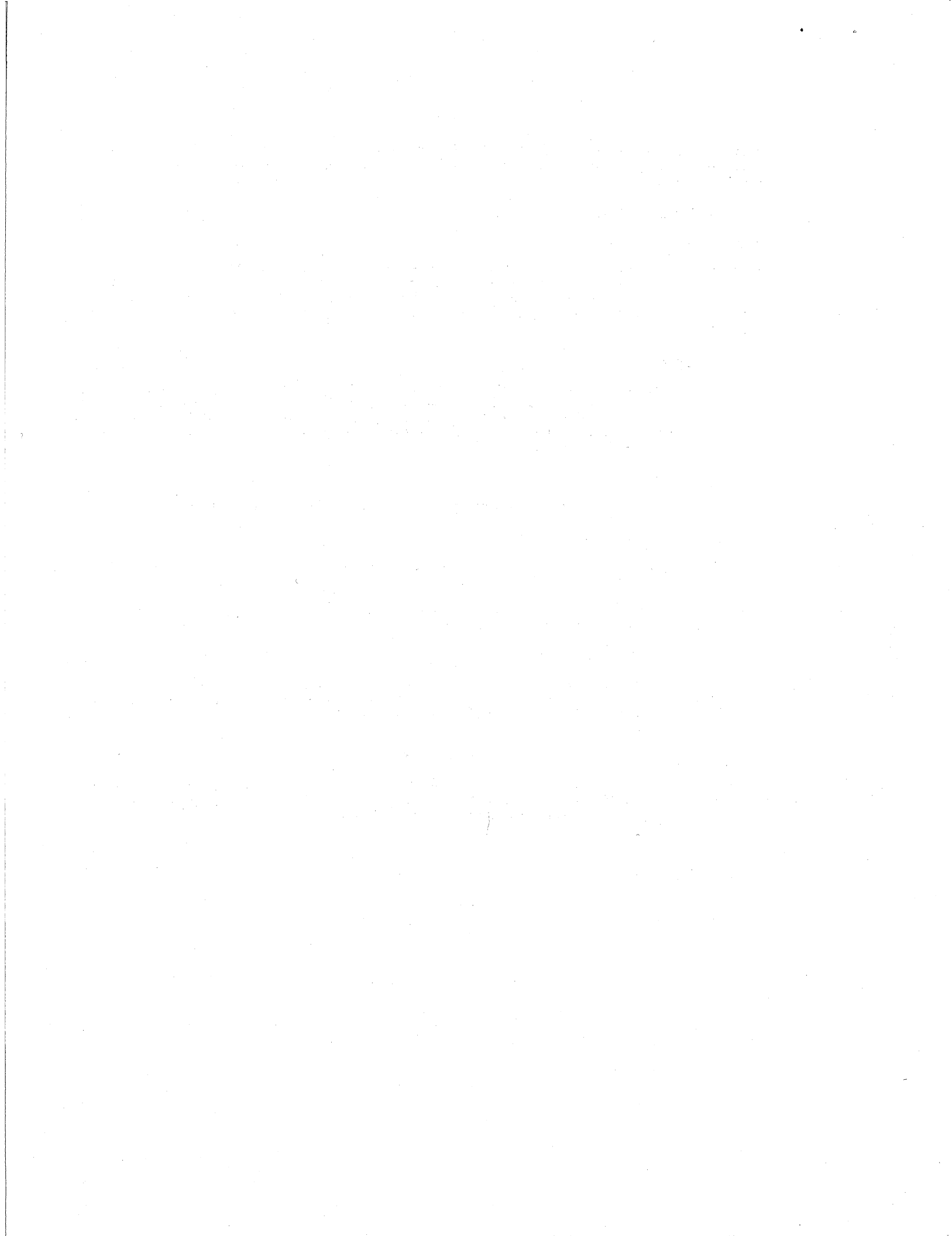
recommends

- i) that analyses of material and data on fecundity, maturity and age composition be completed as soon as possible;*
- ii) that a review of existing knowledge on interrelationships of stocks of hooded seals be completed as soon as possible; and*
- iii) that detailed catch/effort data be collected from year to year at the Front.*

It should be noted that the hooded seal stocks living in the NAFO and the Northeast Atlantic Sealing Convention areas may be related, so that the research recommended in (i) and (ii) includes work on material collected outside the NAFO Convention area.

III. ACKNOWLEDGEMENT

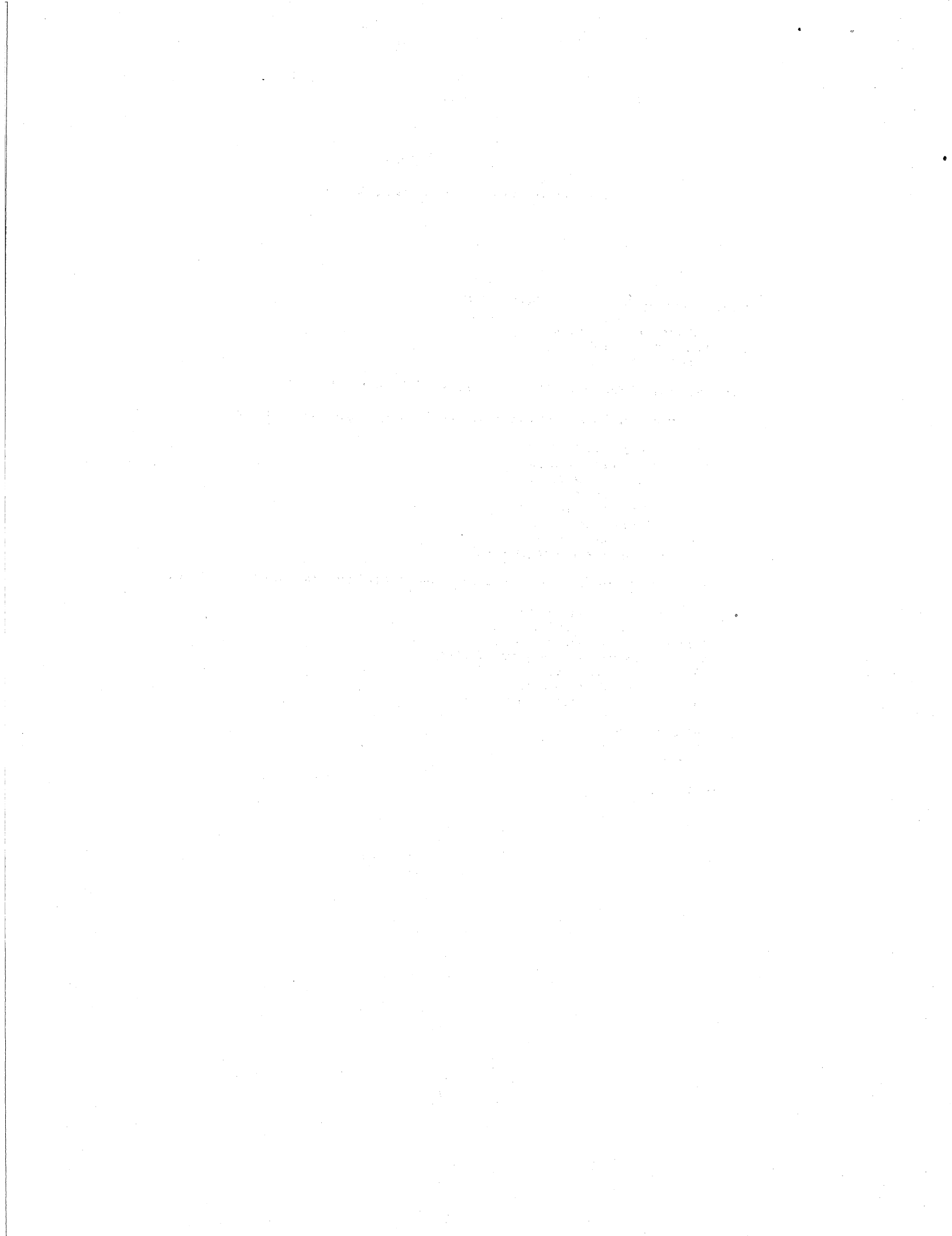
There being no further business, the Chairman expressed his thanks to all participants, especially the conveners and rapporteurs of the working groups, for their interest and cooperation during the course of the meeting, and to the Secretariat for their usual efficient work.



APPENDIX II. AGENDA

Special Meeting on Shrimp and Seals, November 1979

1. Opening (Chairman: Mr R. H. Letaconnoux)
 - a) Appointment of rapporteur
 - b) Adoption of agenda
 - c) Plan of work
2. Consideration of Report of STACFIS (Chairman: Dr G. H. Winters)
 - a) Review of harp and hooded seal stocks (Working Group Convener: Dr A. W. Mansfield)
 - i) Research in 1979
 - ii) Stock relationships
 - iii) Population assessment
 - Vital rates
 - Pup production
 - Stock size
 - Sustainable yield
 - iv) Future research requirements
 - b) Review of shrimp stocks in Subareas 0 and 1 (Working Group Convener: Mr Ø. Ulltang)
 - i) Review of fishery trends
 - ii) Distribution and biology
 - iii) Catch and effort data
 - iv) By-catches in the shrimp fishery
 - v) Biomass estimates
 - vi) Total allowable catch
 - vii) Future research requirements
 - c) Other matters
3. Future Meetings
4. Other Matters



APPENDIX III. LIST OF PARTICIPANTS

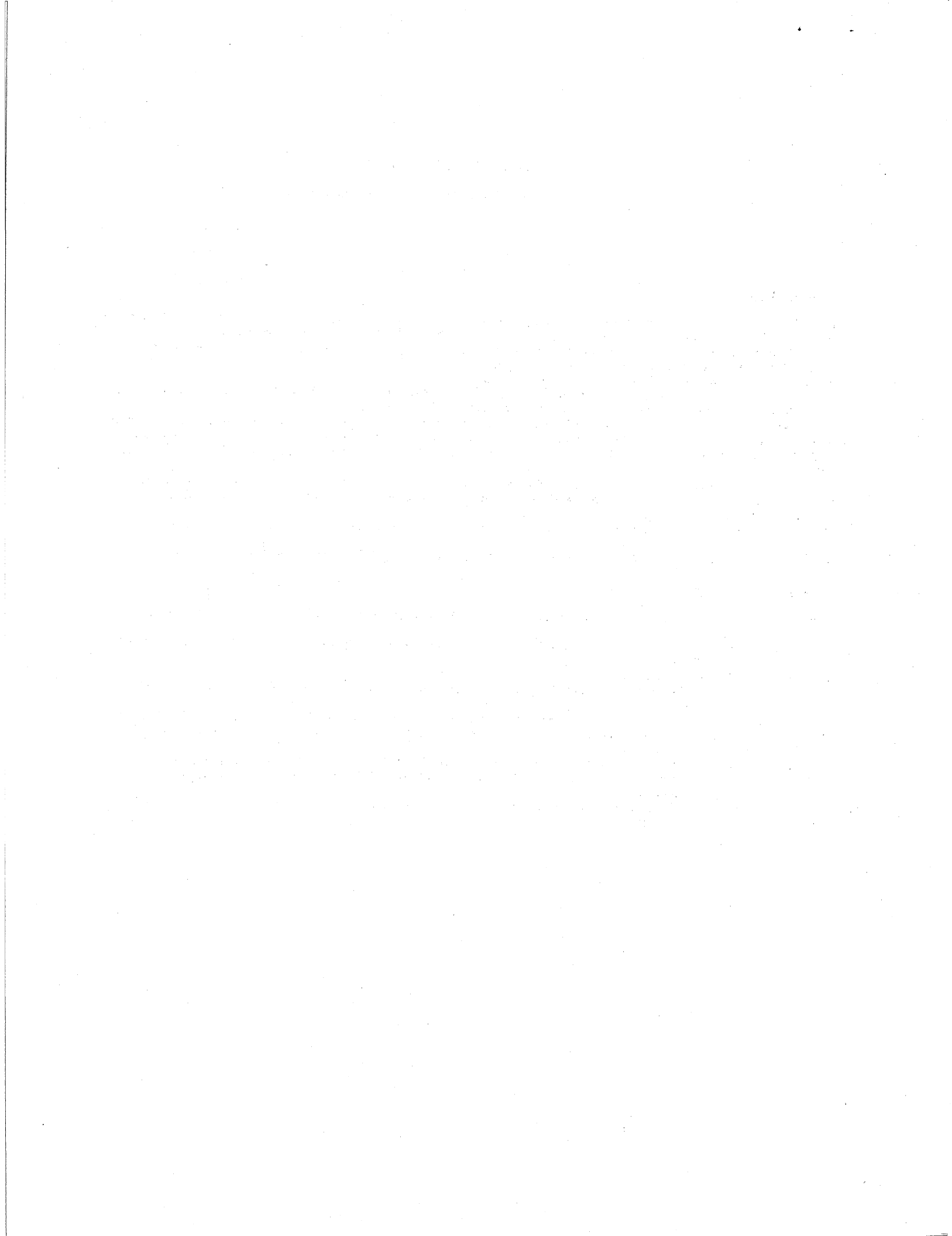
Special Meeting on Shrimp and Seals, November 1979

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APPENDIX IV. LIST OF DOCUMENTS

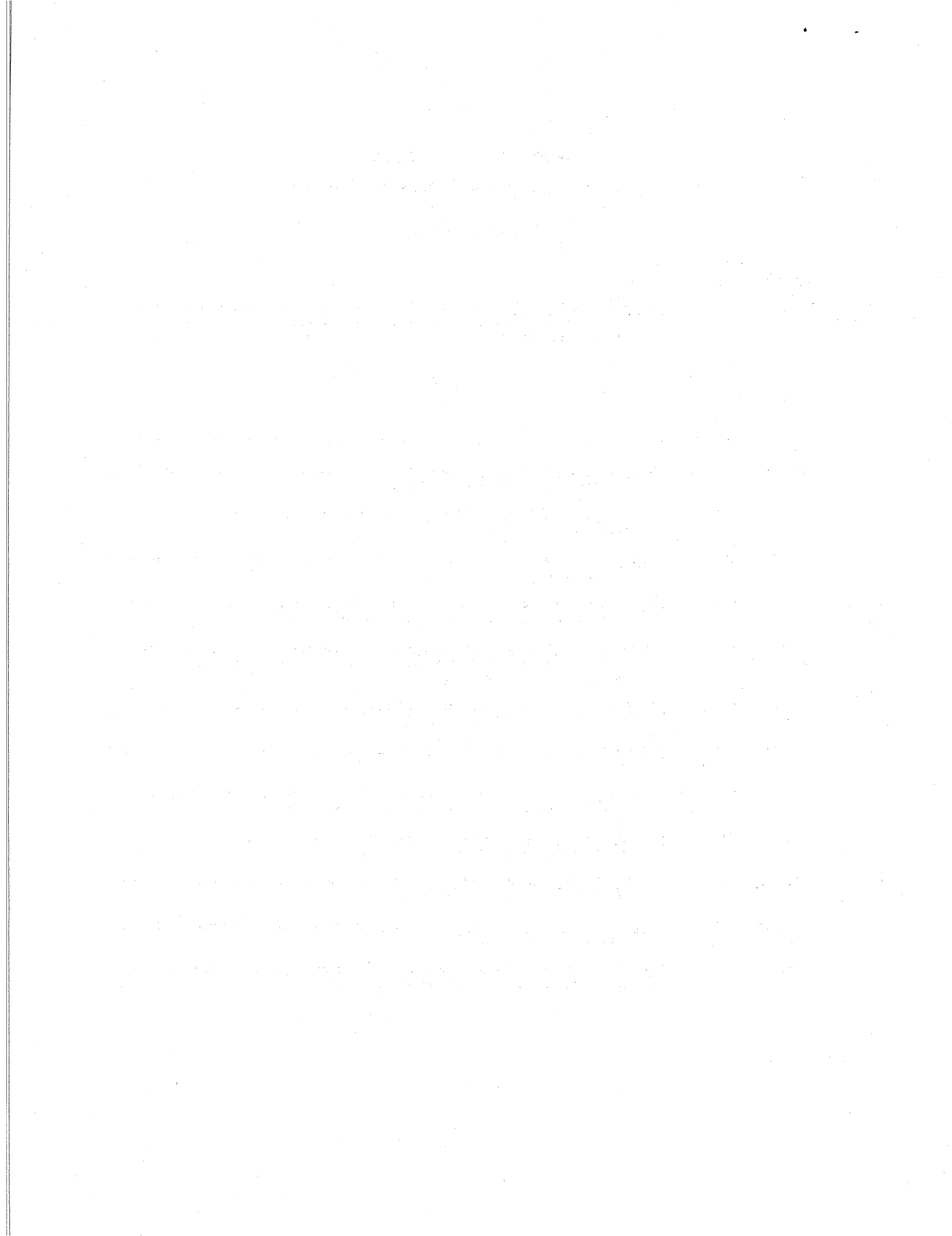
Special Meeting on Shrimp and Seals, November 1979

SUMMARY DOCUMENTS

<u>SCS</u> <u>Doc. No.</u>	<u>Serial</u> <u>No.</u>	
79/XI/1	N025	<u>ASSISTANT EXECUTIVE SECRETARY.</u> Problems encountered in documenting fishery statistics from cooperative arrangements between coastal states and other countries

RESEARCH DOCUMENTS

<u>SCR</u> <u>Doc. No.</u>	<u>Serial</u> <u>No.</u>	
79/XI/1	N012	<u>BOWEN, W. D.</u> Changes in harp seal reproductive parameters: another look
79/XI/2	N013	<u>ULLTANG, Ø, and S. TORHEIM.</u> Norwegian investigations on shrimp, <i>Pandalus borealis</i> , off West Greenland in 1979
79/XI/3 (Rev.)	N014	<u>BOWEN, W. D., and D. E. SERGEANT.</u> Research on the population biology of harp seals in 1979
79/XI/4 (Rev.)	N015	<u>BOWEN, W. D.</u> A mark-recapture experiment to determine harp seal pup production on the Front, 1979
79/XI/5	N016	<u>MINET, J. P.</u> Data on catches, CPUE and biomass of shrimp (<i>Pandalus borealis</i>) from the French fishery off West Greenland in 1979
79/XI/6 (Rev.)	N017	<u>DUPOUY, H., J. FRÉCHETTE, and C. LEROY.</u> Biomass estimate of the northern deep-water shrimp, <i>Pandalus borealis</i> , in NAFO Divisions 1B and 0B - R/V <i>Thalassa</i> survey, September-October 1979
79/XI/7 (Rev.)	N018	<u>PARSONS, D. G.</u> Canadian research efforts for shrimp (<i>Pandalus borealis</i>) in Division 0A and Subarea 1 in 1979
79/XI/8	N019	<u>FRÉCHETTE, J., and H. DUPOUY.</u> Preliminary biological data on the shrimp stocks of Davis Strait
79/XI/9	N020	<u>KANNEWORFF, P.</u> Stock biomass 1979 of shrimp (<i>Pandalus borealis</i>) in NAFO Subarea 1 estimated by means of bottom photography
79/XI/10 (Rev.)	N021	<u>KAPEL, F. O., and A. GEISLER.</u> Progress report on research on harp and hooded seals in Greenland, 1978-79
79/XI/11	N022	<u>CARLSSON, D. M., and P. KANNEWORFF.</u> Areas of basic strata in West Greenland, ICNAF/NAFO Subarea 1
79/XI/12 (Rev.)	N023	<u>BOWEN, W. D., and G. H. WINTERS.</u> On population size and sustainable yield in Northwest Atlantic harp seals
79/XI/13	N024	<u>LARSEN, F., and F. O. KAPEL.</u> Seasonal and regional distribution of tagged harp seals recaptured in Greenland, 1949-79



APPENDIX V. SUBAREAS AND DIVISIONS OF THE NAFO CONVENTION AREA, WITH THE NEW BOUNDARY BETWEEN SUBAREAS 0 AND 1, EFFECTIVE 1 JANUARY 1980

