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PROCEEDINGS
OF
SPECIAL MEETING NOVEMBER 1977
SPECIAL MEETING FEBRUARY 1978
ANNUAL MEETING MAY-JUNE 1978

Dartmouth • Canada

August 1978

Preface

Redbook 1978 contains the reports of the Standing Committee on Research and Statistics (STACRES) from meetings held at ICNAF Headquarters, Dartmouth, Canada, during 15-18 November 1977, at Havana, Cuba, during 13-18 February 1978, and at Bonn, Federal Republic of Germany, during 18 May-2 June 1978. A meeting of the Assessments Subcommittee was held at ICNAF Headquarters during 4-11 April 1978 and its report is included as Appendix I to the report of the 1978 Annual Meeting of STACRES.

The meetings of STACRES reported in Parts A and B were special meetings held at the request of coastal states for advice on the scientific basis for the management of certain stocks within national fisheries zones in Statistical Area 0 and Subareas 1 to 4. Part C contains the 1978 Annual Meeting of STACRES and corresponds to Proceedings No. 1 of the 1978 Annual Meeting of the Commission. Part D contains the agenda for meetings of STACRES held since the 1977 Annual Meeting, a list of STACRES recommendations from the November 1977, February 1978 and May-June 1978 meetings, lists of summary and research documents issued in the last half of 1977 after *Redbook* 1977 had been published, lists of summary and research documents presented to scientific meetings held during the first half of 1978, and a list of participants in scientific meetings of the Commission held during the year from July 1977 to June 1978. There were no meetings of Scientific Advisers to Panels during 1977/78.

12 July 1978

V. M. Hodder
Assistant Executive Secretary

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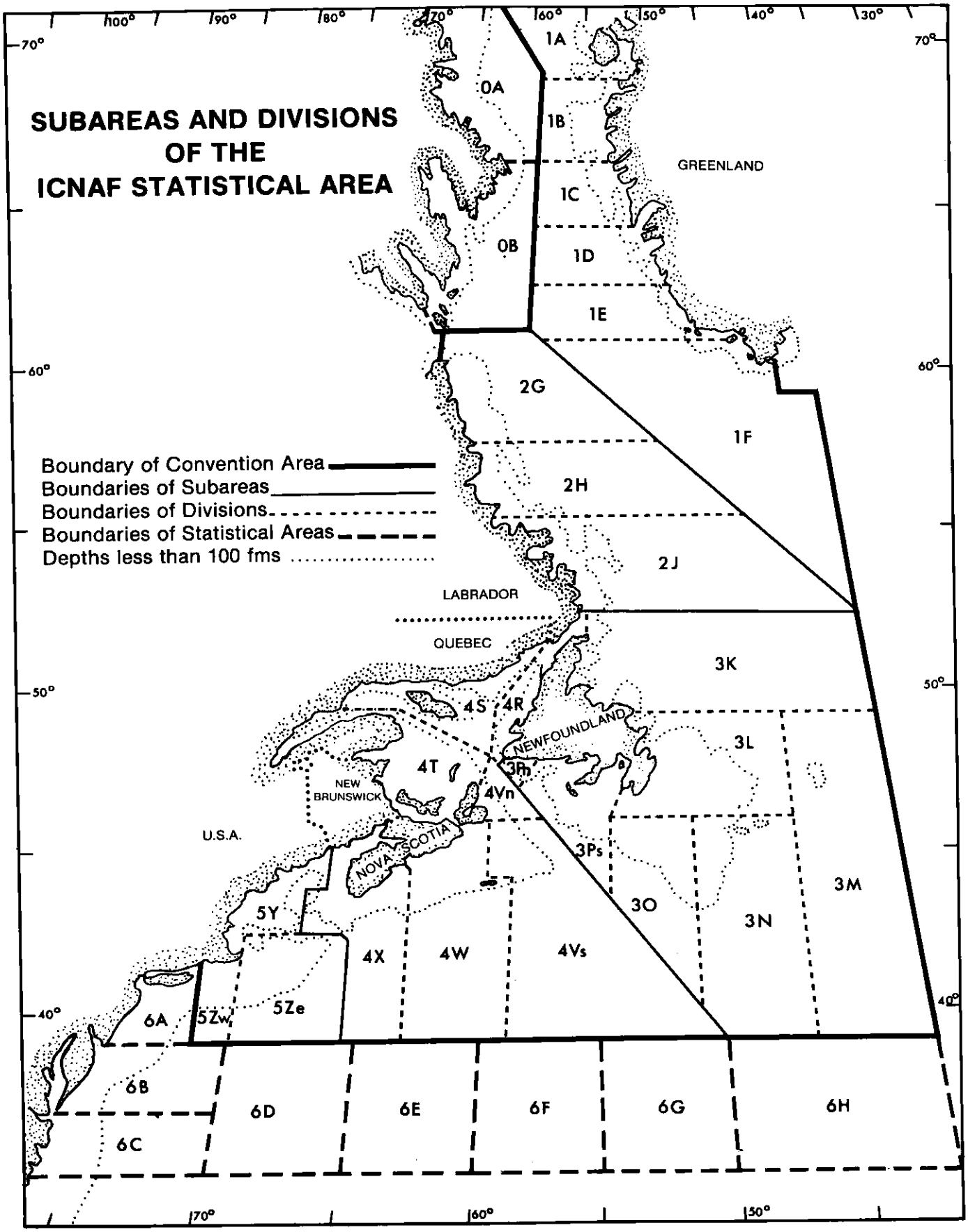
SUBAREAS AND DIVISIONS
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Boundaries of Subareas
Boundaries of Divisions
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Depths less than 100 fms
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PART A

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)[1]

Special Meeting on Shrimp and Seals, November 1977

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[1] Distributed previously as *ICNAF Sum. Doc.* 78/VI/1.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Special Meeting on Shrimp and Seals, November 1977

Chairman: A. W. May Rapporteur: V. M. Hodder

STACRES met at ICNAF Headquarters, Dartmouth, Canada during 15-18 November 1977 to (a) consider the Commission's request for a review of conservation measures for the northern deepwater prawn (=shrimp) (*Pandalus borealis*) stocks in Subarea 1 and Statistical Area 0 (*ICNAF Meet. Proc.* 1977, page 159), and (b) provide advice for the management of the seal stocks, as requested by Canada (Com. Doc. 77/VI/13). The agenda is given in Part D (this volume). Scientists attended from Canada, Denmark, France, Norway, Spain and United States of America.

Meetings of *ad hoc* Working Groups on Shrimp (convened by A. T. Pinhorn) and on Seals (convened by A. W. Mansfield) were held concurrently during 15-17 November, and their reports, as approved by STACRES, are given in Appendices I and II respectively. Brief summaries of these reports, together with other matters considered by STACRES, are given below.

1. Assessment of Shrimp Stocks (App. I)

The total nominal catch in Subarea 1 was nearly 50,000 tons in 1976, of which 42,400 tons were taken on the offshore grounds. The fishery was brought under quota regulation in 1977 with a TAC of 36,000 tons for the offshore grounds. As a consequence of the management regime, the estimated total catch to the end of October 1977 was 36,500 tons, of which nearly 30,000 tons were taken from the offshore areas. Extension of the fishery to Statistical Area 0 occurred in 1976 with a catch of 392 tons. In 1977, the estimated catch to October was 126 tons.

New data on shrimp distribution in Subarea 1 are consistent with previous observations that the greatest concentrations are in Div. 1B. A groundfish survey in Div. 0B of Statistical Area 0[1] revealed shrimp concentrations in the northern part of that division. No information is available on the relationship of these concentrations to the stock off West Greenland, but it is probable that the distribution is continuous in a horseshoe-shaped pattern extending northward along the east coast of Baffin Island, eastward across the Davis Strait Ridge and southward along West Greenland.

The available catch-per-unit-effort data for Div. 1B indicate an increase from 1975 to 1976 and a decline in 1977 to the 1975 level, but the time series was considered not long enough to suggest a decline in stock abundance since the increase in 1976 may have been due to environmental factors. No clear annual trends in commercial catch rates were noted for other divisions during 1975-77, although research vessel survey data indicate declines in abundance in Div. 1C and 1D over the period.

Previous estimates of the offshore biomass in Div. 1B were supplemented by additional work in 1977. The results from bottom trawl and photographic surveys indicated that the biomass level in 1977 was similar to that estimated previously for 1976. Thus, 100,000 tons was again considered as a reasonable minimum estimate of the offshore fishable stock size in 1977 for Subarea 1. On the basis of an autumn survey in Div. 0B of Statistical Area 0 in 1977, 4,000 tons was indicated as a minimum estimate of the biomass. Depth configurations to the northward in Div. 0A indicate a potential for shrimp concentrations, but no data are yet available to support this view.

In the absence of any information that would warrant a change in the assumptions used for the 1976 assessment, it was concluded that the 1978 TAC for the offshore grounds in Subarea 1 should not exceed 40,000 tons (including discards), the same as recommended for 1977 by STACRES at the December 1976 Special Meeting. Consideration was again given to the possible partitioning of the TAC by smaller areas. However, the uncertainties about the inter-relationships between the concentrations on various fishing grounds and about the variation in distribution of the overall biomass precluded the recommendation of a breakdown of the TAC beyond that previously advised for the offshore area adjacent to Disko Bay (i.e. the offshore catches in the area east of longitude 59°00'W between latitudes 68°30'N and 69°30'N should not exceed 3,200 tons in 1978). The information available for Statistical Area 0 was insufficient to provide advice on a TAC for 1978.

Uncertainties about the population dynamics of this species make it important, for future assessments, to improve the collection of detailed data on the commercial fishery through sampling of catches, by-catches and discards and on the distribution and abundance of shrimp over all known and potential areas of shrimp concentrations. There is at present a critical lack of knowledge on recruitment, growth, mortality, migration and local movements, vertical distribution and environmental parameters, all of which are essential for the proper assessment of the stocks.

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[1] See Fig. 1 of Appendix I for divisions of new Statistical Area 0, as agreed by STACRES at this Meeting.

2. Assessment of Seal Stocks (App. II)

a) Harp seals

Estimates of natural mortality (M) ranging from 0.098 to 0.114 were derived from various research documents presented to the meeting. These estimates were averaged with weights inversely proportional to their estimated variances, the resultant value of M being 0.102. Pup production estimates were available from aerial census data, cohort analysis, survival rates and catch and effort analysis. Projections for 1978 indicated pup productions of 309,000-347,000 animals. For M = 0.10, and age composition, sex ratios, maturity and fertility rates as in Lett and Benjaminsen (1977)[2], and for 1978 pup productions of 310,000 and 350,000, the sustainable yields were projected to be 227,000 and 245,000 animals respectively.

The present analyses of production and yield are based on the unit stock concept, the evidence being inadequate to quantify the degree of intermixing between the adults of the Gulf and the Front. However, in view of evidence that some segregation at breeding ages occurs, it is suggested that it would be prudent to divert some hunting effort from the Front to the Gulf.

b) Hooded seals

Based on sequential population analysis, it was concluded that the stock size of age 1+ females appears to have increased from a low of about 53,000 in the early 1960's to 77,000 in 1977. Using a figure of 38,000 as the pup production in 1977, natural mortality M = 0.124 and a mean whelping age of 3.8 years with a catch comprising 10% mature females, the sustainable yield was estimated to be 22,000 animals. However, the available data were considered insufficient to recommend any change in the present total allowable catch.

3. Review of Progress on Publication of Shrimp Papers

STACRES was informed that the shrimp papers from the December 1976 Special Meeting, which are to be published in a special issue of the Selected Papers series, had been returned to the Editor and that some progress had been made in final editing. Due to pressure of other work and the delay encountered by some authors in not returning their revised manuscripts by the 30 June 1977 deadline, Mr Sandeman indicated that progress had been slow and that he would have little time to pursue this project in the near future. The Executive Secretary informed the Meeting that Dr Wilder, who has recently retired from the St. Andrews Biological Station after a long career on lobster research, would be willing to complete the editing of the shrimp papers.

It was pointed out that a number of shrimp papers presented at the current meeting might be suitable for inclusion in the special issue. STACRES agreed that a deadline of 1 February 1978 be set for the submission of revised papers from the current meeting and any further revisions to those of the December 1976 Meeting, so that the special issue of Selected Papers (on shrimp) can be published before the 1978 Annual Meeting.

4. Consideration of 3-alpha Codes for North Atlantic Species

STACRES was informed that the FAO 3-digit codes for species, adopted by ICNAF as one of the standard entries in logbooks (*ICNAF Meet. Proc.* 1975, page 61), were set up for internal use in data processing and were never intended for general use outside FAO. In fact, the so-called "FAO 3-digit" codes have been declared defunct by FAO, and the only official FAO codes for species are the 14-character taxonomic codes, which are completely unsuitable as a species identifier in logbooks.

At its triennial meeting in August 1977, the CWP (Coordinating Working Party on Atlantic Fisheries Statistics) recognized the urgent need for a simplified coding system to be used as standard species identifiers in logbooks, and recommended the use of a 3-alpha coding system for the North Atlantic (ICNAF Sum. Doc. 77/XI/36), as drawn up by the Secretariat representatives of ICNAF and ICES. It was noted that this coding system was adopted by ICES at its 1977 Annual Meeting. STACRES agreed that the matter be placed on its agenda for further consideration at the 1978 Annual Meeting.

5. Northward Extension of Statistical Area 0

In view of the reported catches from the region north of Statistical Area 0 in 1976 and 1977 and the possibility of the continuous distribution of shrimp from Baffin Island across the Davis Strait Ridge to Greenland, STACRES agreed to the extension of Statistical Area 0 northward to latitude 78°10'N, with Div. 0B corresponding to the present Statistical Area 0 and the area to the north of 66°15'N and west of Subarea 1 to be named Div. 0A. The western boundary of Statistical Area 0 extends northward along the coast of Baffin, Bylot, Devon and Ellesmere Islands and follows the 80°W

[2] Lett, P., and T. Benjaminsen. 1977. A stochastic model for the management of the Northwestern Atlantic harp seal (*Pagophilus groenlandicus*) population. *J. Fish. Res. Bd. Canada*, 34(8): 1155-1187.

longitude meridian in the waters between those islands. A map showing the division of the new Statistical Area 0 is given in Fig. 1 of the Report of the *ad hoc* Working Group on Shrimp (App. I).

This realignment of Statistical Area 0 corresponds with the boundaries of Subarea 0 as proposed in the Convention of the new organization to replace ICNAF. It also agrees with the recommendation of the Coordinating Working Party on Atlantic Fishery Statistics (Report of Ninth Session of CWP, August 1977) that ICNAF extend the northern boundary of Statistical Area 0 to take account of catches being made north of this boundary.

The Secretariat was requested to advise FAO of this change and also to incorporate the change in the instructions for completing forms STATLANT 21A and 21B, so that fishery statistics for 1977 will be reported by Div. 0A and 0B separately.

6. Future Scientific Meetings

STACRES reviewed the scheduling of meetings for the first half of 1978 and confirmed the following:

a) Special Meeting of STACRES on squids to be held at Havana, Cuba, during 13-17 February 1978 (Com. Doc. 78/II/2).

b) Regular spring meeting of the Assessments Subcommittee to be held at ICNAF Headquarters, Dartmouth, Canada, during 4-12 April 1978.

c) Annual Meeting of STACRES and its Subcommittees to be held at Bonn, Federal Republic of Germany, during 18-27 May 1978, followed by a meeting of STACTIC on 29 May and meetings of Commissioners during 30 May to 6 June 1978.

d) The ICES/FAO/ICNAF Symposium on the Biological Basis of Pelagic Fish Stock Management will be held at Aberdeen, Scotland, on 3-7 July 1978.

7. Acknowledgement

The Chairman expressed his appreciation to the Secretariat for their usual efficient work, to the conveners and rapporteurs of the Working Groups, and to the rapporteur and members of STACRES for their cooperation during the course of the meeting.

APPENDIX I. REPORT OF *AD HOC* WORKING GROUP ON SHRIMP

Convener: A. T. Pinhorn

Rapporteur: S. Clark

The *ad hoc* Working Group on Shrimp met during 15-17 November 1977 to assess the status of the shrimp (=northern deepwater prawn) stocks in Subarea 1 and Statistical Area 0, the matter having been referred to STACRES by the Commission at its 1977 Annual Meeting (*ICNAF Meet. Proc.* 1977, page 159). Scientists attended from Canada, Denmark (Greenland and Foroes laboratories), France, Norway, Spain and USA. The Working Group reviewed a considerable amount of new information relating to the abundance and distribution of shrimp, including Res. Doc. 77/XI/61, 65, 67, 69 and 70, and several working papers.

1. Fishery Trends

Nominal catches of shrimp in Subarea 1 (Table 1) increased from less than 10,000 tons prior to 1973 to nearly 50,000 tons in 1976. Preliminary statistics for 1977 (to October) indicate a total catch of 36,000 tons, of which nearly 30,000 tons were taken on the offshore grounds. While catches offshore increased rapidly to 42,000 tons in 1976, those of the inshore fishery remained relatively stable at least to 1975 with a decline in 1976. The first record of shrimp catches in Div. 0B of Statistical Area 0 was in 1976 when Spain reported 327 tons, but none have been reported to date in 1977. However, in Div. 0A, Norway caught 65 tons in 1976 and Denmark (F) caught 126 tons in 1977. The shrimp fishery in Subarea 1 was first brought under quota regulation in 1977 with an overall TAC of 36,000 tons for the offshore grounds and a breakdown of the TAC over four management areas. The lower total catch in 1977 is considered to be a consequence of the management regime in the area.

Table 1. Nominal catches (metric tons) of shrimp in Subarea 1, 1970-77.

	1970	1971	1972	1973	1974	1975	1976	1977[2]	
Denmark (F)	130	496	755	1,371	2,023	5,300	11,179	11,560	(Oct)[3]
Denmark (G) a[1]	8,394	9,237	7,218	7,950	10,064	8,700	7,300	6,704	(Oct)
b	165	200	150	185	180	1,089	2,478	5,730	
Denmark (M)	-	-	-	196	308	1,142	2,717	5,384	(Oct)
France	-	-	-	-	-	-	803	756	(Dec)
F. R. Germany	-	-	-	-	-	-	-	34	(Oct)
Japan	-	-	-	-	-	-	146	-	
Norway	-	-	1,409	2,940	5,917	8,678	11,658[4]	6,406	(Oct)
Spain	-	-	-	-	-	6,948	6,925[5]	-	
USSR	-	-	-	-	3,517	6,033	6,468	-	
TOTAL SA 1	8,689	9,933	9,532	12,642	22,009	37,890	49,674	36,574	
Total offshore	295	696	2,314	4,692	11,945	29,190	42,374	29,870	

[1] a = inshore, b = offshore grounds.
[2] Preliminary 1977 data for year to end of month indicated in parentheses.
[3] In addition, 126 tons taken in Div. 0A of Stat. Area 0.
[4] In addition, 65 tons taken in Div. 0A of Stat. Area 0.
[5] In addition, 327 tons taken in Div. 0B of Stat. Area 0.

Data on discards were presented for the Norwegian fishery. However, these data were considered too limited to permit a complete evaluation of the size composition or the magnitude of the discard for this fishery on an annual basis. The Working Group did, however, note the need for discard data and stressed the importance of collecting such data in the future.

2. Distribution (Res. Doc. 77/XI/65, 67, 69, 70)

New data for Subarea 1 are consistent with earlier observations indicating the highest levels of offshore abundance in Div. 1B. A seasonal northwestward shift in fishing activity for Denmark (G) and Denmark (F) occurred in Div. 1B, similar to that first noted in 1976 (Res. Doc. 76/XII/150). It appears that this shift may have resulted from seasonal movements of shrimp concentrations, vessel

movements in response to reductions in stock abundance, or ice conditions. In almost all months for which data are currently available, fishing activity extended farther northward in 1977 than in 1976.

Survey data collected by R/V *Cryos* in Div. 0B of Statistical Area 0 in the autumn of 1977 indicate that shrimp are concentrated primarily in the northern part of this area at depths ranging from 300 to 420 m. Major concentrations occurred in the area between latitudes 64°10' and 65° 40'N, but ice conditions prevented full coverage of the northern part of the area. It was noted that there is currently no information available on the distribution of shrimp offshore in Davis Strait between the areas of known concentrations in Subarea 1 and Statistical Area 0, but that the distribution may be continuous between these areas, extending for some distance along the eastern coast of Baffin Island. Preliminary larval distribution data (Danish plankton hauls) were presented for Davis Strait. Coverage of offshore areas is at present inadequate and no conclusions could be drawn relative to differences between areas or trends over time.

3. Biology (Res. Doc. 77/XI/70)

Bottom trawl survey data collected by R/V *Cryos* in the autumn of 1977 indicated the presence of four age groups of shrimp in Statistical Area 0, these being age 2 (immatures), age 3 (males), age 4 (transitional stages) and age 5+ (females), with mean carapace lengths of 12.9, 17.9, 23.1 and 29.5 mm respectively.

4. Catch and Effort Data (Res. Doc. 77/XI/61, 67, 69)

Catch and effort data were presented for fisheries by Denmark (G), Norway and Denmark (F) in Subarea 1 for 1975-1977. Statistical analyses of Denmark (F) catch and effort data indicated that 39-92% of the variance was explained by variation due to ship, time of day, statistical rectangle and year. The catch-per-unit effort (CPUE) estimates from the model showed good correspondence with the CPUE data previously used. Examination of the data for Div. 1B revealed a close correspondence in seasonal trends for the different countries for periods in which their fleets were active, i.e. catch rates peaked in the spring and subsequently declined to an annual low in the autumn. Similar seasonal differences in catch rates were evident for Div. 1D.

Annual catch rates for the Norwegian fishery in Div. 1B increased from 1975 to 1976 and declined in 1977; the available data suggest a similar trend for the Denmark (F) fishery. However, the corresponding Denmark (G) figures increased from 1975 to 1976 and then remained at about the same level in 1977. It was pointed out that annual catch rates for the Denmark (G) fishery were not strictly comparable to Norwegian and Denmark (F) data due to seasonal differences in distribution of fishing effort. Accordingly, the Working Group concluded that the Norwegian and Denmark (F) data would be the more useful for comparisons between years, i.e. an increase in annual catch rates from 1975 to 1976 followed by a decline in 1977 to the 1975 level. Thus, no significant net decline in catch rates occurred from 1975 to 1977, although it was pointed out that, since intensive fishing activity was comparatively recent and had focused primarily on recruiting females, stock-recruitment effects, if any, would not be evident during the period. The Working Group was uncertain of the basis for the observed increase in 1976, although environmental factors may have been involved.

No clear annual trends in commercial catch rates from 1975 to 1977 were documented for Div. 1D. However, Denmark (G) research vessel survey data indicate declines in abundance for Div. 1C and 1D during this period.

5. Biomass Estimates (Res. Doc. 77/XI/65, 67, 70)

Previous swept-area estimates of the biomass on the offshore grounds in Div. 1B, based on research data for Denmark (G) in 1976 (Res. Doc. 76/XII/150), were supplemented by additional work in 1977. Although the 1977 survey was not as complete as in 1976, the results indicate that the biomass level in Div. 1B is similar to that estimated for the previous year. Estimates from photographic surveys in Div. 1B in 1977 also agreed quite well with swept-area estimates calculated in 1976. It was agreed that bottom and off-bottom photographic surveys were valuable in providing a basis for evaluation of swept-area procedures. Limitations of the swept-area method have been documented previously (*ICNAF Redbook* 1977, p. 13-17).

The Report of the *ad hoc* Working Group on Shrimp in Subarea 1 (*ICNAF Redbook* 1977, p. 13-17) provided a minimum estimate of biomass of 100,000 tons for Subarea 1 (offshore) for 1976. Inasmuch as no evidence was presented indicating marked changes in stock abundance during 1975-1977, it was agreed that the minimum biomass estimate for Subarea 1 (offshore grounds) should remain at 100,000 tons for 1977.

A minimum biomass estimate of 4,000 tons was indicated for Div. 0B of Statistical Area 0 based on autumn groundfish survey data. It was noted that this figure should be regarded as very much a minimum, in that the survey had been conducted using a groundfish survey trawl with a codend mesh

size of 50 mm (stretched mesh). However, available data did not permit an evaluation of what the correction should be. Considerable interest was expressed in the possible distribution of shrimp in Div. 0A of Statistical Area 0. It was noted that depth configurations indicate a potential for shrimp concentrations in that area, but no biomass estimates are as yet available.

6. Total Allowable Catch

In deriving a total allowable catch (TAC) for Subarea 1, the Working Group drew attention to the fact that biological data are limited and that no information is currently available relative to recruitment. Accordingly, the need for caution was stressed, and the Working Group consequently agreed that the approach used at the December 1976 Meeting (*ICNAF Redbook* 1977, p. 15) would again be appropriate. The same assumptions were adopted as for the 1976 assessment, i.e. spawning (hatching) stock size should be maintained at a level equal to 50% of the virgin spawning stock, which would require an F of 0.4 in the model used, assuming an instantaneous natural mortality of 1.5 for females after first hatching of their eggs and a time interval of 1.5 years between recruitment to the fishery and first hatching. With a mean fishable stock biomass of 100,000 tons, this level of fishing mortality would provide a catch of 40,000 tons. The Working Group therefore advises that the 1978 TAC for shrimp should not exceed 40,000 tons (including discards) for the offshore grounds in Subarea 1.

As in the 1976 Meeting, the Working Group considered the possibility of subdividing the TAC for Subarea 1. Two aspects generated concern at the present Meeting: (a) stock relationships between offshore and inshore areas, particularly in the Disko Bay area; and (b) possible concentrations of small shrimp in Div. 1A (as evidenced by Norwegian and Denmark (F) catches), which appear to require special protective measures. The arguments for and against a breakdown of the TAC are summarized in the Report of the December 1976 Meeting (*ICNAF Redbook* 1977, p. 16). Such a breakdown of the TAC would have to take into account the distribution of biomass by whatever management areas are proposed. However, due to the uncertainty concerning the interrelationships between grounds and the uncertainty concerning the variation in distribution of the overall biomass, the Working Group was not able to advise on a further breakdown of the TAC beyond that previously recommended for the Disko Bay area (*ICNAF Redbook* 1977, p. 16), and it was agreed that this breakdown should be maintained. Accordingly, the Working Group advises that the annual catch in the offshore area adjacent to Disko Bay, between latitudes 68°00'N and 69°30'N, east of 59°W longitude, not exceed 3,200 tons for 1978, recognizing that this figure may require future adjustment as new evidence relative to interrelationships between fishing grounds becomes available. The Working Group concluded that the information for Statistical Area 0 was inadequate for recommendation of a TAC.

7. Zone of Overlap

The Working Group considered management implications posed by the fact that part of Subarea 1 falls within the Canadian Fishing Zone and part of Statistical Area 0 falls within the Fishing Zone off Greenland (Fig. 1). A review of available data revealed that a relatively small portion of the estimated fishable biomass in Div. 1B falls within the Canadian Fishing Zone and that some of the fishing activity in Div. 1B occurs there; however, little or none of the biomass falls into the portion of the Canadian Fishing Zone lying within Div. 1C, 1D or 1E. In Div. 0A, shrimp occur both in the Canadian Fishing Zone and in the Fishing Zone off Greenland; however, in the developing fishery in 1976 and 1977, the fishing activity in Div. 0A occurred within the Canadian Fishing Zone. During 1977 (to October), 13% of the Denmark (F) catch in Div. 1B was taken in the Canadian Fishing Zone.

8. By-catch in the Shrimp Fishery (Res. Doc. 77/XI/61)

The Working Group reviewed available data relative to finfish by-catch in the shrimp fisheries. Several species are currently taken as by-catch, notably redfish, Greenland halibut, American plaice, cod, wolffishes and eelpouts; of these, redfish appears to be the most prevalent, and by-catches of this species in commercial shrimp fishing operations appear to be high enough to have a very significant effect on redfish stock abundance. One study by Denmark (G) indicated that the potential by-catch of small redfish in Subarea 1 is in excess of current nominal catch levels for commercial-sized redfish, but Norwegian data indicated much lower by-catches in the shrimp fishery. It was noted that precise estimates are currently not possible for Subarea 1 due to variability in by-catches both seasonally and between areas.

9. Future Research Requirements

The Working Group noted that there is considerable need for additional data from Subarea 1 and Statistical Area 0, if future assessments are to be improved, particularly because, as stressed at the December 1976 Meeting (*ICNAF Redbook* 1977, p. 15), knowledge about the stability of the size of the offshore shrimp stocks is very limited. Immediate information on the distribution of shrimp by area and season is requried, together with data on vertical distribution, if reliable biomass estimates are to be made. Recruitment trends are at present unknown, and there is also a critical lack of knowledge relative to growth, mortality rates, migration and local movements, and other biological

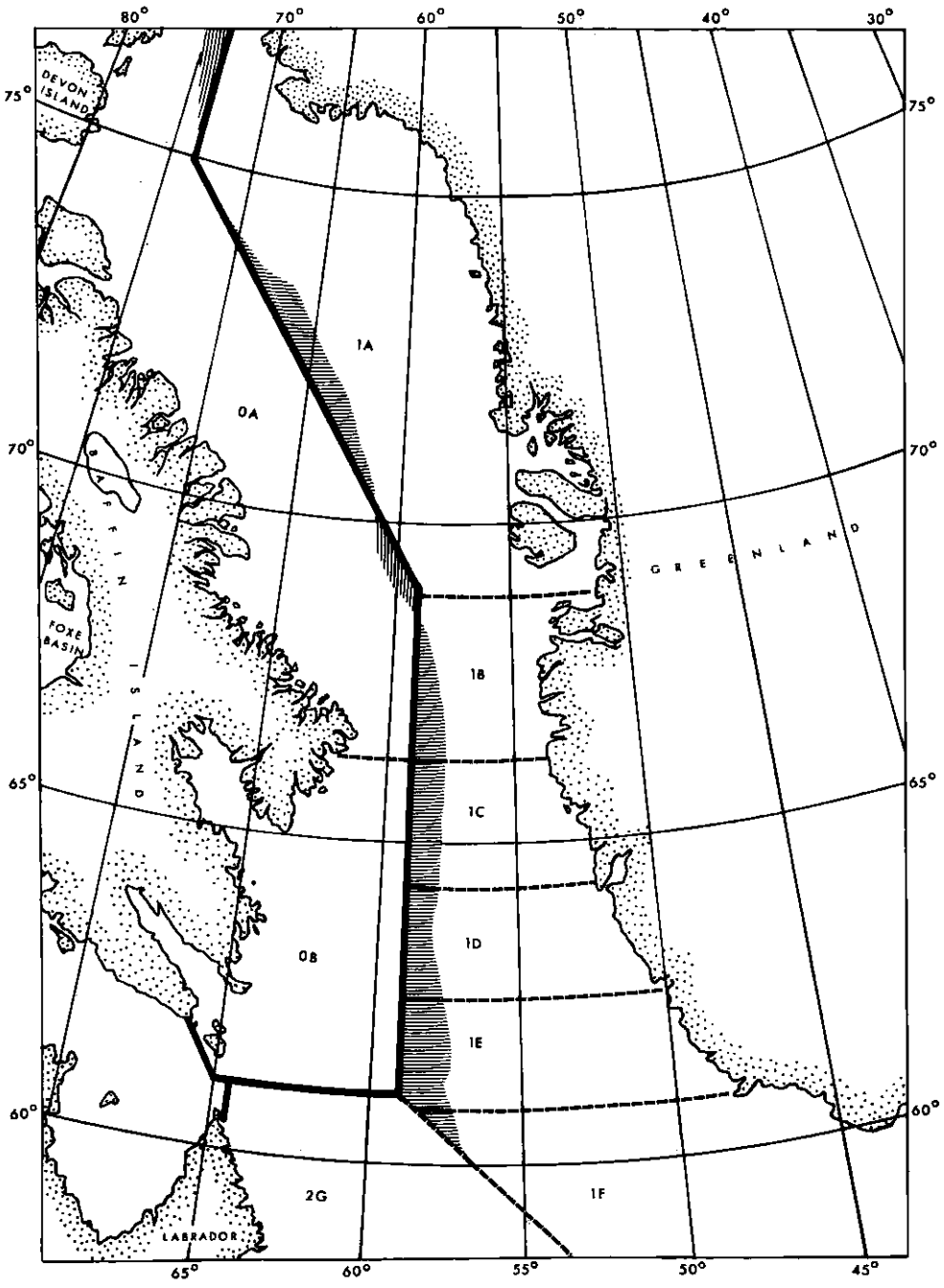

Fig. 1. Map showing the zones of overlap in Subarea 1 and Statistical Area 0 relative to extended fisheries jurisdiction of the coastal states.

and oceanographic parameters. Accordingly, the Working Group

recommends (1)

i) studies of vertical distribution with particular reference to effects of shifts in light intensity;

ii) development of techniques to predict recruitment (which would involve expansion of current plankton surveys, sampling in nursery areas, etc.);

iii) expansion of stratified bottom trawl and photographic surveys and completion of such surveys on an annual basis;

iv) tagging studies to evaluate migrations and local movements between grounds; and

v) general biological studies to provide additional data on growth and mortality rates, age composition, and other parameters. In particular, there is a critical need for development of reliable techniques that could be used to distinguish between older age-groups (females).

10. Scheduling of Future Assessments

The Working Group considered possible scheduling of future meetings. It was suggested that future TACs might be set on a different basis (e.g. other than the calendar year); however, there was general agreement that this approach could lead to confusion at administrative levels and would probably not be appropriate, as fishing activity is currently more or less continuous throughout the year. Concern was expressed that, due to the limited knowledge currently available (particularly with respect to recruitment), more than one meeting a year might be necessary. It was recognized that scheduling requirements could vary in view of requirements of the coastal states involved and availability of data.

APPENDIX II. REPORT OF *AD HOC* WORKING GROUP ON SEALS

Convener: A. W. Mansfield Rapporteur: M. C. Mercer

The *ad hoc* Working Group on Seals met during 15-17 November 1977 to review the status of the harp and hooded seal populations in the Northwest Atlantic, as requested by Canada (Com. Doc. 77/VI/13). Representatives attended from Canada (P. F. Brodie, D. F. Gray, D. M. Lavigne, P. F. Lett, A. W. Mansfield, M. C. Mercer, R. K. Mohn, H. C. Rowsell, D. E. Sergeant and G. H. Winters), Denmark (F. O. Kapel), and Norway (T. Benjaminsen). The Working Group reviewed a considerable amount of new information, including Res. Doc. 77/IX/56, 57, 58, 59, 62, 63, 64, 66 and 68, and several working papers.

1. Conservation of Harp Seals

a) Research in 1977

Canada reported the results of 1977 studies relating to tag and brand recoveries and age composition of the catch (Res. Doc. 77/XI/58), an aerial census of the Front and Gulf herds (Res. Doc. 77/XI/62) with associated ice-level observations (Res. Doc. 77/XI/63), estimates of production utilizing catch and effort data combined with aerial survey results (Res. Doc. 77/XI/68), a critical evaluation of two harp seal population models (Res. Doc. 77/XI/64), and further analyses of mortality and production in harp seals (unpublished). Norway reported on field observations at the Front in 1977 (Res. Doc. 77/XI/59). Denmark presented estimates of catch levels and age composition for West Greenland in 1972-75 (Res. Doc. 77/XI/66).

b) Population assessment

i) Mortality estimates. Estimates of natural mortality (M) were derived from four sources of information as follows:

(1) M = 0.098 was estimated from the updated results of Res. Doc. 76/X/127, the calculated 0-group mortality being similar at M = 0.099.

(2) M = 0.114 was estimated by Lett and Benjaminsen (1977, J. Fish. Res. Bd. Canada, 34: 1155-1187).

(3) M = 0.099 was estimated by Gray and Lett (unpublished), based on pup production estimates for 1962-69, as given by Benjaminsen and Øritsland (unpublished), and on sex ratios and catch-at-age data, as given by Lett and Benjaminsen (1977, ibid.).

(4) M = 0.1058 from unpublished Norwegian data considered in 1976.

Since the estimates of (1) and (4) above were based essentially on the same data, they were averaged to give an estimate of M = 0.1019. This estimate and those of (2) and (4) were then averaged with weights inversely proportional to their estimated variances. The resultant value of M = 0.102, with standard error of 0.00604 and confidence interval of 0.034 at the 5% probability level, was used in the assessment.

ii) Pup production. Estimates of pup production were available from several sources.

(1) An aerial ultraviolet photographic survey was conducted in 1977 (Res. Doc. 77/XI/62). A large herd located west of the Magdalen Islands in the Gulf was surveyed on 9-10 March, but complete coverage was not obtained due in part to a malfunction in the inertial navigation system. A small herd was photographed north of the Bird Rocks on 11 March, but another herd located north of the Magdalen Islands on or about 21 March was not surveyed. The census in the Gulf accounted for less than 30,000 seals, and the authors of Res. Doc. 77/XI/62 concluded that it was not reasonable to estimate total production in the Gulf on the basis of the coverage obtained.

The photographic coverage of the main herds at the Front was reasonably complete, except for a small group of seals south of the main patch (Res. Doc. 77/XI/62). The Working Group discussed the extent of the coverage, particularly with regard to concentrations of seals near the margins of the photographed areas and the possibility of extensive areas of low concentration which would not be accounted for in the survey of the main whelping herds. It was noted that Norwegian sealing ships passed through 45 miles of scattered concentrations of whelping harp seals, with 500-1,000 animals in each, before they reached the main patches (Res. Doc. 77/XI/59), and also through several small patches of harp seal pups over about 25 miles while steaming eastward toward the hooded seal concentrations on 18-20 March. However, the Working Group

could find no basis for any quantification of under-estimation attributable to small concentrations not covered in the survey.

Ice-level observations (Res. Doc. 77/XI/63) were conducted to complement the aerial survey. In the Gulf, difficulties were encountered with photographic imagery and environmental conditions causing incomplete coverage of some control areas, and also in the analysis of the survey results, especially in having the perception of boundary lines on the ice coincide with that of lines subsequently drawn on photographic imagery. Furthermore, there was a decrease in pup counts during the second flight, which suggested that pups were leaving the ground control area, thus causing an upward bias in the proportion of pups in the control area which were thought to have been photographed. Environmental conditions at the Front rendered the foregoing procedure impractical, and observers on the ice there classified pups qualitatively as being in the open, hidden from above or doubtful. On the basis of discussions at past meetings, it was agreed to approximate the percentage of pups available for photography within the photographed area as being 90%. Similar observations in the Gulf indicated a figure of 99% for that area.

Aerial survey estimates for the Front, including a 10% correction factor for seals not detected by the sensor, were computed in a number of ways (Res. Doc. 77/XI/62). The Working Group concluded that the simple random sampling procedure was the appropriate analysis to use, and this gave a mean estimate of 204,000 pups in the area surveyed.

(2) Pup production in 1977 was estimated by the survival index method to be 330,000 animals, derived from a projection of the female breeding stock in 1972 (320,000 animals) and assuming a fertility rate of 92% and a maturity ogive as given in Res. Doc. 76/X/124. Pup production was also estimated for 1977 to be 320,000 animals, from age-specific population estimates by cohort analysis using the same fertility and maturity rates given above. Corresponding estimates for 1978 were projected to be 343,000 and 338,000 animals respectively.

(3) From estimates of total and partial production figures based on the application of the Delury method to daily catch rates and cumulative catches, the total pup production at the Front was estimated to be 199,000 animals for 1977 (Res. Doc. 77/XI/68). It was noted that this estimate applies only to the sections of the herd hunted by landsmen and by large and small vessels and is therefore considered to be a minimum estimate. Analysis of statistics for the Gulf prior to closure of the large-vessel hunt in 1972 produced an estimate of the pup production of 90,000 animals in 1971. Projection of this estimate forward, under the assumption that the mixing of Gulf bedlamers with those of the Front was as indicated in Res. Doc. 77/XI/58 and that their frequency in the Front catch was one-third of the fraction indicated, gives a pup production of 93,000 animals in 1977. Total production of pups for the Gulf and Front in 1977 is therefore estimated to be 292,000 animals in 1977, with a projected production of 309,000 animals in 1978.

(4) Pup production in 1977 was estimated by the survival index method from Norwegian data (Sum. Doc. 76/XII/47, App. III) to be 315,000 animals, with a projected production of 330,000 pups in 1978.

(5) Projected estimates, based on the cohort analysis of Lett and Benjaminsen (1977, J. Fish. Res. Bd. Canada, 34: 1155-1187), indicated pup productions of 330,000 and 347,000 animals for 1977 and 1978 respectively.

The foregoing pup production estimates (thousands of animals) are summarized as follows:

	1977			Projected
	Gulf	Front	Total	for 1978
Aerial census	<30[1]	204	-	-
Cohort analysis	-	-	320 330	338 347
Survival indices	-	-	330 315	343 330
Catch and effort analysis	93	199	292	309

[1] Survey incomplete and not considered a valid basis for an estimate of pup production.

iii) Stock relationships. Returns of harp seals, tagged and branded in the Gulf and recovered in winter and spring at the Front and in the Gulf, are summarized in Res. Doc. 77/XI/58. Crossovers accounted for 79% of 80 returns at age 1, 69% of 16 returns at age 2, 11% of 9 returns at age 3 and none of 7 returns at older ages. However, the author reported that two 8-year-old seals, tagged as pups in the Gulf, were taken at the Front (in Notre Dame Bay) in 1977.

The Working Group reviewed historical trends in stock size for the Front and Gulf separately, based on the results of catch-effort and cohort analyses (Res. Doc. 77/XI/68). Under the assumption that mixing of bedlamers occurs as indicated in the preceding paragraph but that adults home to their area of birth, the results suggest that pup production in the Gulf is increasing and that at the Front is decreasing. Present analyses of production and yield are based on a unit stock concept, the evidence of mixing being inadequate to quantify the degree of interbreeding between the adults of the Gulf and Front areas. However, since some segregation of breeding age-groups apparently occurs, it would be prudent to divert some hunting effort from the Front to the Gulf.

iv) Population models. A critical analysis of population models developed by Lett and Benjaminsen (1977, J. Fish. Res. Bd. Canada, 34: 1155-1187) and by Capstick *et al.* (Res. Doc. 76/X/132) was presented (Res. Doc. 77/XI/64), these being referred to as the L-B model and the Guelph model respectively. Using similar input data in both models, the pup production calculated in the Guelph model is 15% lower, of which 4% relates to different maturity ogives, 3.5% to sex ratio, 1% to pregnancy rate, and 6% to breeding animals over 25 years of age. A sensitivity analysis of the Guelph model (over a 20-year simulation) showed strong dominance of survivorship such that a 1% error in natural mortality would result in a 36% difference in the size of the breeding population. The variance in the final population size is 50 times more strongly affected by uncertainty in this parameter than in any other, due to weaker control of the density-dependent fecundity factor than in the L-B model. The L-B model displayed no dominant sensitivity, the stability being the result of two density-dependent controls.

v) Sustainable yields. Using the L-B model, the Working Group developed estimates of sustainable yield for levels of pup production of 310,000 and 350,000 in 1978 with M = 0.10. Age composition, sex ratios, maturity ogives and fertility rates were applied as by Lett and Benjaminsen (1977, J. Fish. Res. Bd. Canada, 34: 1155-1187). The catch composition was assumed to comprise 80% young of the year and 20% older animals, as has recently occurred in the fishery. The results of the analysis indicate sustainable yields of 227,000 and 245,000 animals for pup production levels of 310,000 and 350,000 respectively. It was also determined that the current total allowable catch (TAC) of 170,000 seals is sustainable at pup production levels of 250,000 and above.

The model was applied as in the preceding paragraph to project population trends of age 1+ animals under varying levels of pup production and projected catches as follows:

1978 pup production	Projected catch	Population size (000 seals) 1979	1980	1981	1982	1983
310,000	170,000	1254	1276	1302	1327	1370
	190,000	1239	1238	1249	1268	1289
	210,000	1228	1213	1224	1241	1244
350,000	170,000	1413	1438	1460	1502	1548
	190,000	1395	1405	1415	1446	1481
	210,000	1378	1365	1373	1386	1410

The ranges of pup production associated with 1983 population projections are 352,000-357,000 and 380,000-385,000 animals for 1978 pup production levels of 310,000 and 350,000 respectively.

c) Future research on harp seals

The Working Group stressed the need for further data on the production and stock relationships of harp seals, including the application of tissue enzyme electrophoresis to the problem of stock identification, and data for use in the calculation of mortality and reproductive rates, and

recommends (2)

i) that a large-scale tagging program be conducted in the Gulf and at the Front in 1978;

ii) that Dr Lavigne and his co-workers undertake a study of tissue enzyme electrophoresis in seals, based on samples of 1,000 pups from each of the Front and Gulf areas with a view to examining up to 30 enzyme systems from four tissues; and

iii) that samples of 1,200 moulting seals be collected in each of the Front and Gulf areas in 1978 for the determination of age, sex and maturity.

The Working Group further

recommends (3)

that, if large-vessel effort is diverted from the Front to the Gulf in 1978, catch and effort data be collected so as to permit their application in stock assessments.

2. Conservation of Hooded Seals

a) Research in 1977

Canada reported the results of an aerial survey of breeding seals in Davis Strait, tagging and branding activities and recoveries, and age composition data (Res. Doc. 77/XI/57). Norway and Canada presented an analysis of hooded seal population data and a population model.

b) Population assessment

i) Production. An area estimate of herds in Davis Strait was obtained and pup production was estimated to be at a minimum of 7,500 (Res. Doc. 77/XI/57). It was concluded that the whelping of hooded seals in Davis Strait (63° to 64°N) was a relatively constant feature.

Pup production for the stock exploited at the Front was estimated to be 38,000 in 1977. This estimate was obtained by projection from a 1971 population estimate determined by sequential population analysis, with recruitment based on a density-dependent ogive (Benjaminsen and Lett, unpublished). Similar projection by sequential population analysis from a 1969 pup production of 27,000 (Res. Doc. 76/X/126) gave an estimated 1977 production of 34,000 pups.

ii) Stock size and sustainable yields. Based on sequential population analysis (unpublished data), the stock size of age 1+ females appears to have increased from a low of about 53,000 in the early 1960's to 77,000 in 1977. Assuming a natural mortality rate (M) of 0.124, mean whelping age of 3.8 years, and a 1977 pup production of 38,000, and taking into account the current regulation restricting the catch of females to 10% of the total catch, the sustainable yield was estimated to be 22,000 animals, comprising 17,700 pups, 2,000 breeding females and 2,300 older males. However, the Working Group considered that the data were insufficient to recommend any change in the TAC.

c) Future research on hooded seals

The Working Group considered the need for extensive age composition data from the Front herd and suggested that jaws be collected from all age 1+ hooded seals taken by large vessels operating in the area. In any case, the Working Group

recommends (4)

that extensive age samples, segregated by sex, be collected from the harvest at the Front in 1978.

The Working Group agreed on the desirability of intensive tagging of older seals in Davis Strait in order to elucidate stock relationships more quickly than by the tagging of pups, and it also considered that tagging in the Denmark Strait area was warranted. Accordingly, the Working Group

recommends (5)

i) that a tagging technique, using drugs to immobilize older seals, be developed for use in 1978.

ii) that tagging be undertaken in the Davis Strait and Denmark Strait areas in order to elucidate stock relationships.

PART B

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)[1]

Special Meeting on Squid, February 1978

CONTENTS

[1] Distributed previously as *ICNAF Sum. Doc.* 78/VI/3.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Special Meeting on Squid, February 1978

Chairman: A. W. May Rapporteur: V. M. Hodder

STACRES met at Havana, Cuba, during 13-18 February 1978, at the request of Canada (Com. Doc. 78/II/2), to provide advice on the scientific basis for the management of the stocks of squid (*Illex illecebrosus*) within national fisheries limits in Subareas 3 and 4. Scientists attended from Canada, Cuba, France, Japan, Poland, Spain, Union of Soviet Socialist Republics (USSR), and United States of America (USA). A considerable amount of new information on squid was reviewed (Res. Doc. 78/II/1 to 78/II/17).

Preliminary consideration of the major agenda items (see Part D, this volume) was carried out in discussion groups led by Dr E. C. Lopez-Veiga (Spain), Mr A. T. Pinhorn (Canada) and Dr F. Nagasaki (Japan), and *ad hoc* working groups were set up as required to review certain key issues in more detail than was possible in the time available for the plenary sessions of STACRES. A summary of the proceedings, as adopted by STACRES at its last session, is given in the following sections.

1. Fishery Trends

The nominal catch of *Illex* in Subareas 2 to 4 increased rapidly from an annual average of about 4,500 metric tons during 1970-74 to 18,000 tons in 1975 and to 42,000 tons in 1976 (Table 1). Preliminary data indicate that the 1977 catch was about 81,000 tons, of which 47% was taken by Canada and 24% by USSR.

In Subarea 5 and Statistical Area 6, the known catch of *Illex* increased from about 2,000 tons in 1970 to nearly 17,000 tons in 1974 with a decline to 14,000 tons in 1975 (Table 2). The statistics for 1970-75 do not reflect the true picture, as a breakdown of the USSR squid catches by *Illex* and *Loligo* separately is not yet available for these years. The *Illex* catch (including USSR data) increased to 28,000 tons in 1976, and preliminary data for 1977 indicate a decline to about 23,000 tons. In 1976 and 1977, more than 80% of the total *Illex* catch was taken by Japan, Poland, Spain and USSR.

In the Northwest Atlantic as a whole, the known catches of *Illex* (excluding USSR catches) increased from 4,000 tons in 1970 to about 32,000 tons in 1975 (Table 3). In 1976, the catch (including USSR) increased significantly to nearly 70,000 tons, and preliminary data for 1977 indicate a further increase to 104,000 tons. During the two most recent years in the development of the *Illex* fishery, the proportion of the total catch taken in Subareas 2 to 4 increased from 60% in 1976 to 78% in 1977.

2. Stock Relationships

Relationships among stocks of *Illex* exploited in Subareas 3-5 and Statistical Area 6 are unclear. However, considerable data have been collated on size compositions and maturities which are amenable

Table 1. Nominal catches (metric tons) of short-finned squid (*Illex illecebrosus*) in Subareas 2-4 by country, 1970-77.

Country	1970	1971	1972	1973	1974	1975	1976	1977[1]
Bulgaria	-	-	-	-	-	25	1,034	2,929
Canada (MQ)	6	16	8	11	65	89	943	8,034
Canada (N)	74	1,606	18	622	17	3,204	9,929	29,678
Cuba	-	-	-	-	-	-	3,248	4,668
France (M)	-	-	-	-	-	-	-	455
France (SP)	-	-	-	-	-	-	442	584
F. R. Germany	-	-	-	-	-	-	27	2,774
German D. R.	-	-	-	-	-	17	-	-
Italy	-	-	-	-	-	-	1,355	2,464
Japan	63	58	11	24	5	507	3,055	3,143
Poland	-	-	-	228	-	-	809	2,936
Portugal	-	-	-	-	-	-	264	-
Romania	-	-	-	-	-	-	-	1,054
Spain	-	-	-	-	265	268	934	2,958
USSR	1,242	7,226	1,831	8,992	85	13,634	16,900	18,953
Ireland	-	-	-	-	-	13	2,827	-
TOTAL	1,385	8,906	1,868	9,877	437	17,757	41,767	80,630

[1] Preliminary data

Table 2. Nominal catches (metric tons) of short-finned squid (*Illex illecebrosus*) in Subarea 5 and Statistical Area 6 by country, 1970-77.

Country	1970	1971	1972	1973	1974	1975	1976	1977[1]
Bulgaria	-	80	479	364	420	171	-	33
Canada (MQ)	-	1	-	-	-	-	54	-
Cuba	-	-	14	-	-	121	8	1
France (M)	-	-	8	27	-	-	-	-
F. R. Germany	-	-	-	-	-	-	1,101	-
German D. R.	20	-	-	313	-	882	996	-
Italy	-	-	1,200	805	980	884	1,117	1,958
Japan	389	176	2,398	1,067	3,327	3,237	3,256	4,733
Poland	-	-	5,264	8,288	5,003	3,051	5,050	656
Romania	-	-	-	-	6	48	9	-
Spain	1,636	3,324	4,878	3,784	6,769	2,204	4,063	7,935
USSR[2]	...	...	...	...	...	...	6,812	7,032
USA	408	455	472	530	148	107	229	1,016
Ireland	-	-	-	-	-	3,085	2,241	-
TOTAL	2,453+	4,036+	14,713+	15,178+	16,653+	13,790+	24,936	23,364

[1] Preliminary data
[2] USSR catches of "squid (NS)" in 1970-75 were 1,065, 6,138, 6,976, 8,977, 8,495, and 8,928 tons respectively.

Table 3. Nominal catches (metric tons) of *Illex* by subareas, 1970-77.

Year	SA2	SA 3	SA 4	SA 5	SA 6	TOTAL
1970	-	111	1,274	1,523[1]	930[1]	3,838[1]
1971	-	1,607	7,299	2,216[1]	1,820[1]	12,942[1]
1972	-	26	1,842	8,545[1]	6,168[1]	16,581[1]
1973	2	620	9,255	12,074[1]	3,104[1]	25,055[1]
1974	31	17	389	8,014[1]	8,639[1]	17,090[1]
1975	-	3,764	13,993	5,896[1]	7,894[1]	31,547[1]
1976	-	11,254	30,510	13,945	10,991	66,700
1977[2]	-	31,660	48,970	(23,364)		103,994

[1] Exclude USSR catches in SA 5 and 6 which have not been reported by *Illex* and *Loligo* separately (see Table 2).
[2] Preliminary data.

to interpretation in this regard (Table 4) when considered from the viewpoint of the seasonal and geographic distribution of the species. Although *Illex* occurs throughout the year on the shelf and slope in Subarea 5 and Statistical Area 6, its abundance is very low during the winter months. *Illex* is taken on the Scotian Shelf (Div. 4VWX) from about April to November and on the Grand Bank (Div. 3LNO) from about May to November. Inshore occurrence at Newfoundland, the northern end of the range, is July to November. The migration pattern may comprise north-south and inshore-offshore components with northern and inshore distribution limited seasonally by temperature.

A general pattern is discernable in the modes of length by area and season (Table 4). Unimodal length compositions are more general at the northern end of the range where modal classes are usually at larger sizes than further south. Growth can be followed by a progressive increase in mantle lengths from spring to autumn in all areas. However, a group of small squid with modal length at 6 cm or less appears in late autumn catches in Subarea 5 and Statistical Area 6, and occasionally a group of small squid is taken in Subarea 4 with a modal length approximately twice as great.

Maturing female *Illex* have been taken on the Scotian Shelf in late autumn (Res. Doc. 78/II/1). A mature fertilized female and two maturing females were also taken in this area in May 1973 (Res. Doc. 74/87). Two mature females were taken on the Grand Bank in May 1953 (Squires, 1957)[1]. Small numbers of large *Illex* of sizes, comparable to those taken in late autumn in Subareas 3 and 4, are taken during the spring in Subarea 5 and Statistical Area 6.

[1] SQUIRES, H. J. 1957. Squid, *Illex illecebrosus* (LeSueur), in the Newfoundland fishing area. J. Fish. Res. Bd. Canada 14: 693-728.

The observed data are consistent with the existence of a protracted spawning season, possibly extending from December to June and ranging over an extensive area. However, the total absence of squid in Subarea 3 of modal sizes comparable to the small squid taken in late autumn in Subarea 5 and Statistical Area 6 indicates that spawning does not occur at the northern end of the range, i.e. northeastern Newfoundland. The occurrence of maturing females on the Scotian Shelf in late autumn (Res. Doc. 78/II/1) indicates that spawning probably occurs nearby. It is conceivable that some *Illex* taken in Subareas 3 and 4 are spawned in Subarea 5 and Statistical Area 6.

Table 4. Modal mantle lengths (cm) of *Illex illecebrosus* by sex, season and area[1].

Month	Holyrood Nfld	Rencontre W., Nfld	Grand Banks	Scotian Shelf	Gulf of Maine	Georges Bank	Southern New England	Mid-Atlantic
Male								
Jan	-	-	-	-	-	-	18	-
Feb	-	-	-	-	-	-	17	16
Mar	-	-	-	-	-	-	9,16-17,26	12-15,23-25
Apr	-	-	-	13-14	12	10-13,16-17	14-16,27	-
May	-	-	13	14-16 10,13	-	12,15 14-15	17	-
Jun	-	-	17	18-20 15	-	-	-	-
Jul	17-20	-	16,18	21 19	-	22 19-20	21	10,18-21
Aug	21-22	16-18	-	21-22	24	20	20	-
Sep	22-24	18-22	-	22	-	-	20-21	5-6,18
Oct	24-25	20,22	-	23	-	8-10,20-22 21-22	7-9,19-22	3-6,18,27
Nov	24-25	-	-	23	22-25	22-23 12,23-24	-	18
Dec	-	-	-	-	-	-	-	13,19
Female								
Jan	-	-	-	-	-	-	18	-
Feb	-	-	-	-	-	-	17	16
Mar	-	-	-	-	-	-	9,16-17,26	12-15,23-25
Apr	-	-	-	13-14	12	10-13,16-17	14-16,27	-
May	-	-	12-14	14-16 10,13	-	12 14-15	-	-
Jun	-	-	17	18-20 15	-	-	-	-
Jul	18-21	-	16,18-19	21 20	-	21-22 19-20	21	22
Aug	21-23	17-19	-	22	24	20	20	-
Sep	23-26	18,22-23	-	23	-	-	20-21	5-8,18
Oct	26-28	19,24-25	-	27	-	8-10,20-22 22-23	7-9,19-22	3-6,18,27
Nov	26-28	-	-	26	25	24 12,26-28	-	18
Dec	-	-	-	-	-	-	-	13,19

[1] Data sources: inshore Nfld (Res. Doc. 75/27), Grand Banks (Res. Doc. 73/79), Scotian Shelf (Res. Doc. 73/79, 74/87, 78/II/2), Gulf of Maine to Mid-Atlantic (Res. Doc. 76/VI/65, 77/VI/4, and unpublished data (A. M. Tibbetts-Lange)). All samples from research catches by lined otter trawl, except inshore Newfoundland samples which were jigged and January, February and December samples which were by commercial otter trawl. Most of the samples from the Scotian Shelf in April to June and from the Gulf of Maine to the Mid-Atlantic were unsexed and the modal lengths are listed under both male and female. Underlining indicates the dominant mode in multimodal frequencies.

3. Stock-recruitment Relationships

The major offshore fishery for *Illex* in the ICNAF Area has developed only recently and no data are yet available to demonstrate a relationship between stock size and recruitment. Because of the short life-span of the species, and hence no significant overlap between generations, intraspecific competition and density-dependent mortality is apparently minimized. It is assumed, therefore, that recruitment should increase gradually with stock size and that the stock-recruitment curve is of the Beverton-Holt rather than the Ricker type, i.e. recruitment would be expected to increase with increasing stock size and level off at some point irrespective of further increases in stock size (Res. Doc. 75/61). A stock with such a stock-recruitment relationship may be strongly influenced by the abiotic environment. It is very difficult, therefore, to predict the magnitude of recruitment in advance of the fishing season unless the relative abundance of pre-recruits can be assessed.

4. Yield-per-recruit

It is considered that *Illex* has a life span of approximately one year at which time spawning takes place with very high post-spawning mortality. Growth and maturation is thus rapid, with full development of gonads being reached within a year. From analysis of mantle length frequency distributions, Mercer (1969)[1] suggested the presence of mixed age-groups within a single year-class, possibly related to a protracted spawning season and area. Squires (1957)[2] suggested that spawning occurred from January to June and that the animals spawned when they had reached an age of about one year. Mesnil (Res. Doc. 76/VI/65) proposed winter-born and summer-born groups with a life-span of 1½ years.

Au (Res. Doc. 75/61) estimated the natural mortality rate from the life expectancy and the growth coefficient from length frequencies by month prepared by Squires (1957)[2]. On the basis of these parameters, an exploitation rate (E_{MSY}) of 0.65 was calculated to achieve the maximum yield-per-recruit. If a moderate degree of density-dependence is assumed, the E_{MSY} is likely to be about 0.50. Sissenwine and Tibbetts (Res. Doc. 76/VI/30), assuming a monthly natural mortality of 0.1, calculated E_{MSY} to be about 0.65, if there is no relationship between stock size and recruitment, and about 0.4, when a moderate stock-recruitment relationship is considered.

Analysis of length frequency data from the commercial fisheries in Div. 4VWX allows estimation of removals by number in each 2-week period. Removals of individuals per 100 metric tons decreased from 2.7 million in the period starting on 17 April 1977 to 0.64 million in mid-June and to 0.32 million in November, reflecting rapid growth during the season. It is likely that growth substantially exceeds mortality early in the season, and that an increase in yield-per-recruit could be achieved by delaying the start of the fishing season until at least the middle of June.

5. Abundance Trends over Time

a) Fluctuations in Newfoundland inshore squid catches, 1955-77

Newfoundland inshore fishermen have traditionally fished squid as bait for the cod fishery with longline gear. Bait was the main use of squid until 1977 when a market for squid as food became available to the inshore fishermen. Thus, the fluctuations in catch of squid by Newfoundland fishermen may be considered as a measure of the abundance of squid in inshore waters during the summer months (Table 5). Between 1955 and 1976, the catches fluctuated in the range of 13 to 11,300 tons. Catches were generally in the range of 2,500-10,000 tons during 1955-67, except for 1958 and 1962 when they were 718 and 482 tons respectively. However, during the 1968-74 period catches exceeded 26 tons only in 1970 (111 tons), 1971 (1,607 tons) and 1973 (600 tons). The catch increased to 3,800 tons in 1975, to 11,300 tons in 1976 and to 29,700 tons in 1977, the last being partly due to an increase in effort in the inshore fishery for squid as food. It should be noted that, although these sharp fluctuations in catch may reflect changes in squid abundance, they may also reflect changes in the availability of squid in the inshore areas.

b) Abundance indices from research vessel surveys

Canadian research vessel surveys in Div. 4VWX during July of 1970-77 indicated fluctuations in squid biomass from a low of 1,900 tons in 1970 to a high of 262,500 tons in 1976 (Table 5). Estimates were in the range of 1,900-14,700 tons during 1970-74, increased to 24,800 tons in 1975 and 262,500 tons in 1976, and decreased to 50,500 tons in 1977. USA research vessel surveys in Subarea 5 and Statistical Area 6 indicated fluctuations in biomass from a low of 400 tons in 1969 to a high of 42,900 tons in 1976. Estimates were in the range of 400-2,500 tons during 1968-74, increased to 8,300 tons in 1975 and 42,900 tons in 1976, and decreased to 23,000 tons in 1977. USSR surveys, mostly in Subarea 5 but with some coverage of Statistical Area 6 and Div. 4X in

1 MERCER, M. D. 1969. Biological characteristics of migrant ommastrephid squid, *Illex illecebrosus* (LeSueur), in the Newfoundland area. Amer. J. Zool. 9: 618-619.

2 SQUIRES, H. J. 1957. Growth and hypothetical age of the Newfoundland bait squid, *Illex illecebrosus*. J. Fish. Res. Bd. Canada 14: 1209-1217.

Table 5. Indices of trends in squid (*Illex*) abundance from various sources, 1955-77.

Year	Newfoundland inshore catch (tons)	Biomass estimates: Canadian surveys in Div. 4VWX (000 tons)	Biomass estimates: USA surveys in SA 5+6 (000 tons)	Biomass estimates: USSR surveys in SA 5+6 (000 tons)[1]	Research vessel surveys by Japan in SA 3-6 (kg/day)
1955	7,019				
1956	7,779				
1957	2,634				
1958	718				
1959	2,853				
1960	5,067				
1961	8,971				
1962	482				
1963	2,119				
1964	10,408				
1965	7,831				
1966	5,017				
1967	6,917				
1968	13		1.8		
1969	21		0.4		
1970	111	1.9	1.5		
1971	1,607	14.7	2.0	100	
1972	26	3.2	1.7	58	
1973	600	8.9	1.9		738
1974	17	9.5	2.5		1,001
1975	3,751	24.8	8.3	197	2,315
1976	11,257	262.5	42.9	258	3,817
1977	29,678	50.5	23.0		

[1] The surveys covered part of Div. 4X in 1971 and 1975.

some years, indicated biomass estimates of 100,000 tons in 1971, 58,000 tons in 1972, 197,000 tons in 1975 and 258,000 tons in 1976. Japanese research vessel surveys in Subareas 3-5 and Statistical Area 6 indicated changes in abundance indices from 738 kg per day fished in 1973 to 3,817 kg per day fished in 1976. It should be noted that, although the biomass estimates from these research vessel surveys cannot be considered as representing absolute measures of squid abundance because the catchability of the trawls used was less than 1.0, they nevertheless should be representative of trends in abundance from year to year.

c) Conclusion

The abundance indices shown in Table 5 indicate that squid abundance may vary greatly over a period of years and may fluctuate by a factor of several times from one year to the next. In general, it seems that a period of high abundance in 1955-67 was followed by a period of low abundance in 1968-74 and that this was followed by another period of high abundance in 1975-77.

6. Current Stock Status and Exploitation Rate

The various abundance estimates available for 1977, based on the area expansion method, were reviewed in relation to catches. Given the uncertainties of stock inter-relationships and migration patterns, it was agreed that the status of the *Illex* stock in Subareas 3 and 4 should be assessed separately for each subarea.

In Subarea 3, a biomass estimate of 116,000 tons in July 1977 for Div. 3LNO is available from Cuban commercial fishery data. An estimate of 48,000 tons in October-November 1977 for Subdiv. 3Ps is available from a stratified-random survey by a French research vessel. Preliminary nominal catches for Subarea 3 in 1977 are approximately 32,000 tons, of which 29,700 tons were taken in inshore Newfoundland waters primarily during August to November. The July biomass estimate is based on data collected at the same time of the year as that used for biomass estimates in Subarea 4. Hence, this estimate and those for Subarea 4 can be considered as estimates of different groups of squid. The inshore catches in Subarea 3 were made subsequent to the biomass estimate and hence cannot be considered additive. The Subdiv. 3Ps squid biomass, estimated in October-November, may or may not represent double counting. However, taking a conservative approach, the estimate for Subdiv. 3Ps was not added to the estimate for Div. 3LNO. If the July biomass estimate of 116,000 tons for Div. 3LNO is taken as representative of squid abundance in Subarea 3, the 1977 catch of 32,000 tons represents an exploitation rate of 28%. If the biomass estimate of squid for Subdiv. 3Ps were considered to be

additional to that estimated in Div. 3LNO in July, the exploitation rate would be 20%.

Three biomass estimates are available for June-August 1977 from commercial fisheries data for Div. 4W. Both the USSR estimate of 60,000 tons and the Polish estimate of 205,000 tons were derived from statistics on directed fisheries for squid. The Cuban estimate of 133,000 tons, derived from statistics for the directed silver hake fishery, since it coincided with the mean of the USSR and Polish estimates, was considered the most suitable for calculation of the exploitation rate. Preliminary nominal catches from Subarea 4 in 1977 were approximately 50,000 tons, and thus the estimated exploitation rate is 38%.

A wide variety of factors affect the accuracy of the biomass estimates used and these are summarized in Res. Doc. 76/VI/31 and 78/II/17. These potential biases cannot be quantified with the data available, and hence it must be recognized that the above calculations of exploitation rate cannot be accredited with high reliability. The Cuban estimates, since they are based on squid by-catches in fisheries directed to other species, are likely to be underestimates.

No new data or analyses are available to indicate the appropriate exploitation rate for *Illex*. One possible management strategy would be to ensure a certain minimum biomass escapement for spawning, and hence the exploitation rate would vary from year to year. However, this would require more detailed knowledge of the biology of the resource than presently available and very accurate management of the fishery. STACRES, at its 1976 Annual Meeting, concluded: "Analysis of yield-per-recruit and stock-recruitment considerations indicated that removals could be about 40% of the stock biomass" (*ICNAF Redbook* 1976, page 112).

7. Mechanisms and Approaches to *Illex* Management

The most direct methods of controlling the exploitation rate are by the imposition of catch and fishing effort regulations. The advantages and disadvantages of these methods have been thoroughly discussed by the Commission in recent years, particularly in reference to proposals for effort control of fisheries in Subarea 5 and Statistical Area 6.

In the particular case of the *Illex* fisheries, catch controls present specialized problems. The short life-span of *Illex* of approximately one year results in the fishery being conducted each year on new recruits. A mechanism has not yet been developed for predicting the quantity of recruits each year, with the result that previous advice has been given in terms of a precautionary TAC (total allowable catch) which was considered to provide adequate spawning escapement even in years of very low recruitment. However, in years of high abundance, such a TAC is very restrictive and results in substantial losses in potential yield. Pre-fishery surveys provide a potential solution to this problem if recruitment can be measured with sufficient accuracy. However, the evaluation of the accuracy of survey indices requires several years of research and presents no solution for the immediate future. Furthermore, the squid migrations may be sufficiently protracted and variable that surveys would not achieve the accuracy required. In summary, the control of exploitation rate through catch control to achieve an optimal exploitation rate is not technically feasible at present and will not be for several years.

Fishing effort controls are theoretically attractive, in that, once the fishing effort and the exploitation rate are calibrated for one year, the fishing effort can be set and maintained at the same level for succeeding years, with the catch varying with abundance as the exploitation rate remains constant. However, there are a number of practical considerations which could be classed as immediate and long-term difficulties. Effective fishing effort is influenced by a wide variety of factors which change with time, e.g. crew experience, vessel size and power, gear size and type, etc., and these factors would have to be continually monitored and calibrated. In the short term (and the long-term), different country-vessel-gear combinations must be inter-calibrated and the complexities of inshore and by-catch fishing effort taken into account.

For countries which conduct only a directed fishery for *Illex*, inter-calibration based on relative catch rates is straightforward. Squid by-catch problems occur mainly in the silver hake fishery and involve primarily Cuba and USSR. Cuban scientists indicate that all squid catches by Cuban vessels are by-catches in the silver hake fishery and that these by-catches are well documented. Thus, it would be possible to calculate effective by-catch effort by the Cuban fleet, based on the ratio of catch rates. In the case of USSR, which has directed fisheries for both squid and silver hake, sufficient data are available from the international observer program to calculate by-catches in each directed fishery. However, the criteria for defining directed fisheries would be somewhat arbitrary, introducing additional sources of error. Such a scheme would require close regulation of the silver hake fishery and trade-offs between the squid and the silver hake directed fisheries may prove to be necessary.

Inshore fisheries, conducted by many small-boat fishermen present serious practical problems for direct effort measurement. However, if the assumption is made that the same stocks are being fished both offshore and inshore, the inshore fishing effort can be expressed in terms of offshore fishing

effort equivalents. (The problems of control of inshore fishing effort are outside the scope of this Committee.)

In summary, there are many potential sources of error in the implementation of fishing effort regulation. However, given the extreme difficulties in setting catch regulations to achieve a particular objective in terms of exploitation rate, effort regulation offers a substantially greater probability of effective management. Squid are widespread in Subareas 3 and 4 and stock inter-relationships are uncertain. Under the circumstances, it would be wise to spread fishing effort throughout the area of distribution to prevent possible over-exploitation of particular stock components. Therefore, consideration should be given to regulating the exploitation rate of *Illex* in Subareas 3 and 4 separately.

8. By-catch Problem and Alternatives for Minimizing By-catch in the Directed Fishery for *Illex*

a) Season

A major constraint encountered in the analysis of Subarea 4 data was in determining the species to which the fishery of certain vessels was directed. However, relatively high by-catches (up to 30%) were recorded early in the fishing season (Res. Doc. 78/II/4). By-catches decreased by mid-July (0-8%) and remained relatively low for the remainder of the season (Res. Doc. 78/II/4; 10). Silver hake was the most predominant by-catch species, with small percentages of cod, flounders, mackerel, haddock, herring and argentine (Res. Doc. 78/II/10, 13, 16, and unpublished data for the Cuban fisheries in 1976 and 1977).

In Subarea 5 and Statistical Area 6, the 1977 catches of *Illex* were low prior to mid-June (Res. Doc. 78/II/8). In the period from mid-June to mid-September, catches were larger (up to 3,000 tons) with by-catches in the range of 0-3%. Silver hake and red hake were the most predominant by-catch species. Subsequent relatively low catches (total of 2,000 tons) had high by-catches of up to 55%.

b) Gear

The fisheries for *Illex* were conducted with both bottom and midwater trawls. By-catches were lower in midwater than in bottom trawls. For species other than silver hake and squid, small-mesh bottom-trawl by-catches varied between 3.5 and 4.8%, while the by-catches in midwater trawls varied between 0.1 and 1.8%. By- catches of squid in the directed fishery for silver hake were very high in the Cuban fishery (>30%) for both gear types (Res. Doc. 78/II/9). In the USSR silver hake fishery, by-catches of squid were 6.3% in bottom trawls and 22.8% in midwater trawls (which were used experimentally in the silver hake fishery). In the directed fishery for *Illex* by USSR, silver hake by-catches were 10.5% in bottom trawls and 1.2% in midwater trawls. The Polish directed fishery for *Illex* with midwater trawls resulted in by-catches of silver hake from 0.1 to 3.0% (Res. Doc. 78/II/10).

Three types of gear were compared in a Canada-Japan research program: bottom trawl, bobbin-type off-bottom trawl, and dangling-chain off-bottom trawl. The bottom trawl was the most efficient in catching squid, while the chain-type was the least efficient (Res. Doc. 78/II/14, 16). However, by-catches in the chain-type off-bottom trawl were much less than in the other two types. This experiment indicated that it would be possible to fish selectively for squid (Res. Doc. 78/II/9).

There is no mesh size regulation for *Illex* in Subareas 3 and 4, but the 60-mm minimum mesh size for silver hake resulted in some countries using this mesh size for *Illex* also. The countries fishing only for *Illex* used codends with mesh sizes in the range of 40-48 mm.

c) Area

Canadian observations in Subarea 4, based on 15% of fishing days, showed that the majority of the fishing activity for *Illex* took place at depths between 100 and 200 m (Res. Doc. 78/II/9) near the area defined for the international regulation of small-meshed bottom-trawl fisheries in Div. 4VWX. Most of the Canadian squid catches (about 4,000 tons) were taken in the Western Gully (42°52'N, 62°50'W) with 0-3% by-catches (Res. Doc. 78/II/4). The Canadian-Japanese research in 3 areas on the Scotian Shelf showed higher by-catches on the Shelf than along the slope in the area designated for small-meshed bottom-trawl fishing (Res. Doc. 78/II/16).

The overall distribution of *Illex* fishing grounds in the Northwest Atlantic is shown in Fig. 1.

9. Review of Existing Regulations

Fisheries for squid in the ICNAF Convention Area and Statistical Area 6 are regulated by mesh size, fishing gear type, open seasons and areas, and catch quotas.

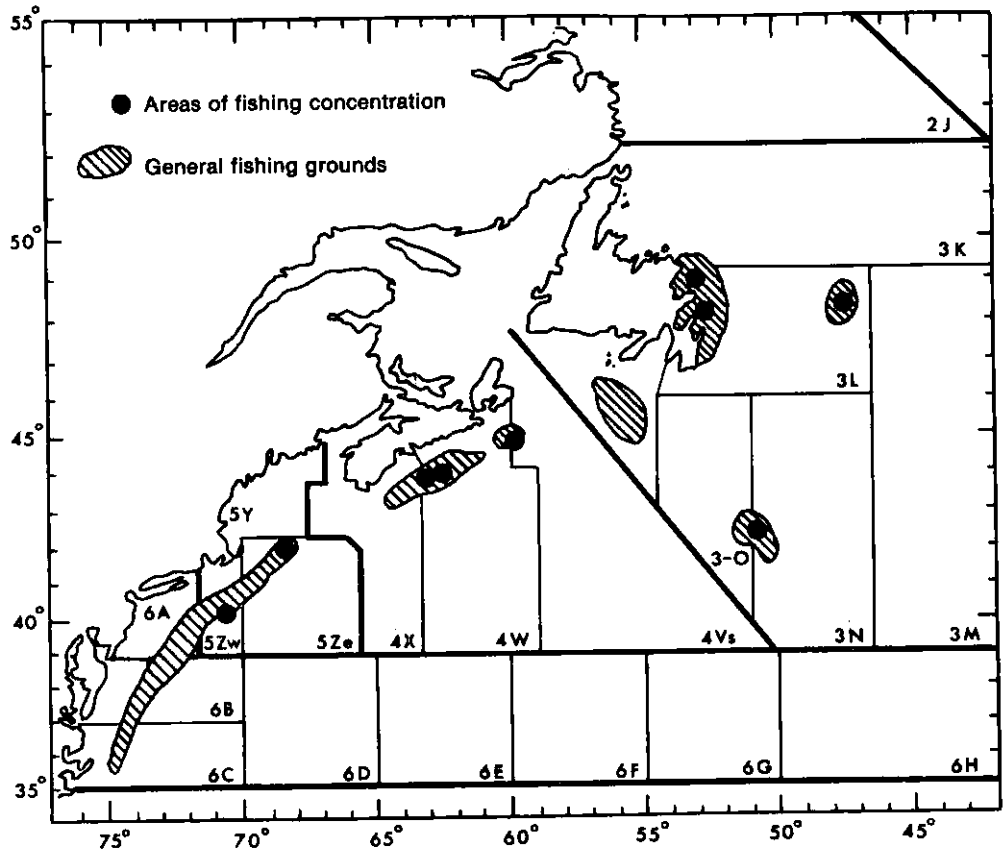

Fig. 1. Chart depicting squid fishing areas, as indicated by information in research documents considered at the meeting.

a) Mesh size regulations

A mesh size regulation of 60 mm exists for squid fishing by bottom trawls in Subarea 5 and Statistical Area 6. There are four authorized topside chafers for use on otter trawl codends (Com. Doc. 78/VI/1, pages 55-59).

b) Fishing gear regulations

Effective from 17 June 1977, no fishing in Div. 4VWX is allowed with bottom trawls, in which the mesh size is less than 130 mm, except in an area defined along the slope of the Scotian Shelf during the period from 15 April to 15 November. Pelagic gear may be used at all times and in all parts of Div. 4VWX (Com. Doc. 78/VI/1, pages 7 and 8).

In Div. 5Z and Statistical Area 6, effective from 17 June 1977, the Commission adopted 6 open areas ("windows") in which fishing could take place as defined in the regulations seasonally along the slope of the continental shelf between Cape Cod and Cape Hatteras (Com. Doc. 78/VI/1, pages 35-37). The regulation also includes an exemption of 1% by weight of all fish on board when fishing for other species and squid is caught by a vessel whose country has no specific allocation. The restrictions on areas of fishing ("windows") and the exemption clause do not apply to the coastal state. These regulations have subsequently been altered and are subject to further change within the US Fishery Conservation Zone.

c) Catch quota regulations

Total allowable catches (TACs) were allocated nationally for *Illex* in Subareas 3 and 4 and for both *Illex* and *Loligo* in Subarea 5 and Statistical Area 6 for 1977 as follows (Com. Doc. 78/VI/1, pages 13-19):

i) For *Illex* in Subareas 3 and 4, the TAC was set at 25,000+ tons, of which 10,000 tons was allocated for Canada, 15,000 tons for USSR, and 3,000 tons for each country without a specific allocation.

ii) For *Illex* in Subarea 5 and Statistical Area 6, the TAC was set at 35,000 tons, with allocations for Bulgaria, Canada, Italy, Japan, Poland, Spain, USSR and USA, and 490 tons for "Others" to cover by-catches only.

iii) For *Loligo* in Subarea 5 and Statistical Area 6, the TAC was set at 44,000 tons, with allocations for Canada, Cuba, Federal Republic of Germany, Italy, Japan, Poland, Spain, USSR and USA, and 300 tons for "Others".

iv) The Commission adopted a second-tier quota in the amount of 520,000 tons for all finfish and squids in Subarea 5 and Statistical Area 6. This overall TAC was allocated nationally to all member countries, except Denmark, Iceland, Norway, Portugal and UK, with a token amount of 50 tons for "Others".

Total allowable catches of *Illex* and *Loligo* in the US Fishery Conservation Zone are 30,000 tons and 44,000 tons respectively for 1978.

10. Specific Advice on Management Alternatives for 1978

a) TAC versus effort regulation

In view of the very short life-span of *Illex* and the apparently large fluctuations in abundance, together with uncertainties about stock identity and migration patterns, it is difficult to specify the effects of alternative management measures in 1978 upon future squid abundance. It is not possible at this time to predict the level of stock abundance which will occur in 1978. Based upon the available estimates of minimum biomass in Subareas 3 and 4 in 1977, it would appear that the exploitation rate in that year was less than 0.4. For the reasons discussed earlier, STACRES favours, in principle, effort regulation as a means of controlling the exploitation rate in the *Illex* fishery. However, it was concluded that effort regulation *per se* would be difficult to design for 1978 because of the practical difficulties of (i) inter-calibration of effort among the different types of vessels and gears, (ii) estimation of effort for *Illex* in mixed fisheries, and (iii) estimation of effort for the relatively large inshore catch. STACRES therefore

recommends (1)

that the feasibility of an effort regulation in 1979 be further examined, requiring the submission by all countries of detailed catch and effort data for Illex in Subareas 3 and 4 with a view to further analysis and discussion at the April 1978 Meeting of the Assessments Subcommittee.

On the basis of the available estimates of minimum biomass from commercial and research trawling, it appears that the minimum biomass in Subareas 3 and 4 was about 250,000 tons in 1977, depending on assumptions about the inter-relationship of *Illex* taken in November in Subdiv. 3Ps and those fished in Div. 3LNO during the summer. With a target exploitation rate of 0.4, the TAC in 1977 could have been about 100,000 tons. If it is assumed that *Illex* will be as abundant in 1978 as observed in 1977, such a TAC could be applied to the 1978 fishery. If such a TAC were adopted, it should be conditional upon licencing of fishing effort based on catch rates achieved in 1977, with no increase in the number of fishing days from the number originally calculated for 1978 if the catch rates are lower than those experienced in 1977. This would provide a safeguard against over-exploitation if the abundance of *Illex* is lower in 1978 than in 1977.

b) Adjustment on the basis of pre-season surveys

Ideally, for such a short-lived species as *Illex*, any catch quota should be determined on the basis of the abundance of the resource in the season under regulation. Pre-season research surveys of the fishing areas would assist greatly in defining the biomass that is likely to be available to the fishery later in the year. If a catch quota is applied for 1978, it should be subject to adjustment on the basis of the results of pre-season surveys.

c) Fishing season

There is some evidence which indicates that by-catches of other species in the directed squid fisheries are relatively high during the early part of the fishing season. Furthermore, observations on the growth rate of *Illex* throughout its life cycle indicate that, if the fishery were concentrated in the latter part of the year, removals would consist of relatively fewer squid per ton caught. For example, it has been calculated that the number of animals removed per 100 tons decreased from 2.7 million in the period starting on 17 April to 0.64 million in mid-June and to 0.32 million in November. It was noted that, in practice, the directed offshore fisheries for *Illex* in recent years have seldom commenced before 1 July. Therefore, STACRES

recommends (2)

i) that the directed fishery for Illex not commence before 15 June; and

ii) that some measures be taken to limit the by-catch of Illex in other fisheries before 15 June.

Concern was expressed by some scientists that severe limits on by-catch could create practical difficulties in mixed fishery situations.

d) Mesh size

There is at present no minimum mesh size regulation for the *Illex* fishery in Subareas 3 and 4. It was noted that in 1977 vessels fishing silver hake with bottom and midwater trawls used 60-mm mesh in the codends. Most of the directed fisheries for *Illex* used trawls with 40-48-mm mesh in the codends. Mesh selection studies have been carried out primarily on *Loligo*. Some preliminary information from 1977 mesh selection experiments aimed at silver hake indicated that trawls with 60-mm meshed codends caught 98% as much *Illex* as those with 40-mm meshed codends. However, it was noted that the implementation of a minimum 60-mm codend mesh size for the directed squid fishery might have an effect on fishing success; also, it was not clear that any substantive benefit would be derived from the introduction of a 60-mm minimum mesh size regulation for *Illex*. However, it has been demonstrated that by-catch effects would be reduced with the application of a 60-mm minimum mesh size as opposed to the use of smaller mesh sizes. It was agreed that mesh selection experiments for *Illex* should be carried out in 1978 and that the question of a minimum mesh size should be reviewed on the basis of the results of these experiments.

e) Gear type

STACRES noted that by-catches in bottom trawling for silver hake were higher than those recorded in midwater trawling, and that by-catches in the Japanese chain-type off-bottom trawl were much less than in the conventional bottom trawl.

f) Management areas

Although it is not clear to what extent the squid occurring in Subarea 3 are related to those fished in Subarea 4, the conservative approach to management of the *Illex* stock would be to spread the fishing effort among the areas of known abundance. STACRES therefore

recommends (3)

that, if a TAC of 100,000 tons is set for Subareas 3 and 4 in 1978, it be partitioned between Subareas 3 and 4.

Based on the relative magnitude of the minimum biomass estimates for Subareas 3 and 4, and using a target exploitation rate of 0.4, an appropriate partition of the TAC of 100,000 tons would be 45,000 tons for Subarea 3 and 55,000 tons for Subarea 4. It was emphasized that the implementation of a TAC should be conditional upon the control of fishing effort, as discussed in section 10(a) above.

11. Future Research Requirements

a) Age determination

STACRES noted with great interest the work being undertaken to determine the age of squid from statoliths (Res. Doc. 78/II/15), and indicated validation studies of the method would be required. It was suggested that the east coast of Newfoundland would be a choice sampling area, as the length frequencies of samples taken there are usually unimodal and leptokurtic throughout the season. It was indicated that statolith readings should be obtained for modal length classes which can be followed from July to November. Accordingly, STACRES

recommends (4)

that studies on the ageing of squid from statoliths be vigorously pursued, and that an effort be made to validate the age readings by following the progression of modal length groups throughout the season.

b) Stock discrimination

In view of the present uncertainties about stock identity and migration patterns, STACRES

recommends (5)

that studies aimed at stock discrimination be intensified through the use of tagging experiments, biochemical techniques and morphometric studies.

It was considered that particular emphasis should be placed on tagging as a means to elucidate migration patterns.

c) Biomass estimates from surveys

It was noted that attempts at estimating the minimum biomass from commercial data and research vessel surveys, although fraught with potential sources of error, had been made in 1977 to provide first approximations of the minimum biomass. STACRES

recommends (6)

that research vessel surveys and the use of commercial data for estimating the biomass should be broadened to encompass the entire area of Illex distribution on a regular basis, using standardized techniques.

d) Mesh selection studies

In view of the urgent need for information on the selectivity of *Illex* in trawls, STACRES

recommends (7)

that mesh selection experiments be conducted in 1978 to determine the selection curves for Illex over the range of mesh sizes (40-60 mm) currently used in the Illex fishery.

e) Larval identification and distribution

It was noted that larval squid had been caught in Subareas 3 and 4 but that the identification of the species had proved to be difficult. It was suggested that the rearing of *Illex* larvae in the laboratory might serve to assist in the field identification of larvae. Studies on larval distribution are required to elucidate spawning areas, and further data are required on the occurrence of mature and maturing females.

f) Biological sampling

STACRES agreed to the adoption of the standards and procedures outlined in Res. Doc. 78/II/5 as a general guide for the biological sampling of *Illex*, involving the collection of data on mantle length, weight, sex determination, maturity stages and stomach fullness. In particular, STACRES

recommends (8)

that length composition data for Illex, both commercial and research samples, be reported by ½-cm intervals for males and females separately, and that data on maturity stages should be collected where possible.

It was recognized that all countries may find it difficult to fully implement this recommendation immediately, as the persons involved in sampling would have to be trained to recognize the sex and maturity stages of the specimens examined.

g) Detailed catch and effort data

STACRES noted that there had been very little response to its request for detailed catch and effort data for *Illex* as set forth in Circular Letter 77/46 (issued 2 August 1977). STACRES reiterated the need for the collection and analysis of such detailed data on the directed squid fisheries, with a view to its possible use in monitoring abundance trends and the estimation of biomass, and urged that every effort be made by all countries fishing for squid in Subareas 3 and 4 to comply with Recommendation (4) of the 1977 Annual Meeting (*ICNAF Redbook* 1977, page 37), the requirements of which were specified in Circular Letter 77/46.

12. Acknowledgement

The Chairman expressed his appreciation to the Cuban authorities for the excellent facilities provided for the meeting and for their generous hospitality, to the Secretariat for their usual efficient work, to all participants for their interest and cooperation and finally to those who assisted in recording the proceedings of the meeting.

PART C

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)[1]

Annual Meeting, May-June 1978

CONTENTS

[1] Proceedings No. 1 of the 1978 Annual Meeting.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Annual Meeting, May-June 1978

Chairman: E. C. Lopez-Veiga Rapporteur: V. M. Hodder

Meetings of STACRES and its Subcommittees were held at Bonn, Federal Republic of Germany, during 18-28 May 1978 to consider and report to the Commission on matters listed in its Agenda (Part D, this volume) and on 2 June 1978 to consider the request from Panel 3 for advice on the feasibility of suspending the application of the current mesh size regulations for redfish on the Flemish Cap (Div. 3M), pending the completion of scientific analysis of the problem (Com. Doc. 78/VI/12). With the resignation of Dr A. W. May (Canada) as announced in Circular Letter 78/30, Dr E. C. Lopez-Veiga (Spain) agreed, with the unanimous approval of all representatives present at the first session of STACRES, to act as Chairman for this Annual Meeting. Representatives were present for the various sessions of STACRES and its Subcommittees from Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Japan, Norway, Poland, Portugal, Spain, and Union of Soviet Socialist Republics (USSR). Observers attended from United States of America (USA), Food and Agriculture Organization of the United Nations (FAO), Statistical Office of the European Economic Communities (Eurostat), and the Organization for Economic Cooperation and Development (OECD).

Since the 1977 Annual Meeting, STACRES met at ICNAF Headquarters, Dartmouth, Canada, in November 1977 to review the state of the shrimp stocks in Statistical Area 0 and Subarea 1 and the seal stocks in Subareas 1 to 4 (Part A, this volume). STACRES also met at Havana, Cuba, in February 1978 to review the state of the squid (*Illex*) stocks in Subareas 3 and 4 (Part B, this volume). A workshop on the ageing of silver hake was held at Dartmouth, Canada, during 28-31 March 1978 (Sum. Doc. 78/VI/10). The Assessments Subcommittee met at ICNAF Headquarters, Dartmouth, Canada, during 4-11 April 1978, and its report was reviewed by STACRES at the present meeting.

The reports of the various Subcommittees, as adopted by STACRES at this Annual Meeting, are given in Appendix I (Assessments), Appendix II (Biological Surveys), Appendix III (Statistics and Sampling) and Appendix IV (Environmental). Brief summaries of these reports, together with other matters considered by STACRES, are given below. Part D of this volume contains the STACRES agenda, a list of recommendations approved by STACRES, lists of summary and research documents, and a list of participants at scientific meetings of ICNAF during 1977/78.

I. ASSESSMENTS (APP. I)

1. Fishery Trends

Details of nominal catches for 1977 are given in Sum. Doc. 78/VI/28 (Revised). The total nominal catch of all species in the Northwest Atlantic (Subareas 1 to 5 and Statistical Areas 0 and 6) was 2.95 million tons, a decline from 3.46 million tons in 1976 and from 3.8 million tons in 1975. Substantial declines occurred in the catches of cod (10%) mainly in Subareas 3 and 4, redfish (12%) in Subareas 2 to 4, silver hake (36%) mainly in Subarea 4, red hake (71%) in Subareas 5 and 6, roundnose grenadier (37%) in Subareas 0 to 3, herring (12%) mainly in Subarea 5, mackerel (68%) in Subareas 5 and 6, other pelagics (14%) in Subareas 5 and 6, and capelin (37%) mainly in Subarea 3. Significant increases occurred in haddock catches (56%) in Subareas 4 and 5, squids (44%) mainly in Subareas 3 and 4, and sea scallops (25%) in Subarea 5. With respect to the total nominal catches of all species by subarea, decreases from 1976 to 1977 were recorded for Statistical Area 0 (8,000 to 5,000 tons), Subarea 3 (813,000 to 623,000 tons), Subarea 4 (758,000 to 678,000 tons), Subarea 5 (647,000 to 518,000 tons) and Statistical Area 6 (900,000 to 787,000 tons). Increases occurred in Subarea 1 (132,000 to 151,000 tons) and Subarea 2 (175,000 to 190,000 tons). It should be noted that fluctuations in catches from year to year do not necessarily imply corresponding fluctuations in the stocks but may, in some instances, be due to conservation measures and to changes in fishing pattern.

2. Stock Assessments

The Assessments Subcommittee met at ICNAF Headquarters, Dartmouth, Canada, in April 1978 to review the assessments for 14 stocks for which Canada requested advice and which lie completely or partly within its 200-mile fisheries management zone in Subareas 2 to 4 and for 3 stocks which overlap the Canadian and Danish fisheries zones in Statistical Area 0 and Subarea 1 (Com. Doc. 78/VI/3). The Subcommittee also reviewed the cod and redfish stocks in Subarea 1 at the request of the European Economic Community (EEC) (Com. Doc. 78/VI/5) and the 3 regulated stocks which lie completely outside of the national fisheries zones in Div. 3M. In addition, the Subcommittee examined the feasibility of an effort regulation for *Illex* in 1979, in accordance with a recommendation of STACRES at its February 1978 Special Meeting (see Part B, this volume). The report of the Assessments Subcommittee is given in Appendix I.

Advice on total allowable catch (TAC) levels for 1979 is summarized in the last column of Table 1. When it was possible to do so for some stocks, management options at various levels of fishing mortality and the long-term effects on catch and biomass were presented rather than a single TAC associated with a particular level of fishing mortality. This was in accordance with the Canadian request in Com. Doc. 78/VI/3. Such management options and their long-term effects were presented for cod in Subarea 1, cod in Div. 2J+3KL, and American plaice in Div. 3LNO. STACRES noted that the Subcommittee had agreed, in considering the degree of reliability in the data and the models used for some stocks, not to advise a change in the TAC in cases where catch projections for 1979 were not significantly different from the TACs set for 1978.

Table 1. Summary of recent catches (1973-77) and TACs (1974-78) for stocks reviewed at the April 1978 Meeting of the Assessments Subcommittee, together with advised TACs for 1979 in parentheses.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)					
		1973	1974	1975	1976	1977[1]	1974	1975	1976	1977	1978	1979
Cod	1	63	48	48	33	39	107	60	45	31	( )[6]	(<26)
	2GH	+	4	7	6	4	20	20	20	20	20	(20)
	2J+3KL	355	373	288	214	173	657	554	300	160	135	( )[7]
	3M	23	25	22	22	27	40	40	40	25	40	(40)
	3NO	80	73	44	24	18	101	88	43	30	15	(25)
Redfish	1	3	3	9	14	31	-	-	-	-	-	(28)
	3M	22	35	16	17	18	40	16	16	16	16	(20)
	3LN	33	22	18	21	17	28	20	20	16	16	(18)
Silver hake	4VWX	300	96	116	97	38	100	120	100	70	(81)	(70)
A. plaice	3M	1	2	2	1	1	2	2	2	2	4	(2)
	3LNO	53	46	43	52	44	60	60	47	47	47	(47)
Witch	2J+3KL	24	16	12	11	8	22	17	17	17	17	(17)
	3NO	7	8	6	6	6	10	10	10	10	10	(10)
Yellowtail	3LNO	33	24	23	8	12	40	35	9	12	15	(18)
G. halibut	0+1	10	14	25	16	13	-	-	20	20	(25)	(25)
	2+3KL	29	27	29	25	32	40	40	30	30	30	(30)
R. grenadier	0+1	5	12	5	9	3	-	10	14	8	(8)	(8)
	2+3	18	28	27	21	15	32	32	32	35	35	(35)
Argentine	4VWX	1	17	15	7	2	25	25	25	20	20	(20)
Capelin	2+3K	136	127	199	216	152	110[2]	160[2]	160[2]	212[2]	212[2]	(300)
	3L	4	58	34	34	26					50	
	3NO	128	101	132	110	45	148[3]	180[3]	180[3]	200[3]	141	( )[8]
	3Ps	1	2	2	+	1					9	
Squid-*Illex*	2+3	1	+	4	11	33	-	25[4]	25[4]	25[4]	(45)	( )[9]
	4	9	+	14	31	55					(55)	( )[9]
Shrimp	0+1	13	22	38	50	42	-	-	-	36[5]	(40)[5]	( )[10]

[1] Based on statistics compiled for the 1978 Annual Meeting (Sum. Doc. 78/VI/28), which may differ slightly from figures given in Table 2 of the Report of the Assessments Subcommittee (Appendix I).
[2] In addition, countries without specific allocations may each take up to 10,000 tons.
[3] In addition, countries without specific allocations may each take up to 5,000 tons.
[4] In addition, countries without specific allocations may each take up to 3,000 tons.
[5] TAC pertains to offshore fishing grounds in Subarea 1.
[6] See *Redbook* 1977, pages 52-53, for options.
[7] See section III(3) of Assessments Report (Appendix I) for options.
[8] See section III(21) of Assessments Report (Appendix I).
[9] See section III(22) of Assessments Report (Appendix I).
[10] See section III(23) of Assessments Report (Appendix I).

Increases in the TACs for 1979, compared with 1978, were advised for cod in Div. 3NO, redfish in Div. 3M and 3LN, and yellowtail in Div. 3LNO. Decreases in TACs were advised for silver hake in Div. 4VWX and American plaice in Div. 3M. The TACs advised for the other stocks were the same as in 1978. A TAC for redfish in Subarea 1 was advised for the first time.

No TAC was advised for shrimp in Subarea 1 because it was considered too risky to use events from the 1977 fishery to extrapolate conservation measures for shrimp in 1979. STACRES therefore

recommends (1)

that the shrimp stock in Subarea 1 be assessed near the end of 1978 when information about the 1978 fishery would be available.

STACRES noted that the Assessments Subcommittee had further considered the feasibility of effort regulation for *Illex* in Subareas 3 and 4 but could not provide any further useful advice on an appropriate effort regulation than that provided by STACRES at its February 1978 Meeting (Part B, this volume). This was mainly due to the lack of detailed catch and effort data (catch per haul) which would allow definition and quantification of effort levels in 1977 in relation to the estimated exploitation rate. Therefore, STACRES

recommends (2)

a) that countries with detailed catch and effort data for the 1977 squid fishery in Subareas 3 and 4 should submit such data to the Secretariat, and that all countries with squid fisheries in 1978 should collect and report such data on a haul-by-haul basis, where feasible; and

b) that advice on an appropriate management strategy for squid in 1979 be considered at a meeting of STACRES in late 1978 or early 1979.

In relation to the capelin stocks in Div. 3LNOPs, STACRES noted that the Assessments Subcommittee was not able to provide advice on the level of TAC for 1979, because the size of the stock in Div. 3N could not be quantified or agreed upon due to the wide range of biomass estimates. In addition, the relative strengths were known for only two year-classes (1973 and 1974) produced by this stock after being subjected to substantial exploitation, and no recruitment effects have been indicated. Furthermore, the fishery in 1979 will depend on the 1975 and 1976 year-classes for which no estimates of size are available. Since more precise estimates of the biomass may be available in late 1978 when more information on the 1978 fisheries in Div. 3NO and Div. 2J+3K should be known, STACRES

recommends (3)

that the TAC for capelin in Div. 3LNOPs should be considered at a meeting of STACRES early in 1979, together with the matter of periodic closure of the fishery and an evaluation of the effect of the fishery on the stock.

STACRES urges that catch and effort data should be collected on a daily basis to allow the calculation of a DeLury population estimate, and that the collection of maturity data should be increased.

II. BIOLOGICAL SURVEYS (APP. II)

1. Review of Survey Abundance Indices

STACRES noted that the Biological Surveys Subcommittee had reviewed research vessel survey indices of recruitment and abundance in the ICNAF Area. Coefficients of variation of survey estimates of abundance were examined, together with correlations between survey indices and abundance indices from commercial catch data. Analyses indicated that the optimum length of tow to maximize the precision of survey indices varied from species to species but that the 30-minute tow commonly used is a good compromise for several species. The two pre-recruit indices examined were found to be sufficiently accurate for use in assessments, and the need for wider use of such survey indices was recognized. The precision of survey indices of total stock abundance varied widely, depending on the stock and the number of trawling stations occupied. While improvements in methodology may be expected to reduce coefficients of variation by perhaps 15% in the foreseeable future, confidence intervals for biomass estimates will remain about ±25 to ±50% unless more than 100 tows are made in the area of distribution of the stock surveyed. STACRES noted that the evaluation of the need for and the value of survey indices of abundance to support stock assessments could not be achieved without a parallel evaluation of the accuracy of commercial fishery based abundance indices, and therefore

recommends (4)

that the Assessments Subcommittee examine the accuracy of commercial fishery based indices of abundance at its April 1979 Meeting and determine survey priorities in cooperation with the Biological Surveys Subcommittee.

2. ICNAF Manual for Groundfish Surveys

STACRES noted the Subcommittee had further discussed a draft manual for groundfish surveys, in which preferred survey methods and procedures were recommended. The feasibility of using a common stratum numbering scheme was discussed, and STACRES

recommends (5)

that member countries submit their stratum numbering schemes to the Assistant Executive Secretary, with a view to developing a common numbering scheme for consideration at the 1979 Annual Meeting.

The value of accumulating information on areas of untrawlable bottom was recognized, and STACRES

recommends (6)

that records be kept of untrawlable units found during the course of random-stratified surveys, and that such records be made available with master stratification charts.

Improved monitoring of trawl performance was considered to be very important for improvement in the accuracy of survey abundance indices, and STACRES strongly

recommends (7)

that member countries develop and implement improved methods of monitoring the performance of research trawls.

3. Review of Survey Activities

Survey activity in the ICNAF Area in 1977 and plans for surveys in 1978 were reviewed. It was noted that a substantial increase in survey activity was planned for 1978. A photographic method of directly estimating the catchability of fish by a research trawl was reviewed. STACRES welcomed this type of research as significantly contributing to survey methodology and encouraged further development of the method. STACRES also noted that the evidence available from surveys indicated a much reduced abundance of herring in the Georges Bank area in 1977.

4. Processing Facilities for Survey Data

With reference to the pilot study of the processing of survey data by the Secretariat, the Assistant Executive Secretary indicated that details of set data, including numbers and weight of species per tow, from two Federal Republic of Germany surveys have been received by the Secretariat but have not yet been processed. It is anticipated that all relevant data will be received and processed prior to the 1979 Annual Meeting.

III. STATISTICS AND SAMPLING (APP. III)

1. Report of the 9th Session of the CWP

The Secretary of the Coordinating Working Party on Atlantic Fisheries Statistics (CWP) presented the report of the 9th Session, which was held at ICNAF Headquarters, Dartmouth, Canada, during 17-23 August 1977.

STACRES noted various matters and recommendations of direct relevance to ICNAF, particularly the list of essential standard elements for fishing sheets and logbooks, proposals for reporting discards, and the 3-alpha codes for use in logbooks to identify North Atlantic species items. With reference to the species code, STACRES

recommends (8)

that the list of 3-alpha species identifiers developed for the Northwest Atlantic be adopted for general use, with the understanding that the list will be supplemented as soon as possible to cover all of the commercial species in the North Atlantic.

Concerning the reporting of catches, STACRES noted that the CWP had decided that the flag of the vessel should, for the time being, be considered as the paramount indication of nationality. Some members of STACRES, however, indicated that the flag of the vessel might not be appropriate as a nationality indicator where vessels from one country are contracted to fish from the quantities reserved for another country. It was recognized that solutions to this problem, of vital importance in the reporting and publication of statistical data, would have to be based on a very careful study of the various aspects. STACRES agreed, as a temporary measure, that the Assistant Executive Secretary and the Secretary of the CWP should keep developments of this problem under constant review.

The 10th Session of the CWP is provisionally scheduled to be held at Madrid, Spain, during 26 June-4 July 1979, at the joint invitation of ICCAT and ICSEAF. STACRES noted that ICNAF should, as in the past, continue to have 3 representatives, and

recommends (9)

that ICNAF participation in the 10th Session of the CWP consist of the Assistant Executive Secretary, the Chairman of the Statistics and Sampling Subcommittee, and a representative to be appointed by Canada.

2. ICNAF Statistical Activities

Instead of the expected improvements in statistical reporting, there was a general deterioration from 1977 to 1978, and the late reporting of data continues to affect the timely compilation of statistical reports for subcommittees and working groups and also for publication, particularly in the Statistical Bulletin. STACRES noted that the advance statistics for the April 1978 Meeting of the Assessments Subcommittee were incomplete and that the Secretariat was unable to compile the 1977 nominal catches by division for this Annual Meeting due to the absence of STATLANT 21A reports for several countries.

STACRES was informed that there was a lack of consistency in reporting catch data in some cases, which casts some doubt on the quality of the statistics. STACRES considered it useful to obtain from each member country a detailed description of its national system of statistical collection and processing. It was observed that ICES, FAO and Eurostat have recognized the need for such national descriptions as part of an overall review of the quality, coverage and consistency of the data provided through these national systems. STACRES again urges that member countries make every effort to improve the quality of their fisheries statistics and to adhere to the established deadlines for reporting.

STACRES noted that information on discards continues to be inadequate, despite specific recommendations from the 1976 and 1977 Annual Meetings. It was agreed that a "change in strategy" was necessary relevant to the annual request for data on discards, and STACRES proposed that the Secretariat make a special effort through correspondence with the appropriate authorities in each country to obtain information on the significance of discarding by all or portions of its fishing fleet.

3. Review of ICNAF Sampling Program

Although some slight improvement in sampling efficiency was observed, STACRES noted that sampling was still very inadequate for many stocks. In particular, STACRES

recommends (10)

that member countries fishing the following stocks make a special effort to sample their commercial catches in 1978 and subsequent years:

a) cod in Div. 2G and 2H,
b) cod in Div. 3M,
c) redfish in Div. 3M,
d) redfish in Div. 3L and 3N, and
e) argentine in Div. 4V, 4W and 4X.

STACRES further urges that each member country examine its sampling program with a view to improving the spatial and temporal coverage of sampling in relation to its commercial fisheries.

STACRES noted that the coastal states' requirements for collecting and reporting sampling data will, for 1978 and future years, significantly modify the standards used up to 1977, and that these modifications will have implications on the work of the Secretariat as well as on member countries. STACRES accordingly

recommends (11)

a) that an ad hoc Working Group be convened by Dr Doubleday (Canada), consisting of a representative from each of Canada, an EEC member state, a member country of ICNAF which is neither a coastal state in the Northwest Atlantic nor an EEC member state, the ICNAF Secretariat, and the Chairman of the Statistics and Sampling Committee;

b) that the United States of America be invited to participate in the Working Group; and

c) that the terms of reference of the Working Group be as follows:

- *review of the present situation,*
- *review of coastal states' positions regarding requirements for sampling data,*
- *review of the proposed NAFO Convention in relation to research and statistics,*
- *evaluation of the need for standardized reporting of individual samples,*
- *implications on the Secretariat of reporting and processing of individual samples,*
- *implications on member countries,*

- *availability of sampling data through the Secretariat, and*
- *design of forms and procedures.*

It was agreed that the Working Group should meet as soon as possible but not later than the autumn 1978 meeting of STACRES at a time and place to be determined by the Convener, after consultation with each of the nominated representatives. It was pointed out that the Convener would have difficulty in obtaining a nomination for the third representative mentioned above unless a decision is taken prior to the end of this Annual Meeting. STACRES therefore requests the Commission to designate a member country from which a nomination can subsequently be obtained to represent the member countries of ICNAF which are not coastal states in the Northwest Atlantic nor member states of EEC. [At the Final Plenary Session on 6 June 1978, the USSR agreed to nominate a representative for the Working Group.]

There was general consensus that the Secretariat could serve as the depository for sampling data from the Northwest Atlantic, and it was agreed that the Secretariat should continue to maintain and update, as required, its current base of sampling data (including data for 1977) in accordance with previously established standard reporting procedures.

4. List of Fishing Vessels

It was noted that the Secretariat had compiled and issued the List of Fishing Vessels for 1976 (Sum. Doc. 78/VI/5) and that the 1977 data would be published in the *List of Vessels* series, in accordance with the relevant recommendations of STACRES.

Since practically all fishing vessels are now diesel-powered, it was agreed that the column "Engine type" could be deleted and footnotes used to indicate deviations from the use of diesel power. Noting that the presence or absence of reduction plants on fishing vessels could provide general information on discarding practices, STACRES

recommends (12)

that a column in the List of Vessels be provided to indicate the presence or absence of reduction facilities on each vessel.

STACRES was informed that all countries fishing within the Canadian 200-mile zone provide the coastal state authorities with the details about each vessel licensed to fish within these waters. To avoid much duplication in reporting, STACRES requested the Secretariat to investigate the possibility of obtaining the annual lists of vessels of the various countries fishing within the 200-mile zones directly from the coastal state authorities and the list of vessels fishing outside the 200-mile zones directly from the countries involved.

5. International Observer Program

STACRES was informed of several programs conducted in 1977 and suggested that bilateral agreements between the countries involved should include clauses specifying the country to be responsible for reporting so as to ensure that the results of such observer programs are submitted to the Secretariat.

IV. ENVIRONMENTAL STUDIES (APP. IV)

1. Flemish Cap Project

STACRES noted that the research completed to data was more extensive than had been envisaged, with results being reported by Canada, Poland, USSR and USA. Plans reviewed for 1978-79 indicate active participation in the program by Canada, Cuba, Poland, USSR and USA, with research vessel coverage extending throughout the periods of spawning and early larval development of cod. Investigations will focus not only on the ichthyoplankton and adult fish communities but also on achieving a satisfactory description of the oceanography of the area.

STACRES noted that attempts at using the Integrated Global Ocean Station System (IGOSS) for the rapid transmission of temperature and salinity data had proven successful, and therefore

recommends (13)

that all countries participating in the Flemish Cap Project transmit temperature and salinity data by radio using the Integrated Global Ocean Station System.

STACRES noted that analytical assessments of the commercial fisheries on the Flemish Cap have not been possible due to the almost complete absence of sampling data, and

recommends (14)

that member countries fishing the Flemish Cap area make a special effort to obtain biological sampling data from their commercial fisheries.

STACRES noted that the Flemish Cap *ad hoc* Working Group plans to meet just before or after the April 1979 Meeting of the Assessments Subcommittee and at the same place.

2. Gulf of Maine-Georges Bank Herring Project

STACRES noted that valuable results were still being generated by this program, and was particularly pleased to note that a major international multi-disciplinary, multi-ship larval herring patch experiment is planned for October-November 1978 on Georges Bank.

3. Environmental Conditions in 1977

STACRES noted the review of environmental conditions in the ICNAF Area in 1977, as presented in Appendix IV, section 3. Progress was reported toward the goal of preparing a unified assessment of annual environmental conditions based on oceanographic data submitted by member countries to the MEDS data base.

4. Marine Environmental Data Service (MEDS)

STACRES was informed that progress had been made in achieving the input of current oceanographic station data to the MEDS data base and that the situation was expected to further improve in 1978-79. STACRES noted that many data products and information summaries could be provided by MEDS and hoped that more ICNAF scientists would avail themselves of this service.

5. Standard Oceanographic Sections and Stations

STACRES noted that the complete list of standard oceanographic sections and stations was recently published in *Selected Papers* No. 3 and that copies are available from the Secretariat upon request. It was pointed out that some of the station depths do not correspond with those found on new recently published charts. STACRES requested that such corrections be reported to the Secretariat for circulation and the maintenance of an updated list.

6. Plankton Studies

STACRES noted that several papers on plankton had been reviewed by the Environmental Subcommittee. These include Continuous Plankton Recorder results for 1976 and 1977, a report of the Scotian Shelf Ichthyoplankton Workshop held at Dartmouth, Canada, in early 1978, ichthyoplankton studies on the Flemish Cap, and distribution of silver hake eggs and larvae on the Scotian Shelf.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Ageing Workshop on Silver Hake

With reference to its recommendation at the 1977 Annual Meeting (*Redbook* 1977, page 44), STACRES noted that another workshop on the ageing of silver hake was held at Dartmouth, Canada, during 28-31 March 1978 (Sum. Doc. 78/VI/10). The Workshop was convened by Mr J. J. Hunt (Canada) with the participation of scientists from Canada, Cuba, USSR and USA. It was noted that the classification of weak hyaline zones was an inherent problem and contributed to one source of error (apparently random), while differences in early growth and the probable size of age 1 and 2 fish contributed to a source of bias in interpreting pelagic zones, check zones and large or small first annuli. Having considered the conclusions of the Workshop, STACRES agreed that further workshops would unlikely improve agreement on ageing but that the problems should be pursued through otolith exchanges and other studies. STACRES therefore

recommends (15)

a) that a continuing exchange of silver hake otoliths be initiated among participating countries as soon as possible, each providing a sample of up to 50 otoliths and sections together with data on the length, sex and maturity of the specimens and on the location, date and method of capture of the sample;

b) that specific studies to determine the duration of silver hake spawning within geographic areas be initiated to provide estimates of the range of the growing season in the first year of life;

c) that sampling of small silver hake (<20 cm) be carried out by short time intervals and small areas to provide length frequency distributions suitable for unbiased estimates of modal length and growth; and

d) *that Mr J. J. Hunt (Canada) be requested to draft as soon as possible a set of guidelines for the ageing of silver hake from otoliths, that these guidelines be circulated as a research document to scientists for comment, and that a revised paper be prepared and submitted to the Secretariat for publication in one of the ICNAF publication series.*

With reference to (a) above, it was noted that the otolith exchange would be initiated by USA, with other participating countries providing samples as soon as possible, and that the interpretation of the otoliths should follow the guidelines given in Sum. Doc. 77/VI/13. Other countries wishing to participate in the exchange should notify the ICNAF Secretariat and Mr J. J. Hunt (Coordinator) of their intent. STACRES urged that the results of age validation studies should be reported as soon as possible and that supporting studies to establish metabolic rates and other factors affecting the early growth potential of silver hake should be pursued.

STACRES noted that a study of back-calculated length-at-age for silver hake (Res. Doc. 78/VI/42) indicated good correlation between age-length keys and growth curves generated from otolith measurements and those derived from Canadian estimates of age.

2. Other Studies on Ageing

a) STACRES noted the inability of the Assessments Subcommittee to carry out an analytical assessment of the redfish stock in Div. 3LN due to inadequate sampling and lack of agreement on ageing from the scanty data available, and accordingly

recommends (16)

that a redfish scale and otolith exchange program (including photographs, if possible) be initiated as soon as possible by the St. John's Laboratory, and that the otoliths and scales be read only by experts who are routinely involved in the ageing of redfish.

b) Note was taken of the recommendation by STACRES at its Special Meeting in February 1978 regarding the ageing of squid (see Part B, this volume).

3. Guidelines for Cod Otolith Interpretation

With reference to its earlier recommendation for the development of a set of guidelines for the interpretation of cod otoliths (*Redbook* 1977, page 44), STACRES took note of the preliminary draft prepared by Mr R. Wells (Convener of the February 1977 Ageing Workshop on Cod), and

recommends (17)

a) that a final draft of the guidelines for cod otolith interpretation be completed as soon as possible and circulated as a 1978 research document to scientists for comments; and

b) that a revised paper be prepared and submitted to the Secretariat for publication in one of the ICNAF publication series.

VI. GEAR AND SELECTIVITY

1. Selectivity Studies on Silver Hake

With reference to its recommendation at the 1977 Annual Meeting that silver hake mesh selection experiments be carried out in 1977 (*Redbook* 1977, page 45), STACRES was pleased to note the results of selection experiments reported in Res. Doc. 78/VI/34, 60 and 63, and reviewed by the Assessments Subcommittee (Appendix I). In order to provide additional data on mesh size effects, it was suggested that a cover be attached to the codend of trawls used during some future surveys for silver hake.

2. Gear and Selection Studies on *Illex*

STACRES noted that Canadian and Japanese scientists had carried out joint studies on the effect of different types of trawls on the by-catch in the squid fishery (Res. Doc. 78/VI/14, 16). The urgent need for information on the selectivity of *Illex* was discussed at the February 1978 Special Meeting of STACRES (Part B, this volume) and reference was made to the recommendation from that Meeting "that mesh selection experiments be conducted in 1978 to determine the selection curves for *Illex* over the range of mesh sizes (40-60 mm) currently used in the *Illex* fishery".

3. Need for Selection Studies on Greenland Halibut

STACRES endorsed the concern of the Assessments Subcommittee about the lack of adequate data for Greenland halibut, and

recommends (18)

that selectivity experiments be carried out on Greenland halibut to provide the basis for determining the most appropriate mesh size for the Greenland halibut trawl fishery.

4. Other Selection Studies

STACRES indicated the need to keep the selection factors for all of the major commercial species under constant review and the desire that all countries report on selection studies for any species.

VII. REPORT TO PANEL 3 ON CANADIAN PROPOSAL TO SUSPEND MESH REGULATIONS FOR REDFISH ON FLEMISH CAP

1. Introduction

STACRES met on 2 June 1978 to consider the request from Panel 3 for advice on the feasibility of suspending the application of the current mesh regulations for redfish on the Flemish Cap (Div. 3M), pending the completion of scientific analysis of the problem, as proposed by Canada (Com. Doc. 78/VI/12).

2. Background Information on Mesh Regulations in Subarea 3

Regulation of the groundfish fisheries in Subarea 3 by a minimum mesh size of 114 m, with exemptions for redfish in Div. 3N, 3O and 3P, was instituted in 1961, on the basis of analyses carried out in 1960 by the *ad hoc* Working Group on Mesh Assessments in Relation to Regulation Problems, the report of which was published in 1962 as a supplement to *ICNAF Annual Proceedings* Vol. 11. The redfish fishery on Flemish Cap was not exempted from the mesh regulation at that time because the length compositions of the redfish catches taken there in the late 1950's were more similar to those taken along the continental slopes in Subarea 2 and the northern part of Subarea 3 than to those of smaller-sized redfish prevalent along the southern slopes of the Grand Bank (Div. 3N and 3O) and St. Pierre Bank (Div. 3P), for which exemptions were made. Subsequently, on the basis of scientific analysis of the benefits in yield to be derived from the release of primarily young cod and also for the practicality of having a uniform mesh size for most of the groundfish species in all subareas, the minimum mesh size for Subarea 3 was increased from 114 mm to 130 mm in 1970, with exemptions continuing to apply for directed redfish fisheries in Div. 3N, 3O and 3P.

3. Consideration of Suspending or Changing the Mesh Regulations for Redfish (*Sebastes*) in Div. 3M

With reference to the proposal that the application of the current mesh regulation to redfish fishing on the Flemish Cap be suspended, pending the results of a scientific review, STACRES noted with concern the reports of Canadian fishermen that the use of the current mesh size results in significant quantities of redfish floating out through the meshes at the surface and being lost from the catch during the process of taking the catch on board. USSR scientists reported similar losses from redfish catches in the Barents Sea which are not accounted for in the reported catch.

It was pointed out that these observed losses at the surface may be quite small relative to the potential gain in yield achieved by the escapement of small fish (redfish and other species) through the 130-mm meshes during the towing process. It was noted that, although the suspension of the current mesh size for redfish or the reduction of the mesh size to the suggested 75 mm would undoubtedly reduce the wastage of commercial-sized redfish at the surface, the effects of such action on the escapement of young fish cannot be predicted from the very limited information available to STACRES at this Meeting. Also, because of the apparent overlapping distributions of cod and redfish and the possible detrimental effect of a considerably smaller mesh size on the cod stock and on the smaller sizes of redfish, STACRES advises that there should be no reduction in the minimum mesh size until the immediate and long-term effects of such action on the cod and redfish stocks have been studied. Data were not available to permit STACRES to undertake such studies at this Meeting.

4. Research Requirements

STACRES considered in some detail what could be done during the current year to enable it to provide advice on the question of possible exemptions for redfish from the current mesh-size regulations in Div. 3M, and agreed that the following lines of research should be vigorously pursued:

a) Studies on the relative distribution, both geographically and seasonally, of redfish and cod from commercial and research vessel data for Flemish Cap;

b) Review of all past data on the selection of redfish in trawls for the North Atlantic;

c) Review of data on the relative abundance and distribution of *mentella*-type and *marinus*-type red-

fish on Flemish Cap;

d) Detailed analyses of by-catches in the directed fishery for redfish and of redfish by-catch in other fisheries on Flemish Cap;

e) Analyses of size distributions of redfish on Flemish Cap to determine if small and large redfish are segregated by depth and area;

f) Analyses of the effects on the redfish stock of decreasing the minimum mesh size for redfish;

g) Analyses of the effects on the cod stock of decreasing the minimum mesh size for redfish;

h) Canada is requested to conduct an experiment on commercial trawlers with scientific observers on board, permitting the use of small-meshed codends on three trips to Flemish Cap in 1978, for comparison of data with results from trawlers using codends of 130-mm mesh size.

VIII. TAGGING ACTIVITIES

1. Tagging Activities in 1977

STACRES noted the compilation of tagging experiments on a variety of species, as reported to the Secretariat for 1977 (Sum. Doc. 78/VI/19), and agreed that the procedure of acquiring and reporting such information should be continued. In addition, reference was made to tagging studies on shrimp and seals (Sum. Doc. 78/VI/1).

2. Proposed Tagging Experiments in 1978

STACRES was informed that Canadian scientists plan to tag cod in the Labrador area and to continue the tagging of herring in Subarea 4, that USSR scientists plan to tag cod, American plaice and Greenland halibut in Subareas 2 and 3, and that Canadian and Japanese scientists expect to conduct preliminary experiments on the tagging of squid.

IX. REVIEW OF RESEARCH PAPERS IN STACRES

1. STACRES noted that most of the research documents and the relevant summary documents had been reviewed by the various subcommittees and working groups, except for the following:

a) Res. Doc. 78/VI/19. This paper describes a method for solving the catch equation by Newton's method, including a program for use in pocket calculators. It was noted that the iteration converges very rapidly but that the occasional occurrence of negative roots presented a problem. It was suggested that the author prepare a supplement to the paper describing how to select the appropriate value of terminal fishing mortality (F_T) in order to avoid the appearance of negative roots. Noting that similar papers have been presented in the past, STACRES indicated its appreciation for the interchange of such information among scientists from time to time.

b) Res. Doc. 78/VI/50. This paper describes the occurrence and distribution of mackerel on the Scotian Shelf in winter. The data indicate a correlation between hydrological conditions and the occurrence of mackerel, which is dependent on the prevalence of water temperatures greater than 6°C.

X. COLLABORATION WITH OTHER ORGANIZATIONS

1. Mr Horsted informed STACRES that the revised manuscript of one of the major contributions to the Report of the Joint ICES/ICNAF Salmon Tagging Experiment had only recently been received and was now being edited. It was noted that a number of other contributions had been edited but were not yet forwarded to the printer. STACRES again reiterates its concern for the great delay in the preparation of the papers for publication in a volume of ICES *Rapports et Procès Verbaux*.

2. STACRES noted that the Joint ICES/ICNAF Symposium on the Biological Basis of Pelagic Fish Stock Management will be held at Aberdeen, Scotland, during 3-7 July 1978. It was noted that an amount of $5,000 will be contributed by ICNAF, as recommended by STACRES at the 1977 Annual Meeting, and that the Assistant Executive Secretary will attend on behalf of ICNAF.

3. STACRES was informed that plans for the Second International Symposium on the Early Life History of Fish had essentially been completed and that the Symposium is scheduled to be held at Woods Hole, USA, during 3-6 April 1979. Noting that the Planning Group, without ICNAF representation and input of views, had already prepared and issued a prospectus for the Symposium, STACRES agreed in principle

to support the Symposium. However, in view of the absence of ICNAF representation on the Planning Group and the resultant unavoidable overlap of the dates set for the Symposium with those of the Meeting of the Assessments Subcommittee in April 1979, STACRES agreed that ICNAF's contribution should be limited to the printing of the proceedings of the Symposium, providing that this does not interfere with the Secretariat's schedule of printing for ICNAF publications, and requested the Secretariat to explore the possibility of such assistance.

4. STACRES noted that the 9th Session of the Coordinating Working Party on Atlantic Fisheries Statistics (CWP) was held at ICNAF Headquarters in August 1977, and expressed its appreciation for the continuing interest of FAO in ICNAF activities by the active participation of Mr L. P. D. Gertenbach, Secretary of the CWP, in the work of STACRES and its Subcommittee on Statistics and Sampling.

5. STACRES noted that ICNAF had been invited to co-chair, with ICES, the Special Session on the Theory and Application of Sampling Systems and Statistical Data Analysis in Fisheries Science, to be held during the 66th Statutory Meeting of ICES at Copenhagen, Denmark, in October 1978. STACRES requested the Secretariat to inform the General Secretary of ICES as soon as the name of the co-chairman has been decided.

XI. STEERING AND PUBLICATIONS

1. Organization and Operation of STACRES

STACRES noted that there was no difficulty with the scheduling of meetings of subcommittees and working groups in the time allotted at this Annual Meeting. It was agreed that there should be no change in the present structure of STACRES and its Subcommittees at this time but that the situation should be reviewed annually.

2. Review of Publications and Printing Facilities

a) Scientific publications

STACRES noted that, since the 1977 Annual Meeting, the following publications have been issued or are in press:

i) *Redbook* 1977 (116 pages), containing the reports of STACRES Meetings in December 1976 and in May-June 1977, was distributed in August 1977.

ii) *Statistical Bulletin* Vol. 26 for 1976 (236 pages), containing tabular summaries of catches of selected species (1962-76) and 8 tables of catch and effort statistics for 1976, was distributed in January 1978.

iii) *Sampling Yearbook* Vol. 20 for 1975 (46 pages), containing information on the ICNAF sampling program and the lists of sampling data available for commercial fisheries in 1975, was distributed in February 1978.

iv) *Selected Papers* No. 3 (117 pages), containing 13 scientific papers and the list of standard oceanographic sections and stations, was distributed in March 1978.

v) *Research Bulletin* No. 13, containing seven scientific papers, is currently in press and will probably be ready for distribution in July or August 1978.

vi) *Selected Papers* No. 4, containing 11 scientific papers on shrimp, is currently being typeset and will probably be ready for distribution in August or September 1978.

b) The Secretariat's copying and printing facilities

STACRES was pleased to note that the Secretariat had acquired a Comp/Set 500 type-setting machine, which has enabled the Secretariat to reduce publication cost estimates by about 50% from 1977/78 to 1978/79 and to have full control over all printing, thus avoiding delays in dealing with commercial printers.

STACRES was also informed that the Secretariat had facilities for reducing and enlarging various sizes of work maps, charts, forms, etc. Member countries wishing to avail themselves of these facilities may obtain information upon request to the Secretariat.

3. Review of Editorial Policy Relating to Research Bulletin and Selected Papers

STACRES was informed that the workload on the Secretariat was quite heavy during 1977/78, due mostly to the great amount of time required in the editing of the shrimp papers for publication in a special

issue of *Selected Papers*. It was noted that Dr Wilder, formerly of the St. Andrews Biological Station, New Brunswick, Canada, was contracted to review these papers, and his suggestions were incorporated with those of the Secretariat and forwarded to authors for consideration. The final editing has been completed and it is anticipated that the volume will be ready for distribution in late summer.

STACRES was informed that all papers in hand for *Research Bulletin* No. 13 have been refereed and edited and that this volume was expected to be printed and distributed in July 1978. STACRES requested the Secretariat to issue a call for papers through its Circular Letter series. It was noted that some authors may wish to upgrade for publication in the *Research Bulletin* their contributions selected for the *Selected Papers* series, although very few have taken this approach in the past two or three years.

4. Review of 1977 and 1978 Papers for Publication

a) Research documents presented to the 1978 Meetings of STACRES were reviewed by the Steering and Publications Subcommittee, and the following were selected for possible publication in *Selected Papers* No. 5, subject to the authors' approval and revision where appropriate: Res. Doc. 78/II/1, 7; 78/VI/23, 42, 60, 18+72, 73, 74, 76 and 77. Interest was expressed in the publication of Res. Doc. 78/II/15 and 78/VI/52, but it was pointed out that updated versions of these contributions would likely be presented at STACRES Meetings in late 1978 or early 1979, when a decision could be made on their suitability for publication.

b) STACRES requested the Secretariat to consult with the Convener of the Working Group on Seals (Dr Mansfield) regarding the selection of research documents on seals, presented at the November 1977 Special Meeting, for possible publication.

c) Noting the publication in *Selected Papers* No. 1 of the Report of the Workshop on the Ageing of Cod held at Vigo, Spain, in October 1975, STACRES agreed that the reports of the ageing workshops on silver hake (Sum. Doc. 77/VI/13 and 78/VI/10) and on cod (Sum. Doc. 77/VI/12) should be finalized and published in the *Selected Papers* series.

d) STACRES agreed that the proposed guidelines for the ageing of cod and silver hake (to be prepared by Mr R. Wells and Mr J. J. Hunt respectively) should be first issued as research documents with the request for comments from workshop participants and others, and be subsequently published as research papers, possibly in the *Special Publication* series.

e) STACRES noted that *Redbook* 1978, to be issued in August 1978 will contain (i) the Report of the STACRES Special Meeting on Shrimp and Seals held in November 1977 (Sum. Doc. 78/VI/1); (ii) the Report of the STACRES Special Meeting on Squid held in February 1978 (Sum. Doc. 78/VI/3); and (iii) the Report of the Annual Meeting of STACRES held in May-June 1978, including the reports of subcommittees as appendices.

5. Annual Indexing of ICNAF Publications and Documents

STACRES noted that the Assistant Executive Secretary had prepared a provisional index and list of titles for ICNAF publications and meeting documents for 1976 (Sum. Doc. 78/VI/18), and hoped that such an index could be issued annually. It was proposed that these indexes be collated and published at 5-year intervals, in a format similar to that used in *Special Publication* No. 11, issued in 1975.

Some progress was reported on the compilation of the index of meeting documents for the period 1950-74, which is expected to be completed late in 1978 or early 1979.

XII. FUTURE SCIENTIFIC MEETINGS

1. STACRES noted that the Assessments Subcommittee had not found it possible to advise on conservation measures for 1979 of the shrimp stocks in Subarea 1 and Statistical Area 0, the capelin stock in Div. 3LNOPs, and the squid (*Illex*) stocks in Subareas 3 and 4, as the assessment of these stocks requires that data for the major part of the 1978 fisheries be available. STACRES also noted the Canadian request for advice on the scientific basis for management of seal fisheries within national fishing limits (Com. Doc. 78/VI/13). Accordingly STACRES agreed that an appropriate time to review (i) the status of the shrimp and seal stocks would be at a meeting in late November 1978, and (ii) the status of the capelin and squid (*Illex*) stocks would be at a meeting in early February 1979.

STACRES noted the invitation of Norwegian scientists to hold the November 1978 Meeting at Bergen, and the invitation of Japanese scientists to hold the February 1979 Meeting in Japan.

2. STACRES noted that the Assessments Subcommittee would require about 8 days in early April 1979 to complete its work if advice is requested on the same number of stocks assessed at its April 1978 Meeting. STACRES also noted the need for a joint meeting of the Assessments and Biological Surveys Subcommittees to determine survey priorities and further work by the Assessments Subcommittee to

examine the accuracy of abundance indices based on commercial fisheries statistics. STACRES considered that 12 days would likely be required and agreed that these meetings be held during 28 March to 10 April 1979 at the new fisheries laboratory in St. John's, Newfoundland, Canada.

3. STACRES noted that the *ad hoc* Working Group on Standardization of Reporting Procedures for Sampling Data plans to meet as soon as possible in 1978 but not later than the proposed Special Meeting of STACRES in November 1978.

4. STACRES agreed to meet, together with its Subcommittees, in advance of the 1979 Annual Meeting of the Commission, with sufficient time allotted for the Subcommittees to complete their work.

XIII. OFFICERS FOR 1978/79

1. The Chairman of STACRES and its Subcommittees were elected (or re-elected) as follows:

STACRES	- Dr E. C. Lopez-Veiga, Spain (elected)
Assessments Subcommittee	- Dr G. H. Winters, Canada (elected)
Biological Surveys Subcommittee	- Dr W. G. Doubleday, Canada (re-elected)
Statistics and Sampling Subcommittee	- Dr J. Messtorff, Fed. Rep. Germany (re-elected)
Environmental Subcommittee	- Mr E. J. Sandeman, Canada (re-elected)

2. Members of the Steering and Publications Subcommittee were confirmed as follows:

Canada	- Mr L. S. Parsons
Denmark, Fed. Rep. Germany, UK	- Mr Sv. Aa. Horsted (Denmark)
Cuba, France, Portugal, Spain	- Mr R. H. Letaconnoux (France)
Iceland, Italy, Japan, Norway	- Dr F. Nagasaki (Japan)
Bulgaria, German Dem. Rep., Poland, Romania, USSR	- Dr V. A. Rikhter (USSR)
Ex officio Chairman	- Chairman of STACRES

XIV. ACKNOWLEDGEMENTS

1. The Chairman of STACRES expressed his appreciation for the excellent work of all scientists, including the chairmen and rapporteurs who participated in the various meetings of STACRES and its Subcommittees and Working Groups and also to the Secretariat for their usual efficient work.

2. STACRES expressed its thanks to Mr A. T. Pinhorn (Canada) who very ably performed his duties as Chairman of the Assessments Subcommittee during the past three years. STACRES was also grateful to Dr E. C. Lopez-Veiga (Spain) for agreeing to preside over this meeting upon very short notice.

APPENDIX I. REPORT OF ASSESSMENTS SUBCOMMITTEE

Chairman: A. T. Pinhorn

The Subcommittee met at ICNAF Headquarters, Dartmouth, Canada, during 4-11 April 1978 to review the state of and advise on catch levels in 1979 for certain stocks in Statistical Area 0 and Subareas 1 to 4 (Com. Doc. 78/VI/3, 5), and to examine the feasibility of an effort regulation for *Illex* in Subareas 3 and 4 (see Part B, this volume). The relevant section of the STACRES agenda is given in Part D (this volume). Representatives attended from Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Japan, Poland, Portugal, Spain and USSR and observers from USA.

The review of the status of the stocks and catch levels was carried out in two working groups of the Subcommittee as follows: Working Group No. 1 (convened by E. C. Lopez-Veiga) reviewed the relevant stocks of cod, redfish, Greenland halibut, roundnose grenadier and shrimp; and Working Group No. 2 (convened by G. H. Winters) reviewed the relevant stocks for American plaice, witch flounder, yellowtail flounder, silver hake, argentine, capelin and squid. The results of these discussions are given in sections II and III below. In connection with the discussions on squid, an *ad hoc* working group was set up (convened by F. Nagasaki) to study the feasibility of an effort regulation for *Illex* in Subareas 3 and 4, and its report is at Annex 1.

Since the 1977 catch statistics available to the Subcommittee at this April 1978 Meeting were confined to species and stocks under catch quota regulation, the Chairman was requested to prepare the usual summary of fishery trends from more complete catch statistics that would be available at the 1978 Annual Meeting. Section I, therefore, contains a summary of fishery trends in 1977, which was prepared for inclusion in this report prior to its adoption by STACRES.

I. FISHERY TRENDS

1. General Trends in the ICNAF Area

Provisional nominal catches in the Northwest Atlantic for 1977, as compiled from the STATLANT 21A returns of the 17 member countries of ICNAF and the United States of America, are listed by species, division and country in Sum. Doc. 78/VI/28 (Revised). These are summarized by subarea in Table 1, together with comparable figures for 1976. It is important to note that the catch figures for 1977 used in this section of the report may differ slightly from those used in sections II and III, the latter figures having been based on preliminary advance statistics provided prior to the April 1978 Meeting of the Subcommittee.

The total nominal catch of all finfish and invertebrates declined from 3.4 million tons in 1976 to 2.9 million tons in 1977 (15%), after having declined from 3.8 million tons in 1975. The total groundfish catch declined from 1.31 million tons in 1976 to 1.16 million tons in 1977 (11%); within this category, significant declines occurred in cod (10%) mainly in Subareas 3 and 4, redfish (12%) in Subareas 2 to 4, silver hake (36%) mainly in Subarea 4, red hake (71%) mainly in Subarea 5 and Statistical Area 6, and roundnose grenadier (37%) in Statistical Area 0 and Subareas 2 and 3. A significant increase occurred in haddock catches (56%) in Subareas 4 and 5. The total pelagic fish catch declined from 885,000 tons in 1976 to 635,000 tons in 1977 (28%); within this category, herring catches declined by 12% mainly in Subarea 5, mackerel by 68% in Subareas 4 and 5 and Statistical Area 6, and "other pelagics" by 15% in Subarea 5 and Statistical Area 6. Catches in the "other fish" category declined from 462,000 tons in 1976 to 315,000 tons in 1977 (32%); within this category, the catch of capelin declined by 37% mainly in Subarea 3. The total catch of invertebrates increased slightly from 771,000 tons in 1976 to 810,000 tons in 1977 (5%), with significant increases in the catches of squids (44%) mainly in Subareas 3 and 4, and sea scallops (25%) mainly in Subarea 5. It should be noted that fluctuations in catches from 1976 to 1977 do not necessarily imply fluctuations in stocks but may in some instances be due to conservation measures.

2. Statistical Area 0

The total nominal catch of all species decreased from 8,000 tons in 1976 to 5,000 tons in 1977. The 1977 catch consisted essentially of 4,000 tons of Greenland halibut and 1,000 tons of roundnose grenadier, whereas the catches of those species in 1976 were 5,000 tons and 3,000 tons respectively. No catches of cod were reported in 1976 or 1977.

3. Subarea 1

The total nominal catch of all species increased from 132,000 tons in 1976 to 151,000 tons in 1977 (14%). The catch of cod increased from 33,000 tons in 1976 to 39,000 tons in 1977 (18%), redfish from 14,000 tons to 31,000 tons (121%) and "other fish" category from 2,000 to 11,000 tons (450%) mainly due to increases in the "finfish not specified" category. Catches of flounders were about the same as in

Table 1. Nominal catches (000 tons) in 1976 and 1977[1]. (The symbol + indicates less than 500 tons.)

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Cod	-	-	33	39	41	47	272	214	149	132	30	39	+	+	525	472
Haddock	-	-	-	+	-	-	+	1	19	25	6	14	+	+	26	40
Redfish	+	+	14	31	16	7	82	73	56	33	11	13	+	-	179	158
Silver hake	-	-	-	-	-	-	+	+	97	38	69	63	13	14	179	115
Red hake	-	-	-	-	-	-	-	-	1	+	21	7	8	2	30	9
Pollock	-	-	+	+	1	-	1	1	24	23	13	16	+	+	40	40
Flounders	5	4	14	13	11	14	110	109	49	39	35	40	10	11	233	228
Roundnose grenadier	3	1	6	2	7	3	14	12	-	-	-	-	-	+	29	18
Other groundfish	+	-	14	13	2	1	12	12	18	19	13	19	10	13	70	77
Herring	-	-	+	+	1	+	29	30	199	200	93	53	1	1	323	283
Mackerel	-	-	-	-	-	-	5	8	28	15	102	5	106	49	242	78
Other pelagics	-	-	-	-	-	-	+	+	1	1	54	18	265	256	321	275
Argentine	-	-	-	-	-	-	+	-	7	2	+	-	-	-	7	2
Capelin	-	-	+	+	95	108	266	116	+	2	-	-	-	-	361	227
Other fish	-	-	2	11	1	5	6	10	30	15	20	12	33	33	93	86
Squids	-	-	-	-	-	+	11	33	31	55	24	10	26	32	92	130
Shrimp	+	+	50	42	+	3	+	-	5	5	1	+	1	1	57	51
Other invertebrates	-	-	-	-	-	+	4	5	39	40	153	208	426	377	622	629
All species[2]	8	5	132	151	175	190	813	623	754	643	645	517	900	787	3427	2916

[1] Nominal catches for 1977 are based on STATLANT 21A reports compiled for the 1978 Annual Meeting.
[2] Except seaweeds.

1976, whereas catches of roundnose grenadier declined from 6,000 tons to 2,000 tons (67%) and catches of shrimp from 50,000 tons to 42,000 tons (16%).

4. Subarea 2

The total nominal catch of all species increased from 175,000 tons in 1976 to 190,000 tons in 1977 (9%). The catch of cod increased from 41,000 tons to 47,000 tons (15%), flounders (mainly Greenland halibut) from 11,000 tons to 14,000 tons (27%), capelin from 95,000 tons to 108,000 tons (14%) and shrimp from less than 500 tons to nearly 3,000 tons. Catches of redfish declined from 16,000 tons to 7,000 tons (56%) and roundnose grenadier from 7,000 tons to 3,000 tons (57%).

5. Subarea 3

The total nominal catch of all species declined from 812,000 tons in 1976 to 623,000 tons in 1977 (23%). The groundfish catch declined from 491,000 tons to 421,000 tons (14%); in this category, declines occurred in the catches of cod (21%) and redfish (12%), while the catches of other species remained similar to those for 1976 except that 1,300 tons of sandeels were taken in 1977, the first time that a significant catch of this species has been recorded. Catches in the "other fish" category declined from 272,000 tons to 126,000 tons (54%) due entirely to a decrease in the capelin catch from 266,000 tons to 116,000 tons. Catches of invertebrates increased from 15,000 tons to 38,000 tons (153%) due mainly to increased squid catches from 11,000 tons to 33,000 tons (200%).

6. Subarea 4

The total catch of all species (except seaweeds) declined from 755,000 tons in 1976 to 647,000 tons in 1977 (14%). The total groundfish catch declined from 414,000 tons to 307,000 tons (26%); within this category, cod catches declined by 11%, redfish by 42%, silver hake by 61% and flounders by 20%. Some of these decreases (e.g. redfish and silver hake) resulted from conservation measures introduced on the Scotian Shelf area of Subarea 4. Haddock catches increased from 19,000 to 25,000 tons (32%) due to improvement in some of the haddock stocks in the area. Catches of other groundfish species remained approximately the same in both years. The total catch of pelagic species declined only slightly (5%) because of a decrease in mackerel catches from 28,000 tons to 15,000 tons, the catch of herring being about 200,000 tons in both years. The total catch of "other fish" declined from 38,000 tons to 20,000 tons (47%) due to declines in argentine from 7,000 tons to 2,000 tons (71%) and other fish (mainly

dogfish, skates and unspecified finfish) from 31,000 tons to 16,000 tons (48%). Total invertebrate catches increased from 75,000 tons to 100,000 tons (33%) due entirely to increases in catches of squid from 31,000 tons to 55,000 tons (77%).

7. Subarea 5

The total catch of all species (except seaweeds) declined from 645,000 tons in 1976 to 517,000 tons in 1977 (20%). The total groundfish catch increased slightly from 198,000 tons to 212,000 tons (7%), with increases occurring for cod (30%), haddock (133%), redfish (18%), pollock (23%), flounders (14%) and other groundfish catches (54%), while decreases occurred in silver hake (9%) and red hake (67%) catches. The total pelagic catch declined from 249,000 tons to 76,000 tons (70%) due to declines in herring (44%), mackerel (94%) and other pelagic (69%) catches. These latter declines probably resulted from a combination of stock declines and management measures which affected the level of fishing effort in some parts of the area. The total invertebrate catch increased from 178,000 tons to 218,000 tons (22%). Declines in squid catches from 24,000 tons to 10,000 tons were more than offset by increases in other invertebrate catches from 153,000 tons to 208,000 tons.

8. Statistical Area 6

The total catch of all species declined from 900,000 tons in 1976 to 787,000 tons in 1977 (13%). This decline was accounted for almost entirely by declines in mackerel (54%) and invertebrates (12%).

II. SUMMARY OF RECENT CATCHES AND TACs

The Subcommittee used as the basis for discussion the Canadian request for advice on 14 stocks which lie completely or partly within its 200-mile fisheries zone in Subareas 2 to 4, and three stocks which overlap the Canadian and Danish fisheries zones in Statistical Area 0 and Subarea 1 (Com. Doc. 78/VI/3). The Subcommittee reviewed the cod and redfish stocks in Subarea 1 at the request of the European Economic Community (EEC) (Com. Doc. 78/VI/5), and the three stocks which lie completely outside of the national fisheries zones in Div. 3M. The Subcommittee also examined the feasibility of an effort regulation for *Illex* in 1979, in accordance with the recommendation of STACRES at its meeting in Havana, Cuba, in February 1978 (see Part B, this volume).

In reviewing the state of the various stocks, the Subcommittee took account of the Canadian view on options to be considered in providing advice on the scientific basis for management in 1979 (Com. Doc. 78/VI/3). A summary of recent catches and TACs relevant to stocks reviewed at the present meeting of the Subcommittee is given in Table 2, together with advised TACs for 1979. Details of the stock reviews are given in section III below.

Table 2. Summary of recent catches (1973-77) and TACs (1974-78) for stocks reviewed at the April 1978 Meeting of the Assessments Subcommittee, together with advised TACs for 1979 and some for 1978 in parentheses.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)					
		1973	1974	1975	1976	1977[1]	1974	1975	1976	1977	1978	1979
Cod	1	63	48	48	33	36	107	60	45	31	( )[6]	(<26)
	2GH	+	4	7	6	4	20	20	20	20	20	(20)
	2J+3KL	355	373	288	214	170	657	554	300	160	135	( )[7]
	3M	23	25	22	22	25	40	40	40	25	40	(40)
	3NO	80	73	44	24	15	101	88	43	30	15	(25)
Redfish	1	3	3	9	14	28	-	-	-	-	-	(28)
	3M	22	35	16	17	16	40	16	16	16	16	(20)
	3LN	33	22	18	21	16	28	20	20	16	16	(18)
Silver hake	4VWX	300	96	116	97	35	100	120	100	70	(81)	(70)
A. plaice	3M	1	2	2	1	1	2	2	2	2	4	(2)
	3LNO	53	46	43	52	43	60	60	47	47	47	(47)
Witch	2J+3KL	24	16	12	11	8	22	17	17	17	17	(17)
	3NO	7	8	6	6	6	10	10	10	10	10	(10)
Yellowtail	3LNO	33	24	23	8	11	40	35	9	12	15	(18)
G. halibut	0+1	10	14	25	16	13	-	-	20	20	(25)	(25)
	2+3KL	29	27	29	25	31	40	40	30	30	30	(30)
R. grenadier	0+1	5	12	5	9	2	-	10	14	8	(8)	(8)
	2+3	18	28	27	21	15	32	32	32	35	35	(35)

Table 2. (Cont'd)

Species	Stock area	Nominal catches (000 tons) 1973	1974	1975	1976	1977[1]	TACs (000 tons) 1974	1975	1976	1977	1978	1979
Argentine	4VWX	1	17	15	7	2	25	25	25	20	20	(20)
Capelin	2+3K	136	127	199	216	153	110[2]	160[2]	160[2]	212[2]	212[2]	(300)
	3L	4	58	34	34	25					50	
	3NO	128	101	132	110	42	148[3]	180[3]	180[3]	200[3]	141	( )[8]
	3Ps	1	2	2	+	1					9	
Squid-*Illex*	2+3	1	+	4	11	84	-	25[4]	25[4]	25[4]	(45)	( )[9]
	4	9	+	14	31						(55)	( )[9]
Shrimp	0+1	13	22	38	50	41	-	-	-	36[5]	(40)[5]	( )[10]

1 Provisional statistics for the April 1978 Assessments Meeting
2 In addition, countries without specific allocations may each take up to 10,000 tons
3 In addition, countries without specific allocations may each take up to 5,000 tons
4 In addition, countries without specific allocations may each take up to 3,000 tons
5 TAC pertains to offshore fishing grounds in Subarea 1
6 See *Redbook* 1977, p. 52-53, for options.
7 See Section III(3) for options.
8 See Section III(21).
9 See Section III(22).
10 See Section III(23).

III. STOCK ASSESSMENTS

1. Cod in Subarea 1 (Res. Doc. 78/VI/44)

a) Fishery trends

The nominal catch of cod in 1976 was 33,300 tons, 74% of the TAC for that year, and provisional statistics for 1977 indicate a small increase to about 35,600 tons. The TAC for 1977 was 31,000 tons, and the fishery was closed to offshore vessels in the middle of the year. Local inshore catches (included in the above figures) increased from 5,100 tons in 1976 to about 14,000 tons in 1977. The offshore trawlers' share of the total catch was about 58% in 1976 and 52% in 1977. The improvement in catches was mainly a result of the recruitment of the 1973 year-class to the exploited stock.

Fishing by Greenland trawlers in January and February 1978 indicates further improvement in the catch rate. By the end of March 1978, their catches had exceeded 10,000 tons. The 1973 year-class had to some extent been recruited to the spawning stock at the beginning of 1978, and this is probably the reason for good fishing on pre-spawning concentrations in the southern part of Div. 1C in the early months of 1978. Hydrographic observations in the winter of 1977/78 showed an extraordinarily strong inflow of warm water along the western slopes of the West Greenland fishing grounds, and it is likely that some immigration of cod from southeastern Greenland contributed to the improved fishing.

b) Trends in distribution, abundance and composition of the stock

For the offshore trawl fishery, there was an overall increase in catch rate of 65% from 1976 to 1977. A further increase seems to have occurred in Div. 1C in the early months of 1978. Offshore fishing in Div. 1A and 1B has been negligible in recent years.

No catch-per-unit-effort data are available for the inshore fisheries, but the improved fishing may by itself have stimulated fishermen to the extent that effort may have increased from 1976 to 1977. However, the fact that inshore catches more than doubled from 1976 to 1977 points to an improvement in the stock, at least in Div. 1C to 1F.

More than 75% of the total catch in 1977 (by number as well as by weight) and about 75% of the catches in January-February 1978 consisted of fish of the newly recruited 1973 year-class. Cod older than 6 years were scarce in the 1977 catches except in gillnet catches. Younger cod, especially age 2, were observed in inshore poundnet catches, from which they were discarded. The age compositions of the catches in 1976 and 1977 are given in Table 12 of Res. Doc. 78/VI/44.

c) Assessment parameters

Fishing mortality. From analyses of trends in fishing effort and catches, the Subcommittee concluded at its April 1977 Meeting that effort had decreased by about 25% from 1975 to 1976, when F for fully recruited age-groups was considered to be about 0.25. Although there was an increase in catch from 1976 to 1977, the catch/effort data indicate that the effective fishing effort decreased further from 1976 to 1977. Applying the catch per unit effort of Greenland trawlers to the offshore catch to obtain total offshore effort and taking into account the seasonal variation in the catchability coefficient (ICES, 1973)[1] indicates that the offshore effort in 1977 was about 1/3 below that in 1976. At the same time, the inshore effort may have increased somewhat, although the main reason for the increased inshore catches was higher catch rates. The Subcommittee considered that F in 1977 could be between 0.16 and 0.20, and the analyses were carried out using these two values of F.

Recruitment estimates. The 1973 year-class recruited to the fishery in 1976/77. The size of this year-class may have been underestimated in previous assessments, as new analyses indicate that it may consist of as many as 200 million fish (at age 3). However, since this year-class seems to be similar in size to the 1968 year-class (both partly of East Greenland origin and both preceded by weak year-classes) and since the 1968 year-class was overestimated in the first year or two after its recruitment, the Subcommittee also considered a figure of 120 million recruits for the 1973 year-class in the analyses.

Of the younger year-classes, that of 1975 seems to be the most important, especially in the northern divisions (1B to 1D). The 1974 year-class seems to be rather evenly distributed throughout the area but is not considered to be as large as the 1973 and 1975 year-classes. The 1976 year-class seems to be poor. Environmental conditions were favourable for the 1977 year-class (better than for the 1975 year-class), but larvae were not found in the quantity that would be expected for a good year-class. Research surveys in 1978 may reveal better information about this year-class. For the purpose of this assessment, the sizes of these year-classes (millions of age 3 cod) are estimated as follows:

ICNAF Div.	Size of year-classes			
	1974	1975	1976	1977
1A-1D	25	50	10	25
1E-1F	15	25	10	25
SA 1	40	75	20	50

Partial recruitment. Since fishing has been concentrated on the 1973 year-class, the Subcommittee considered that the partial recruitment pattern used in the previous assessment (Res. Doc. 77/VI/8; *Redbook* 1977, page 53) is still valid, i.e. 60% for age 3, 72% for age 4, 88% for age 5, and 100% for older age-groups.

d) Assessment results

The results of the assessment will vary with the input values of the parameters. The greatest variation in predicted catch and spawning biomass is associated with the range of estimates of the strength of the 1973 year-class (120 to 200 million recruits at age 3) but variation is also rather large in connection with the range of values for fishing mortality in 1977 (0.16 to 0.20). Various strategies of fishing were analyzed, all of them assuming that the catch in 1978 will be 25,000 tons.

For each of the strategies, Table 3 gives the resultant minimum and maximum figures for predicted catch and spawning biomass, the latter including all age 6 and older fish although in practice maturation occurs gradually over several years from age 5. The minimum figures result from using 120 million recruits for the 1973 year-class and F = 0.20 in 1977, and the maximum figures result from using 200 million recruits for the 1973 year-class and F = 0.16 in 1977. Strategy 1 assumes that the fishing mortality in 1979-81 remains at the level of F in 1978; Strategy 2 assumes that F = 0.30 in 1979-81; Strategy 3 assumes that F = 0.40 in 1978-81; and Strategy 4 assumes that F in 1979 is equal to F in 1978 but that F in 1980-81 corresponds to $F_{0.1}$ (0.40). The results of the analyses show that the recruitment of the 1973 year-class to the spawning biomass will lead to an improvement of the spawning biomass, about 2/3 of which in 1979 and 1980 will consist of the 1973 year-class.

[1] Report of the ICES/ICNAF Working Group on Cod Stocks in the Northwest Atlantic. ICES Coop. Report No. 33, page 49.

Table 3. Cod in Subarea 1: projected catch and spawning biomass (000 tons) for different management strategies as explained in the text. The spawning biomass relates to the beginning of the year.

Strategy No.		1	2	3	4
1978	Spawning biomass	81-104	81-104	81-104	81-104
	Fishing mortality(F)	0.11-0.07	0.11-0.07	0.11-0.07	0.11-0.07
	Projected catch	25	25	25	25
1979	Spawning biomass	181-287	181-287	181-287	181-287
	Fishing mortality(F)	= F in 1978	0.30	0.40	= F in 1978
	Projected catch	26	67-93	86-118	26
1980	Spawning biomass	227-357	188-286	170-259	227-357
	Fishing mortality(F)	= F in 1978	0.30	0.40	0.40
	Projected catch	31	69-92	81-108	103-143
1981	Spawning biomass	275-397	231-259	160-214	207-289
	Fishing mortality(F)	= F in 1978	0.30	0.40	0.40
1982	Spawning biomass	269-378	200-207	119-151	153-201

The level of the spawning biomass estimated for 1979-80 is less than 1/3 and probably only 1/4 of the level in the 1950's and 1960's. The spawning biomass in 1981 and 1982 will to a large extent depend on the fishing mortality generated after 1978 but also on the strengths of the 1974 and 1975 year-classes. If these are as assumed in the assessment, the level of spawning biomass in 1979-80 can only be maintained through 1981 and 1982 if catches are kept below the level corresponding to fishing at F = 0.30.

Without having any firm advice to offer regarding a target spawning biomass, the Subcommittee considers it most prudent to ensure that the spawning biomass is maintained or even further increased, which could occur when the 1975 year-class recruits to the spawning stock by 1981 (or possibly to some extent in 1980). The Subcommittee also considers that the recruitment of the 1975 year-class to the fishery in 1978 and 1979 could lead to an early harvest of this possibly important year-class as was the case with the 1973 year-class in the 1976 and 1977 fisheries.

Although prospects for fishing are improving, the Subcommittee considers it desirable to delay any increase in catch until after 1979, and therefore advises that the 1979 catch should not exceed 26,000 tons. This would give a much better opportunity for maintaining or further increasing the spawning stock, and thereby increasing the chance of better year-classes. Environmental conditions in 1975 and 1977 seemed to have been favourable for the production of good year-classes. The very low level of spawning stock in these years may well have been a limiting factor, but the Subcommittee was not able to quantify this assumption.

A low level of fishing in 1979 would ensure a higher yield per recruit of the 1975 year-class. It would also provide a better basis for future advice, if the exploited stock and the spawning biomass were to consist of more than one good year-class, as was the case in former years. Present prediction of yields and stock sizes, and the resultant advice, is greatly dependent upon the judgement about the size of just one year-class.

2. Cod in Divisions 2G and 2H

The provisional nominal catch in 1977 was about 3,500 tons compared with a catch of 5,900 tons in 1976. During the 1970-76 period, catches ranged from 300 (in 1973) to 18,000 tons (in 1970), the average being 8,800 tons. Catches in the 1960's were much higher. On the basis of an analytical assessment in 1973, which indicated that the stock was depressed and that recruitment prospects were poor, a TAC of 20,000 tons was established in 1974.

Because fishing in this area is generally unpredictable due to variable ice conditions, the planning of biological sampling has been very difficult. In fact, the sampling has been so poor in recent years that a reassessment of the stock has not been possible. Samples from research vessel catches by Federal Republic of Germany in October 1976 indicated that the 1973 year-class may be a successful one. Catch rates of Federal Republic of Germany trawlers indicate little change in the state of the stock from 1976 to 1977.

Lacking substantial new biological information, the Subcommittee could find no reason to recommend a change in the TAC, and therefore advises that the TAC for 1979 should remain at 20,000 tons.

3. Cod in Divisions 2J, 3K and 3L (Res. Doc. 78/VI/25, 26, 66; Sum. Doc. 78/VI/9)

Nominal catches for this stock declined from an average of 640,000 tons in 1966-70 to an average of 380,000 tons in 1971-75. The catch was 214,000 tons in 1976 and provisional statistics for 1977 indicate a further decline to about 170,000 tons. The trends in recent annual catches and TACs are as follows:

	1973	1974	1975	1976	1977
TAC (000 tons)	666	657	554	300	160
Catch (000 tons)	355	373	288	214	170

Variation in the catch per tow, from USSR research vessel surveys in Div. 3K, corresponded with the changes in yield from Div. 2J and 3L over the 1971-76 period. In addition, the catch rates in Div. 3K and 3L declined from 1972 to 1975 but increased in 1976. A further increase in catch rate from USSR surveys was indicated in 1977. In Div. 2J, the commercial catch rates in the fisheries of various countries were considerably lower in 1975 and 1976 than those prevailing in 1968-70. Preliminary USSR data for Div. 2J+3KL as a whole indicate a catch rate of 17.5 tons per day in 1977 compared with 16.5 tons per day in 1975. The catch rate for Spanish otter trawlers was 0.67 tons per hour in 1977 compared with 0.82 tons per hour in 1975. Information given in Res. Doc. 78/VI/26 indicates that, if the average mortality rate for each age-group in 1973-77 applied in 1977-79, biomass estimates for 1978 and 1979 would be 2.1 and 2.7 times the biomass in 1977.

Age compositions for 1977 were derived for each division, gear and quarter of the year as the sampling data permitted. Catches were composed largely of the 1972 and 1973 year-classes as age-groups 5 and 4 respectively.

From regressions of fishing mortality (F) and fishing effort from USSR and Spanish commercial fisheries and from USSR research surveys, the F for 1977 was estimated to be in the range of 0.3-0.5. An intermediate value of F = 0.4 was used in the virtual population analysis.

Research vessel surveys by Federal Republic of Germany have clearly shown that the 1972 and 1973 year-classes were very strong in comparison with older age-groups in the catches. The survey results for 1977 give reason for optimism in that the 1974 and 1975 year-classes may also be strong. From the numbers caught per hour of 2- and 3-year-old cod in Div. 3K, 3L and 3KL for the 1960-72 period in USSR young fish surveys and the corresponding abundance of 4-year-old cod estimated in the virtual population analysis, it was estimated that the abundances of the 1973, 1974 and 1975 year-classes as 4-year-old cod were 530, 465 and 432 million respectively. For year-classes subsequent to that of 1975, an average recruitment of 500 million was used in the analysis.

The partial recruitment pattern, estimated for 1976 from the virtual population analysis, was as follows:

Age	4	5	6	7	8	9	10	11	12	13
% recruited	47	61	76	87	93	97	100	100	100	100

This partial recruitment pattern was used for stock size calculations for 1977 and for catch predictions from 1978 onwards.

In the projections of catch and spawning biomass, the average weight-at-age estimates were those pertaining to the catches of 1977. However, the weight-at-age may be expected to vary from time to time. In addition to density-dependent growth changes, the growth rate in Div. 2J+3KL varies from south to north and the weight-at-age may therefore vary according to the area and time of capture.

From the virtual population analysis, the stock size in 1977 was estimated and catch projections made for 1979-86, under the assumption that the 1978 TAC of 135,000 tons will be caught. Estimates of catch and spawning biomass for 3 levels of fishing mortality are given in Table 4. The spawning biomass includes cod of ages 7-13; in the 1977 assessment, cod of ages 7-14 were included. The Subcommittee stresses that long-term forecasts should only be considered as indicative of trends, as the actual recruitment in future years may be much better or much worse than the average.

Table 4. Cod in Divisions 2J+3KL: projections of catch and spawning biomass (000 tons) in 1979-86 for 3 levels of fishing mortality.

	$F_{0.1}$ = 0.2		F = 0.16		F = 0.10	
Year	Catch	Spawning biomass	Catch	Spawning biomass	Catch	Spawning biomass
1978	135	235	135	235	135	235
1979	197	469	162	469	102	469
1980	256	892	214	920	141	969
1981	306	1,204	262	1,279	180	1,412
1982	350	1,418	306	1,550	217	1,787
1983	388	1,654	345	1,845	252	2,198
1984	419	1,842	377	2,088	282	2,556
1985	442	1,981	402	2,277	307	2,852
1986	454	2,054	416	2,381	323	3,030

At its April 1977 Meeting (*Redbook* 1977, page 54), the Subcommittee considered that the target spawning biomass for this stock might be in the range of 1.2 to 1.8 million tons, with 1.5 million tons as the reference point. The Subcommittee notes that by 1982 the target will be reached if fishing is regulated by either of the 3 options indicated in Table 4. It further notes that the spawning stock biomass in 1982 will be composed of cod for which recruitment estimates at age 4 were not merely estimates of average recruitment but will include year-classes which have already been observed in the fishery or have been estimated from surveys.

The Subcommittee notes that the rate of rebuilding of the stock increases as fishing mortality is reduced, and that the rate of rebuilding for all 3 options is projected to be faster than that projected at the April 1977 Meeting of the Subcommittee.

4. Cod in Division 3M (Res. Doc. 78/VI/23, 27, 51, 57, 58; Sum. Doc. 78/VI/9)

The nominal catch of cod in this area declined from an average of 42,000 tons in 1965-69 to about 23,000 tons annually in 1973-76, largely due to the poor recruitment of the 1969, 1970 and 1971 year-classes. Provisional data for 1977 indicates that the catch was about 25,000 tons, composed almost entirely of cod of the 1972 and 1973 year-classes with the latter predominating. USSR research vessel survey data indicate that the 1973 year-class is exceptionally strong.

Three general production model assessments of this stock, incorporating data for 1977, were reviewed by the Subcommittee. Estimates of yield in 1979 at F_{MSY} and at 2/3 F_{MSY} range from 15,000-34,000 tons and 10,000-22,000 tons respectively.

Biomass estimates for the 1972-77 period were derived from the results of USSR research vessel surveys. The catch per tow (in numbers and weight), the area swept by the trawl and the catchability rates for cod were taken into account in determining the distribution and abundance of cod over the entire area of the Flemish Cap to a depth of 500 meters. The results indicate that the biomass has increased from about 40,000 tons in 1972-74 to about 165,000 tons in 1977, the increase being mainly due to the strong 1973 year-class and, to a lesser extent, the 1972 year-class. The Subcommittee observed that the strong 1973 year-class was produced from the lowest level of biomass indicated in USSR survey results for the 1972-77 period. The Subcommittee further noted that the catch per hour fishing increased by 51% from 1976 to 1977 in USSR surveys and by 47% from 1977 to 1978 in Canadian surveys. The catch per hour fishing by Portuguese side trawlers increased by 4% from 1976 to 1977.

Concern was expressed that, in making short term projections of yield, general production models do not take into account the recruitment of year-classes which are very much different from the average. It is clear that the 1973 year-class is exceptionally strong in Div. 3M, and, consequently, the catch projections for 1979 corresponding to particular levels of fishing mortality may well be underestimated. On the other hand, variability in biomass estimates derived from research vessel survey data has been demonstrated for various stocks. If the biomass estimates for 1977 are in fact overestimated, the projected catches for 1979 may well be too high and thus produce fishing mortalities in 1979 in excess of the target level.

Given the uncertainties in determining the status of this stock due in part to the very poor commercial catch sampling in recent years, the Subcommittee points out the following:

i) If the biomass is as high as indicated by the survey results, a catch of 40,000 tons in 1979 would be appropriate. If the biomass is in fact lower than that estimated, a catch of 40,000

tons would result in a reduction of the stock, because the sizes of the year-classes following that of 1973 are estimated to be much lower than that year-class, and the prospect would be a lower yield in 1980.

ii) If the general production model assessments adequately reflect the status of the stock, yields of 16,000 tons at 2/3 F_{MSY} and 25,000 tons at F_{MSY} are indicated for 1979. If the assessments do not adequately reflect the abundance of the younger year-classes, particularly the 1973 year-class, the implication is that there would be a corresponding loss in yield in 1979.

Taking into account the above considerations, the Subcommittee advises that the TAC for 1979 should not exceed 40,000 tons. The Subcommittee does, however, point out that the adoption of this TAC for 1979 may make it necessary to reduce the yield in 1980, since the absolute abundance of the strong 1973 year-class in the catches is expected to decline after 1980, especially if the size of this year-class is overestimated in the present assessment. Retaining the present TAC (40,000 tons) in 1980 and 1981 requires that the 1973 year-class is exceptionally strong and that this year-class is followed immediately by one or more good year-classes after the relatively poor 1974 year-class.

The Subcommittee reviewed a paper about the effect of water dynamics on recruitment to the cod stock on Flemish Cap. The analysis showed a good positive correlation between the intensity of horizontal and vertical water circulation on the central part of the bank and the strength of year-classes at age 2. The Subcommittee recommended that this type of study should be continued, as it could be a good approach toward forecasting future recruitment levels.

5. Cod in Divisions 3N and 3O (Res. Doc. 78/VI/59; Sum. Doc. 78/VI/9)

Cod catches in this area declined from a high of 227,000 tons in 1967 to 24,300 tons in 1976. Provisional data for 1977 indicate a catch of about 15,000 tons. Seasonally adjusted catch rates of Spanish pair trawlers declined from 1.5 tons per hour in 1971 to 0.4 ton per hour in 1975. The catch rate increased to 1.0 ton per hour in 1976 but declined to 0.5 ton per hour in 1977.

USSR survey data indicate that the 1974 year-class is strong, and both Canadian and USSR surveys indicate that the biomass in 1977 was substantially higher than in the preceding few years. A general production model assessment, using standard methods and including data for 1977, indicates that a catch of 25,000 tons is appropriate for fishing at 2/3 F_{MSY}. Evidence from 1977 sampling data indicates that the fishing mortality in recent years has, on the average, been about 0.35, which is considerably higher than F_{max} (0.2). The Subcommittee advises a TAC for 1979 of 25,000 tons, which corresponds with the yield from fishing at 2/3 F_{MSY}. The Subcommittee further indicates that, given good recruitment prospects, a catch of 30,000 tons in 1979 would not prevent the rebuilding of the stock.

6. Redfish in Subarea 1

a) Fishery trends

Nominal catches have fluctuated widely over the 25-year period for which statistics have been reported to ICNAF. The catch increased during the early 1950's to an average of 25,000 tons in 1955-59 period, reached its highest average level (47,000 tons) in the 1960-64 period with a peak of 61,000 tons in 1962, decreased rapidly from 19,000 tons in 1965 to 5,000 tons in 1969, and remained at a low average level of 4,400 tons during 1970-75.

An increase to 13,700 tons occurred in 1976 and provisional statistics indicate a doubling of the catch to nearly 28,000 tons in 1977, primarily due to a directed trawl fishery by Federal Republic of Germany, which accounted for 91% of the total redfish catch in that year.

Up to 1976, the fishery was to a great extent a mixed fishery (cod and redfish), and data on fishing effort directly related to redfish catches were not available at the present meeting. However, the decline in catches in the late 1960's was likely to have been mainly due to a decrease in effort as fishing for cod declined. Some discarding of redfish is likely to have occurred in the trawl fishery for cod, and, in the present shrimp fishery, considerable quantities of small redfish are discarded (Part A, this volume).

b) Biological information

No information on the biology of this redfish stock was presented, due to the very short notice given regarding the inclusion of this item on the agenda for this meeting. The Subcommittee noted, however, that there are small redfish in Div. 1A and 1B, and that their mean size increases from north to south, indicating a southward migration from the northern nursery grounds. Also, tagging experiments in Godthaab Fjord (Div. 1D) confirm the hypothesis that there is a migration of redfish from West to East Greenland waters. Redfish do not appear to spawn off West Greenland, but the West Greenland stock is recruited by larval drift from the breeding areas off

Southeast Greenland. Therefore, the assessment of redfish in Subarea 1 must take into consideration the fishery and the assessment of the stock off Southeast Greenland.

c) Assessment and advice on management

Partly due to the short notice given for advice on the management of this stock and partly due to the general lack of information, the Subcommittee could not do an assessment of the present state of the stock in Subarea 1, and doubted that it would be in a much better position to give advice later in 1978 when advice for the shrimp stock in Subarea 1 is likely to be considered. Since the laboratories concerned with research on redfish would need some considerable time to compile and analyze all of the available data, the Subcommittee concluded that the most appropriate time for full consideration of the assessment for this stock would be the April 1979 Meeting of the Subcommittee.

The Subcommittee was, however, concerned that, in view of the recent large increases in catch, an unregulated fishery could lead to too high exploitation of the stock. Concern was also expressed that a large fishery for redfish could lead to increased fishing mortality on cod due to by-catches of cod in the redfish fishery. The Subcommittee was not in a position to quantify such by-catches, but noted that the by-catches might be high during the pre-spawning and spawning periods when cod are in deeper water. Pending the provision of further information and an assessment of the stock, the Subcommittee advises that fishing should not be allowed to expand beyond the 1977 catch level (about 28,000 tons).

7. Redfish in Division 3M (Res. Doc. 78/VI/48, 56; Sum. Doc. 78/VI/9)

The nominal catch of redfish in this area declined from 42,000 tons in 1972 to 22,000 tons in 1973, increased to 35,000 tons in 1974 under a TAC regulation of 40,000 tons for that year. Since 1975 the fishery has been regulated by a TAC of 16,000 tons and catches have been close to that figure. The 1976 catch was 17,000, slightly higher than the TAC, and provisional statistics indicate a catch of 16,000 tons in 1977.

Examination of length frequencies from Canadian commercial catches in 1977 with both bottom and midwater trawls indicates a modal size of 31 cm for males and 32 cm for females. Redfish taken as by-catch in Spanish pair-trawl fishing for cod appear to be of commercial size, 35-37 cm for males and 36-38 cm for females (Res. Doc. 78/VI/48).

The Subcommittee reviewed general production modal assessments presented by Canada (Res. Doc. 78/VI/48) and by Cuba (Res. Doc. 78/VI/56). The fishing effort, in standard days fished by tonnage class 7 trawlers, fluctuated greatly during the late 1950's and 1960's, increased from a low of 250 days fished in 1969-70 to a high of 2,100 days fished in 1974, and declined to 600 days fished in 1976. The catch per standard day fished, for tonnage class 7 vessels using bottom trawls, reached a peak of 26 tons per day in 1958, declined to a low level in the 1960's and early 1970's, and increased to a maximum of 28 tons per day in 1976.

The Cuban assessment, utilizing data for 1957-76 with effort based on fishing by tonnage class 7 trawlers, indicated an MSY in the range of 16,000-24,000 tons. The Canadian assessment, with effort based on fishing by tonnage class 4 vessels, indicated that the stock was in good condition and that the MSY was lower at 15,000-17,000 tons. Therefore, taking into account the evidence of increasing catch-per-unit-effort, and that the points corresponding to the 1975 and 1976 catches are on or above the yield curves, depending on the effort standard used, the Subcommittee advises that the TAC for 1979 should be increased to 20,000 tons.

8. Redfish in Divisions 3L and 3N (Res. Doc. 78/VI/46; Sum. Doc. 78/VI/9)

Nominal catches fluctuated considerably prior to 1971 but generally showed an increasing trend to a high of 34,000 tons in 1971 followed by a decline to 29,000 tons in 1972 and an increase to 33,000 tons in 1973. Since then the fishery has been regulated by TACs of 28,000 tons in 1974, 20,000 tons in 1975 and 1976, and 16,000 tons in 1977 and 1978. Thus the catch declined to 22,000 tons in 1974 and was 18,000 and 21,000 tons in 1975 and 1976 respectively. The provisional catch for 1977 was 16,000 tons. Although there has been an increase in midwater trawling in this area in recent years, the greater part of the catch continues to be taken by bottom trawls. In the late 1960's and early 1970's, the major part of the catch from these divisions was taken in Div. 3N, but in more recent years there has been a shift in the fishery to the extent that about 75% of the catch in 1976 was taken in Div. 3L.

From an average level of about 15,000 hours (standard units) during 1963-1970, fishing effort increased to 32,000 hours fishing in 1971 but declined to a level of about 12,000 hours in 1975 and 1976. Catch-per-unit-effort, on the other hand, has progressively increased from a low of 1.07 tons per hour in 1971 to 1.74 tons per hour in 1976.

Length and age composition data for the commercial fishery have not been adequate for this stock over the years and sampling remained poor in 1977. The most common length groups caught by both bottom and midwater trawls range between 31 and 37 cm for both sexes. Length frequencies from research vessel catches indicate that the size of redfish increases with depth in both Div. 3L and 3N. In Div. 3L, the modal size was 27 cm for males and 29 cm for females at 270-370 m, 32 cm for both sexes at 370-550 m, and 34 cm for males and 36 cm for females at 550-730 m. In Div. 3L, on the other hand, the modal length for both sexes ranged from 23 cm at 270-370 m to 33 cm at 550-730 m. If the differences in size between divisions are indicative of different stocks, the greater fishing activity in Div. 3L relative to that in Div. 3N may have to be considered in the future management of the redfish stock in this area.

The initial assessment of this stock was given in a paper presented at the 1973 Annual Meeting[1], utilizing the Schaefer yield model to provide approximate estimates of maximum sustainable yield. The assessment has been updated by recalculating the yield curves with the same standard effort units as used previously and including data for 1971-75. At the 1976 Meeting of the Subcommittee, the TAC of 16,000 tons for 1977 was set below the long-term MSY level of 20,000 tons to allow for some rebuilding of the stock, as the heavy fishing of the early 1970's had reduced the stock to a low level. From the updated general production model assessment, there is evidence that the stock is recovering from the effects of high level of fishing in the early 1970's. There is also evidence of good recruiting year-classes in Div. 3N but not so in Div. 3L. The Subcommittee therefore advises a TAC of 18,000 tons for 1979, which corresponds to fishing at 2/3 F_{MSY}.

The Subcommittee noted that there were differences in length-at-age data, particularly at larger lengths, presented by USSR (Sum. Doc. 78/VI/9) and Canadian data for other redfish stocks, and suggested that some attempt should be made to obtain better agreement in ageing, in order to facilitate the use of analytical modals in assessing this stock.

9. Silver hake in Divisions 4V, 4W and 4X (Res. Doc. 78/VI/31, 34, 42, 55, 60, 62, 63; Sum. Doc. 78/VI/10)

a) Fishery trends

A directed fishery for silver hake began in 1962, and since then the USSR and more recently Cuba, have accounted for most of the catches with only incidental by-catch by other countries. The catches peaked at 299,000 tons in 1973 and have been under TAC regulation from 1974. Preliminary statistics indicate a catch of about 36,000 tons in 1977, of which 32,100 tons were taken by USSR, 1,900 tons by Cuba and 1,800 tons by other countries. This is a significant decline from the 1976 catch of 97,000 tons and is about 50% of the 1977 TAC of 70,000 tons. Such factors as mesh regulation (60 mm), geographic restrictions on fishing activity and the early achievement of squid allocations probably contributed to the reduced catch in 1977. A TAC of 81,000 tons was advised by the Subcommittee for 1978.

b) Biological studies

The age and growth of silver hake have been considered at several workshops and attempts to resolve differences in estimating the age appear to have been successful. The 1978 Workshop (Sum. Doc. 78/VI/10) concluded that improvement in age determinations between various age readers has been significant and that a high level of agreement (80%) can be maintained by working participants. However, the continuing problem of first-year age validation has been identified as a limiting factor which cannot be resolved by otolith interpretation but requires supporting data on spawning duration and other information to demonstrate early growth. The Workshop participants concluded that further workshops would not be warranted at this time but that otolith exchanges be undertaken in 1978. The Subcommittee recommended that a manual on silver hake ageing should be compiled with provision for updating as required.

A study of back-calculated length-at-age (Res. Doc. 78/VI/42) indicates good correlation between otolith measurements and fish size. Age-length keys generated from the otolith measurements appear to be consistent with those derived from Canadian estimates of age as are the growth curves based on back-calculated mean length-at-age.

As recommended by STACRES (*Redbook* 1977, page 58), mesh selection studies were carried out in 1977 through Canada-Cuba and Canada-USSR cooperative research programs (Res. Doc. 78/VI/34, 60 and 63). Independent analyses by scientists of the participating countries were in general agreement and suggested a selection factor of 3.5 for silver hake. However, the accuracy of this value may have been affected by masking, either by the method of cover attachment or by the high mixture of species in some of the experimental catches. The factor of 3.5 may therefore be lower than that representative of commercial-sized trawls and catches. Although large catches, as commonly experienced in commercial fishing operations would tend to lower the 50% retention

[1] Parsons, L. S., and D. G. Parsons. 1975. An evaluation of the status of ICNAF Divisions 3P, 30 and 3LN redfish. ICNAF Res. Bull. No. 11, p. 5-16.

length of silver hake, it was suggested that a selection factor of 4.0 would be more realistic for the commercial trawl fishery. Analyses of the selection ogives by age-group and mesh size, based on Canadian data, are summarized in Table 5 and the percentages released by length group and mesh size are listed in Table 6.

Table 5. Mesh selection by age (sexes combined) and by mesh size for silver hake in Div. 4VWX.

Age (yr)	Proportion of fish retained			
	40 mm	60 mm	90 mm	130 mm
1	0.59	0.40	0.34	0.11
2	0.93	0.74	0.52	0.21
3	0.99	0.87	0.59	0.25
4	1.00	0.95	0.64	0.27
5	1.00	0.97	0.69	0.34
6	1.00	0.99	0.83	0.64

Table 6. Escapement of silver hake by length from codends of various sizes, calculated from the results of the joint Canada-USSR mesh selection study in Div. 4VWX in October-November 1977. (Percentages are running averages of 5.)

Total length (cm)	Percent released from codends of various mesh sizes				
	40 mm[1]	60 mm	70 mm	90 mm[1]	127 mm
15	59	73	62	77	91
16	56	71	62	76	90
17	53	68	61	74	90
18	51	66	58	73	90
19	46	63	57	71	89
20	41	61	55	68	88
21	37	57	53	66	86
22	33	53	49	64	84
23	30	48	45	62	82
24	27	45	42	60	80
25	21	40	38	56	78
26	17	35	34	52	77
27	11	30	30	48	76
28	8	25	27	46	76
29	3	20	22	44	76
30	1	15	18	42	75
31	0	11	17	40	75
32		8	14	38	74
33		5	14	37	73
34		4	11	35	71
35		4	9	33	71
36		4	8	31	71
37		3	5	30	69
38		3	3	28	66
39		2	3	27	61
40		1	2	26	53
41		0	2	25	46
42			2	24	45
43			1	23	43
44			1	22	40
45			1	20	39
46			1	19	34
47			0	14	29
48				10	28
49				7	25
50				2	22
51				1	19
52				0	18
53					15

Table 6. (Cont'd)

Total length (cm)	Percent released from codends of various mesh sizes				
	40 mm[1]	60 mm	70 mm	90 mm[1]	127 mm
54					15
55					15
56					13
57					10
58					7
59					2
60					0

[1] Estimated values using linear interpolation of data for the 60, 70 and 127 mm mesh sizes and taking account of data from the joint Canada-Cuba mesh selection study.

Concern was expressed about the mixed species aspect of the silver hake fishery and the associated catches of squid. Mesh size regulation of the silver hake fishery would have a significant effect on the catches of squid, and vice versa. The general morphology of squid is such that there is a high potential for masking which would tend to lower the selection factor of the various meshes relative to values for homogeneous catches of silver hake.

In summary, the mesh selection studies indicate a selection factor of 4.0 for silver hake in the commercial trawl fishery and that this value is affected by catches of mixed species, particularly squid. Consequently, agreement could not be reached on a recommendation to change the mesh size from the present minimum of 60 mm. In order to obtain additional information on mesh size effect, it was suggested that, if personnel and gear were available, a codend cover be used during some future trawl surveys for silver hake to provide selection data incidental to the primary purpose of the surveys.

c) Abundance estimates

Accurate estimates of biomass based on survey data are not available for this stock. Previous analyses have shown that estimates of biomass from Canadian surveys do not agree with the results from virtual population analysis but that they may represent a relative index of abundance. Estimates from the 1977 survey were similar to those of 1976. The results of a Canadian virtual population analysis suggest a biomass (for age 2+ fish) of 120,000 tons in 1977 and a catch-per-unit-effort of about 1.26 tons per hour or a calculated effort of 2,700 days. Reported effort was about 2,200 days in 1977, indicating that the estimated biomass of 120,000 tons may be close to the actual biomass of age 2+ fish.

d) Catch composition

Two estimates of catch-at-age were available, one based on USSR data and the other on Canadian ageing. Relative to the Canadian age composition data the age frequency from USSR data was shifted by one year towards the older age-groups. This apparent difference could not be resolved, but it was noted that the 1977 age compositions did not reflect the results of discussions on ageing at the 1978 workshop. In anticipation of more comparable results for data in 1978 and subsequent years, the Subcommittee agreed to use the Canadian data on the age composition of the 1977 catch for subsequent analysis.

e) Assessment parameters

Projections of catch and biomass were presented by Canada (Res. Doc. 78/VI/62) and by USSR (Res. Doc. 78/VI/31). The latter assessment used a value of 0.5 for M and USSR catch-at-age data for 1976 and 1977. However, at its April 1977 Meeting, the Subcommittee considered it appropriate to use M = 0.4 and the Canadian catch-at-age data in the virtual population analysis, and these parameters were again considered appropriate for use in the present analysis. At the same time, the USSR catch projections were noted.

The Canadian analytical assessment was based on new estimates of $F_{0.1}$ and F_{max} derived from yield-per-recruit data. Starting F values for 1976 were estimated by trial VPA and the resultant F-values (for ages 2 to 4) regressed against fishing effort to estimate 1976 fishing mortality. These data were then used to project through 1977, using known catch-at-age in 1977 and the F-values required to generate the catch, and the implied partial recruitment was estimated by assuming full recruitment at age 6 (Table 7, Options 1 and 2). The partial recruitment pattern for Options 3 and 4 is discussed later in connection with the alternative projections.

Table 7. Partial recruitment values used for the various options of catch projections.

Age (years)	1	2	3	4	5	6
Options 1 and 2	0.003	0.106	0.185	0.600	0.319	1.000
Options 3 and 4	0.040	0.740	1.000	0.960	0.500	0.500

Mean weight-at-age data used in the analysis, based on Canadian length-at-age data and a new length-weight relationship, are as follows:

Age (years)	1	2	3	4	5	6
Mean weight (kg)	0.044	0.122	0.204	0.298	0.425	0.732

The use of these values substantially changed the potential yield-per-recruit and the projected catches. However, these were accepted subject to future analysis of long-term variation within age-groups.

f) Results of assessment

Yield-per-recruit estimates of $F_{0.1}$ = 0.96 and F_{max} = 2.8 were obtained on the basis of the new weight-at-age data. Recruitment at age 1 was estimated to be 730 million and 2,100 million fish for the 1975 and 1976 year-classes respectively and was assumed to be 1,000 million for subsequent year-classes. Using these recruitment values and partial recruitment for 1977, catch and biomass projections for 1978 to 1980 at $F_{0.1}$ were made. The results imply yields of 33,000 tons in 1978, 48,000 tons in 1979 and 82,000 tons in 1980 as indicated for Option 1 (Table 8) and an increase in biomass to about 380,000 tons in 1978 and later years. If the fishing mortality is increased in 1978 to attain the 1978 TAC, projected catches are 35,000 tons in 1979 and 64,000 tons in 1980 (Option 2).

Partial recruitment to a fishery regulated by a 60-mm minimum mesh size was discussed, and it was concluded that the very large change in partial recruitment as calculated from 1977 fishing data was unlikely. It was therefore agreed to recalculate the catch projections using full recruitment at age 3 with the other age-groups adjusted proportionally. The resultant recruitment pattern (Table 7, line 2) was intermediate between that calculated for 1977 and that observed historically. The new $F_{0.1}$ was calculated to be 0.597 and the additional catch projections (Table 8) were made (i) assuming that the intermediate partial recruitment and the associated $F_{0.1}$ are applied for 1978 and subsequent years (Option 3), and (ii) assuming that the TAC of 81,000 tons is taken in 1978 with the intermediate recruitment pattern (Option 4).

Table 8. Silver hake in Div. 4VWX: catch projections for 1978-80 under various options as defined in the text.

Year	Option 1	Option 2	Option 3	Option 4
1978	33,427	81,000	81,712	81,000
1979	47,848	35,453	83,287	83,615
1980	82,023	63,963	75,632	75,799

The Subcommittee noted that, if the 1977 partial recruitment pattern holds in 1978 and 1979 and the TACs are set above the levels corresponding to fishing at $F_{0.1}$, severe damage to the stock is unlikely, as only a small proportion of ages 2 and 3 fish would be available to the fishery and licence limitations would probably prevent high mortality being generated on these age-groups. If the partial recruitment pattern changes to that hypothesized, TACs of about 80,000 tons in 1978 and 1979 could be taken, but if the projections are seriously in error, damage to the stock could occur unless licencing limitations are very restrictive.

Since the basis for the catch projections under Options 3 and 4 is the more critical, the sensitivity of other associated assumptions was examined. In particular, the validity of the estimated size of the 1976 year-class was examined, and it was noted that the estimate of 2,100 million fish at age 1 made it the second strongest year-class observed in the history of the fishery. If this year-class results in being only of average size, the projected yield for 1979 would be less than 60,000 tons. To reflect the uncertainty about the size of the 1976 year-class, the Subcommittee advises a TAC of 70,000 tons for 1979.

10. American plaice in Division 3M (Sum. Doc. 78/VI/9)

This stock has been under regulation since 1974 with a TAC of 2,000 tons in 1974-77 and 4,000 tons for 1978. Catches ranged from 1,000 to 2,000 tons during 1973-76 and provisional statistics indicate a catch of about 600 tons in 1977. The American plaice catches in this area are taken entirely as by-catches in the cod and redfish fisheries. At its April 1977 Meeting, the Subcommittee advised an increase in the TAC for 1978 to 4,000 tons, on the basis of abundance indices from USSR research vessel surveys in 1976. However, in the light of 1977 survey data, the indices for 1976 appear to have been too high. The Subcommittee therefore advises that the TAC for 1979 should be reduced to 2,000 tons, an amount which should be adequate to cover unavoidable by-catches of American plaice in fisheries for other species.

11. American plaice in Divisions 3L, 3N and 3O (Res. Doc. 78/VI/35, 36; Sum. Doc. 78/VI/9)

a) Fishery trends

The highest recorded catch from this stock was 94,000 tons in 1967. Since then, catches declined to an average level of about 47,000 tons annually during 1973-76. Provisional statistics for 1977 indicate a catch of about 43,000 tons. The fishery was regulated by a TAC of 60,000 tons in 1973-75 and 47,000 tons subsequently.

b) Abundance

Although catch-per-unit-effort data (average catch per tow) from Canadian and USSR surveys indicate an increase in abundance, especially in Div. 3L, the catch rates of commercial trawlers have remained relatively the same over the past 3 years.

c) Assessment parameters

Length and age composition and mean weight-at-age data were derived from Canadian commercial sampling of the catches from each of the 3 divisions in most months. Quarterly age-length keys and monthly catch data were used to estimate the numbers caught at age in each month from the monthly length frequencies.

The fishing mortality in 1977, used to initiate the cohort analysis, was derived from the regression of fishing mortality of fully recruited age-groups on total fishing effort from 1963-75 data. Total fishing effort in 1977 was 105,000 hours (using the catch and effort data of Canadian stern trawlers as the standard), giving F-values of 0.60 and 0.45 for males and females respectively (weighted average 0.51). These values are higher than the $F_{0.1}$ values of 0.50 for males and 0.40 for females (average 0.43).

d) Results of assessment

Stock size and catch projections for 1979-86 were carried out based on fishing at the $F_{0.1}$ (0.43) level of fishing mortality and at a lower level of F = 0.33. Recruitment values used in the projections are averages of 1973-75 recruits (from cohort analysis) at age 5 for males (103 million fish) and at age 5 for females (136 million fish). The projections for the two options are listed in the following table, together with data for 1962-64, 1965-70 and 1977:

		1962-64	1965-70	1977	1979	1982	1986
A.	Fishing mortality	0.23	0.50	0.51	0.43	0.43	0.43
	Biomass (000 tons)	560	425	427	426	508	517
	Catch (000 tons)	28	72	43	43	57	59
B.	Fishing mortality				0.33	0.33	0.33
	Biomass (000 tons)				426	525	543
	Catch (000 tons)				36	51	56

Estimates of biomass for the 1962-70 period were based on cohort analysis for Div. 3LN, with estimates added for Div. 30, based on the ratio of biomass calculated for Div. 30 to that for Div. 3LN in 1973.

The catch projection for 1979 is 43,000 tons, which corresponds to fishing at $F_{0.1}$. However, in view of the evidence of increased abundance from research vessel surveys, the Subcommittee advises that the TAC for 1979 should remain at 47,000 tons.

The projections to 1986 are intended to indicate relative trends only, since environmental fluctuations could have unpredictable effects on the population parameters, especially on the annual recruitment levels. However, Option A indicates that management at $F_{0.1}$ (0.43) would increase the potential catch to 59,000 tons by 1986 (close to the 60,000 tons TAC level before 1976). Under Option B, the biomass would increase more rapidly, but the catch would remain below that for Option A and would not reach the 60,000-ton level until sometime in the late 1980's.

12. Witch flounder in Divisions 2J, 3K and 3L (Res. Doc. 78/VI/37; Sum. Doc. 78/VI/9)

a) Fishery trends

Nominal catches from this stock increased from 4,400 tons in 1961 to 24,000 tons in 1973, but declined to 16,000 tons in 1974 (TAC of 22,000 tons), to about 11,000 tons in 1975 and 1976, and to 8,000 tons (provisional) in 1977. On the basis of an assessment in 1974, the TAC for 1975 was reduced to 17,000 tons based on management at the $F_{0.1}$ level of fishing mortality and remained at this level for 1976-78.

b) Assessment

The Subcommittee considered that the offshore otter trawl samples were more representative of the population than the inshore gillnet data, and hence the updated assessment was made using length and age data from the Canadian otter trawl fishery in 1974-77. Estimates of total mortality (Z), obtained from catch curves (numbers caught at age) based on the 1974-77 data, were Z = 0.59 for males and 0.35 for females.

Application of the Beverton and Holt yield-per-recruit model indicated that the age at first entry to the fishery (t_p) was 5 years for both sexes with mean selection ages ($t_{p'}$) of 8.5 years for males and 11.5 years for females (Res. Doc. 78/VI/37). The $F_{0.1}$ level of fishing mortality was estimated to be 0.43 for males (M = 0.20) and 0.27 for females (M = 0.15).

The fishing mortality values from the catch curves (0.39 for males and 0.20 for females), which are indicative of catches in the range of 12,000-13,000 tons during the past 10 years, are slightly below those corresponding to $F_{0.1}$. Because of the uncertainty about the estimates of total mortality from the catch curves, the Subcommittee advises that the TAC for 1979 should remain at 17,000 tons.

13. Witch flounder in Divisions 3N and 3O (Res. Doc. 78/VI/40)

a) Fishery trends

Nominal catches from this stock increased from 4,700 tons in 1969 to 15,000 tons in 1971, decreased to 9,000 tons in 1972 and have been in the range of 6,000-8,000 tons during 1973-76. Provisional statistics for 1977 indicate a catch of about 6,000 tons. The TAC has remained unchanged at 10,000 tons from 1974 to 1978.

b) Assessment

The Subcommittee welcomed this first attempt to assess this stock by cohort analysis (Res. Doc. 78/VI/40), based on Canadian commercial sampling data for 1974-77. Because of the irregular nature of the fishery in Div. 3N and 3O, it was not always possible to fulfil the aim to obtain at least one length and one age sample for each month.

Since effort data were not available for 1977, it was not possible to obtain an estimate of fishing mortality from a regression of F on fishing effort. Hence, the terminal F used to initiate the cohort analysis was a value (F = 0.5 for both males and females) derived from recent catch curves (Res. Doc. 77/VI/12). Partial recruitment was derived from a matrix of catch-at-age (numbers) and the F-values averaged for 1974-77 (Res. Doc. 78/VI/40).

With estimated recruitment of 27 million males and 35 million females at age 8 and fishing at $F_{0.1}$ (0.45 for males and 0.40 for females), the projected catch in 1979 is 6,500 tons. However, in view of the inadequacy of the data, especially the uncertainty about the current level of fishing mortality, the Subcommittee advises that the TAC remain unchanged at 10,000 tons for 1979.

14. Yellowtail flounder in Divisions 3L, 3N and 3O (Res. Doc. 78/VI/36, 41; Sum. Doc. 78/VI/9)

a) Fishery trends

Nominal catches from this stock increased from 3,100 tons in 1965 to 25,600 tons in 1970 and to 39,300 tons in 1972. The stock has been subjected to TAC regulation since 1973 with TACs and catches (1977 provisional) as follows:

	1973	1974	1975	1976	1977	1978
TAC (000 tons)	50.0	40.0	35.0	9.0	12.0	15.0
Catch (000 tons)	32.8	24.2	22.9	8.6	11.2	

The assessment in 1975 indicated that the stock was being rapidly depleted and the TAC was reduced sharply to 9,000 tons for 1976.

b) Abundance indices

Catch-per-unit effort data (average number and weight of fish per set) from Canadian research vessel surveys indicate that there has been a gradual increase in abundance from the low level in 1973-74. Correlation of research vessel abundance indices with estimates of spawning biomass from cohort analyses also points toward a recovery of the stock, although it is apparently still below the biomass levels of 1971 and 1972. USSR research vessel survey data indicate somewhat lower catch rates in 1977 than in 1976.

c) Assessment parameters

Length and age composition and mean weight-at-age data were derived from Canadian commercial sampling of catches from each of the 3 divisions in each month. Quarterly age-length keys and monthly catch data were used to estimate the numbers caught at age in each month from the monthly length frequencies.

The fishing mortality for 1977 was set at F = 0.40 (fully recruited age-groups) to initiate the cohort analysis. A second value of F = 0.28 was estimated from the population structure based on research vessel data and the current numbers at age.

Recruitment estimates were derived from the correlation of average number per tow (age 4 fish) from random stratified research vessel surveys with corresponding population numbers from cohort analysis and also from the average numbers of recruits in 1974-76 from cohort analysis. Partial recruitment was derived from the average F-values calculated from the matrix of the numbers at age in 1974-77 (Res. Doc. 78/VI/41).

d) Results of assessment

Two estimates of the age structure of the population (000 fish) in 1977 were derived as follows:

	Age (years)							$F_{0.1}$
	4	5	6	7	8	9	10	
A.	85,000	62,593	43,521	25,531	14,216	4,613	867	0.5
B.	85,000	60,000	40,000	43,000	25,000	5,300	800	0.4

The first estimate of the age structure (A) was derived from the current cohort analysis. The alternative estimate (B) is based on values predicted from the regression of population numbers at age from cohort analysis (1971-75) on the average number per tow from random stratified surveys in the same period. Because of the selection pattern produced by (B), it was necessary to make a new yield-per-recruit calculation giving $F_{0.1} = 0.4$, compared to $F_{0.1} = 0.5$, with partial recruitment values as used in the cohort analysis.

Projections of yield in 1979 at $F_{0.1}$ indicate a TAC of 14,000 tons using the population structure in (A) and 18,000 tons for (B). However, in view of the improved condition of the stock from abundance indices and because of the excellent correlation of research vessel data with spawning

biomass from cohort analysis, the Subcommittee advises a TAC of 18,000 tons for 1979.

15. Greenland halibut in Statistical Area 0 and Subarea 1 (Res. Doc. 78/VI/24, 38, 45 and 53)

a) Fishery trends

Nominal catches from this stock were less than 5,000 tons prior to 1952 but increased to 14,000 tons in that year. Following a decline to 10,000 tons in 1973, the catch increased rapidly to 25,000 tons in 1975 but declined to 16,000 tons in 1976. Provisional data for 1977 indicate a catch of about 13,000 tons. Lacking adequate data for assessment, the Subcommittee in 1975 advised a precautionary TAC of 20,000 tons for 1976, which remained in effect for 1977. Countries reporting catches of Greenland halibut from these areas indicated that the fishery was directed toward that species.

b) Assessment

At its April 1977 Meeting, the Subcommittee reviewed a paper (Res. Doc. 76/VI/109) which gave estimates of stock size based on observations from USSR scouting and commercial vessels. The results suggested that the yield from this stock could be as high as 50,000 tons. However, there was some doubt about the catchability rate of the trawls used, which was reported to be 10%, and the Subcommittee advised a precautionary TAC of 25,000 tons for 1978.

New data presented at this meeting indicated that the catchability rate of the trawls used by the USSR vessels was in fact 16% rather than 10%, implying a somewhat lower estimate of the biomass than that indicated previously. A virtual population analysis presented by USSR suggested that the yield could be as high as 35,000 tons. However, this assessment did not include catch data for 1977.

It was the general consensus of the Subcommittee that, while the new assessment was quite valuable, the uncertainty about the state of the stock was sufficient to advise a continuation of the precautionary TAC of 25,000 tons for 1979. It was noted that this level of yield would allow some expansion of the fishery (catches in 1976 and 1977 were only about one-half of this TAC level) and would allow more time to evaluate some of the population parameters and thus improve the scientific advice.

c) Future research requirements

The Subcommittee noted that, although the Greenland halibut inhabiting Statistical Area 0 and Subareas 1 to 3 may be a single stock and should possibly be managed as such, there is still a lack of basic information regarding the distribution and migration of this species and agreed that the stocks (SA 0+1 and SA 2+3) should, for the present at least, be managed separately. However, the Subcommittee recommended that research programs aimed at providing information on migrations and stock discrimination be expanded.

The Subcommittee indicated the need for information on the appropriate mesh size for the Greenland halibut fishery and recommended that consideration be given to this problem.

16. Greenland halibut in Subarea 2 and Divisions 3K and 3L (Res. Doc. 78/VI/39; Sum. Doc. 78/VI/9)

Nominal catches have ranged between 25,000 and 30,000 tons annually since 1971, with more than half of the catch now being taken in the Canadian inshore gillnet fishery. Provisional statistics for 1977 indicate a catch of about 31,000 tons. The TAC was 40,000 tons in 1974 and 1975. On the basis of an analytical assessment in 1975 (*Redbook* 1975, page 32), the TAC was reduced to 30,000 tons for 1976 and has remained at that level to the present time.

The size and age compositions of commercial otter trawl and gillnet catches indicate that the larger mature fish inhabit the deeper water and are progressively more abundant in the catches from south to north. However, the major portion of the catches consist of immature fish which inhabit the shallower parts of the continental shelf.

In an updated assessment reviewed at this meeting (Res. Doc. 78/VI/39), the levels of fishing mortality ($F = 1.11$ for males and 0.35 for females) were considered to be maximal due to localized fishing. Consequently, the Subcommittee advises that the TAC for 1979 should remain at 30,000 tons.

17. Roundnose grenadier in Statistical Area 0 and Subarea 1 (Res. Doc. 78/VI/47, 54)

Nominal catches in 1972-76 were in the range of 4,900-12,300 tons. The provisional catch of 2,200 tons in 1977 was much lower than the 1976 catch of 8,500 tons, the decline being mainly due to a decrease in the USSR catch (8,200 to 1,700 tons). The TAC was initially set at 10,000 tons for 1975, increased to 14,000 tons for 1976, and reduced to 8,000 tons for 1977 and 1978 on the basis of an assessment presented at the 1976 Meeting of the Subcommittee (*Redbook* 1976, page 71).

The Subcommittee reviewed an updated analytical assessment (Res. Doc. 78/VI/54) based on more representative and more complete data than given previously. The assessment indicates that fishing mortality was, on the average, at the level of $F_{0.1}$. It was noted that fishing at $F_{0.1}$ and at F_{max} should give sustainable yields of 6,900-7,500 tons and 7,000-8,700 tons respectively, depending on the level of natural mortality used (M = 0.1 or 0.2). The average annual catch of 6,200 tons during 1968-76 was therefore near the lower part of the range of sustainable yield at $F_{0.1}$.

In addition to the analytical assessment, the Subcommittee reviewed a general production model assessment for the 1968-76 period (Res. Doc. 78/VI/47), which indicated an MSY of about 8,000 tons, a value within the range of estimates from the analytical assessment. The Subcommittee accordingly advises that the TAC for 1979 should remain unchanged at 8,000 tons.

18. Roundnose grenadier in Subareas 2 and 3 (Res. Doc. 78/VI/47, 54)

Nominal catches in 1972-76 were in the range of 17,600-28,400 tons. Provisional statistics for 1977 indicate a catch of 15,300 tons, which is less than the 1976 catch of 20,600 tons. The TAC for this stock was maintained at 32,000 tons during 1974-76, and increased to 35,000 tons for 1977 and 1978 on the basis of an assessment presented at the 1976 Meeting of the Subcommittee (*Redbook* 1976, page 81).

The Subcommittee reviewed an updated analytical assessment (Res. Doc. 78/VI/54), which provides the most recent estimates of fish mortalities, stock sizes and sustainable yields. The assessment indicates that fishing mortality was, on the average, at the level of $F_{0.1}$. It was noted that fishing at $F_{0.1}$ and at F_{max} should give sustainable yields of 26,100-30,700 tons and 27,700-37,000 tons respectively, depending on the level of natural mortality used (M = 0.1 or 0.2). The average annual catch of 28,000 tons during 1967-76 was therefore within the range of sustainable yield at $F_{0.1}$.

In addition to the analytical assessment, the Subcommittee reviewed a general production model assessment (Res. Doc. 78/VI/47) for the 1967-76 period, which indicated an MSY of about 32,000 tons. It is shown that catch-per-unit effort has remained reasonably constant since 1970, indicating a fairly stable biomass. Except for 1971, total effort has been below the level corresponding to that giving the MSY. Considering the results of both assessments but noting also the uncertainties associated with assessments of grenadiers, the Subcommittee advises that the TAC for 1979 should remain unchanged at 35,000 tons.

19. Argentine in Divisions 4V, 4W and 4X

Nominal catches varied between 1,000 and 17,000 tons during 1972-76, the average being 9,000 tons. Provisional statistics for 1977 indicate a catch of about 2,000 tons compared with 7,000 tons in 1976. The TAC was 25,000 tons during 1974-76 but was reduced to the estimated MSY level of 20,000 tons in 1977. Very few data have become available which would allow the present state of the stock to be evaluated, but the recent low level of catches suggests that the stock is not being excessively exploited. Hence, the Subcommittee advises that the TAC should remain at 20,000 tons for 1979.

20. Capelin in Subarea 2 and Division 3K (Res. Doc. 78/VI/30, 43)

Nominal catches increased sharply from an average of about 600 tons in 1967-71 to 46,000 tons in 1972 and to 216,000 tons in 1976. Provisional statistics for 1977 indicate a catch of 153,000 tons, the decline from 1976 to 1977 being mainly attributed to a reduction in fishing effort. Recent catches and TACs for this stock are given in Table 2 (page 3).

The Subcommittee reviewed estimates of the capelin biomass from surveys by USSR and Canada in October and November 1977. The USSR estimate of 860,000 tons, obtained by acoustic-photogrammetric methods (Res. Doc. 78/VI/30), was considered to be an underestimate because the survey did not cover the area within the Canadian territorial zone and because the distribution of capelin was abnormal, making acoustic and photogrammetric methods less reliable. The Canadian estimate, based also on acoustic techniques but including areas inside and outside the territorial limit, was in the range of 507,000-635,000 tons (Res. Doc. 78/VI/43). This estimate was also considered to be minimal because the Canadian echo integration system does not estimate capelin density from surface to bottom and because the survey did not cover the entire area of capelin distribution.

Canadian and USSR sampling data revealed that the 1973 year-class was dominant. This year-class will contribute to the spawning biomass in 1978 but will not appear in the 1979 fishery. Instead, the fishery will depend on the 1975 and 1976 year-classes but their strengths are unknown. The need for pre-recruit surveys of capelin was emphasized and Canadian and USSR scientists indicated that joint pre-recruit surveys were being planned for 1978. It was noted, however, that the reliability of the predictions of year-class strength based on 1978 and future surveys will not be known until the surveys have been conducted for a number of years. Lacking sufficient new biological information on the stock, the Subcommittee advises that the TAC for 1979 should remain at the present level of 300,000 tons.

21. Capelin in Divisions 3L, 3N, 3O and 3Ps (Res. Doc. 78/VI/22, 29, 52; Com. Doc. 78/VI/3)

Nominal catches from this stock complex increased from an average of 1,900 tons in 1967-71 to 25,000 tons in 1972 and to 167,000 tons in 1975. There was a decline to 144,000 tons in 1976 and provisional statistics for 1977 indicate a decrease to 68,000 tons in 1977. In Div. 3L the catch declined from about 34,000 tons in 1975 and 1976 to 25,000 tons in 1977. In Div. 3NO the decline was more pronounced; catches were in the range of 101,000-132,000 tons during 1973-76 but decreased to 42,000 tons in 1977. In both 1976 and 1977, Norway caught less than half of its allocation in Div. 3NO. In 1977, USSR caught about 70% of its allocation in Div. 3L but less than one-third of its quota in Div. 3NO. Recent nominal catches and TACs for this stock are listed in Table 2 (page 3).

In Com. Doc. 78/VI/3, STACRES was requested to review the status of this stock and, in particular, to evaluate the possible effects of the fishery on capelin production. In the past, STACRES has advised that the fishery in Div. 3NO, concentrated on the mature portion of the stock, could remove all except the fraction of the spawning stock necessary to provide adequate future recruitment (*Redbook* 1974, page 83). Therefore, an evaluation of the effects of the fishery on the stock is restricted to consideration of stock-recruitment limits and not yield-per-recruit consideration.

The Subcommittee noted that catch rates (catch per day) of USSR and Norwegian vessels had declined from 1975 to 1977, but no agreement could be reached on the validity of catch per day fished as an index of stock abundance.

Three estimates of the size of the spawning stock in Div. 3N were available. An estimate of 1,000,000 tons was indicated by the USSR survey based on acoustic and photogrammetric techniques and underwater observations (Res. Doc. 78/VI/29). It was suggested that the survey provided an estimate of a major portion of the spawning stock. Norwegian scientists conducted a tagging experiment in 1977, which resulted in an estimate of 106,000 tons for a portion of the spawning stock (Res. Doc. 76/VI/22). The magnitude of the entire spawning stock could not be estimated because of incomplete mixing of tagged and untagged fish. The Canadian estimates of the spawning stock in Div. 3N in 1975, based on analytical methods, ranged from 80,000 to 130,000 tons (Res. Doc. 78/VI/52). The results of these analyses indicated that the stock size was much higher in 1972-74 but that it had declined and remained at its present level during 1975-77. The analyses confirmed the relative strengths of the 1969 and 1973 year-classes and indicated that the spawning biomass in 1978 was likely to be about the same level as in 1977.

Sampling data, presented by Canada, Norway and USSR, indicated that the strong 1973 year-class contributed greatly to the spawning stock in Div. 3N in 1977. Since this year-class will not contribute to the stock in any magnitude in 1979, the fishery at that time will depend on the 1975 and 1976 year-classes for which there is little or no data.

The low levels of biomass predicted from some of the analyses presented suggest that the present TAC may be too high. However, the size of the stock in Div. 3N could not be quantified or agreed upon because of the wide range of biomass estimates. In addition, relative strengths were known for only two year-classes (1973 and 1974) produced by this stock when subjected to substantial yields, and no recruitment effects were indicated. Furthermore, the fishery in 1979 will depend on the 1975 and 1976 year-classes for which no estimates are available. It is therefore not possible at this meeting to advise on any adjustment to the present TAC for 1979. The Subcommittee also considered the suggestion that periodic closure of the fishery be enacted to allow capelin to spawn undisturbed and to allow research to be conducted, but no agreement could be reached on this matter at present.

Since more precise estimates of the biomass may be available in late 1978 when information on the 1978 fisheries in Div. 3LNO and Div. 2J+3K should be known, it was indicated that STACRES should convene a meeting in late 1978 to analyze data collected in 1978 and to advise a TAC for 1979. It was indicated that the matter of periodic closure for the fishery could be considered at the meeting, together with an evaluation of the effects of the fishery on the southern capelin stock, considering that more information on the size of the 1975 and 1976 year-classes will be available at that time.

In the meantime, the Subcommittee urged that catch and effort data should be collected on a daily basis to allow the calculation of a DeLury population estimate. The collection of maturity data should be increased, since these data not only provide information on the relative abundance of mature fish recruiting to the spawning stock but also are crucial for precise estimations of biomass using the Canadian analytical models.

22. Squid-*Illex* in Subareas 3 and 4 (Res. Doc. 78/VI/49, 60, 61)

In accordance with the recommendation of STACRES at its Special Meeting on Squid in February 1978 (Part B, this volume), the Subcommittee reviewed new information available on the squid (*Illex*) fisheries in Subareas 3 and 4. Two new estimates of the size of the squid stock in Subarea 4 in 1977 were presented. The initial population size was estimated at 370 million individuals by the Leslie method (*Biometrika* 39: 363-388) compared with 430 million from cohort analysis (Res. Doc. 78/VI/61). These

levels of population size imply an exploitation rate of about 0.75 in 1977 compared with the estimate of 0.38 which was derived at the February 1978 Meeting from the ratio of catch weight to minimum biomass. However, in view of the assumptions required for the use of such models (M = 0 in the case of the Leslie method and a closed stock in the case of the cohort analysis), the estimates of population size are likely to be substantially underestimated. Therefore, a definitive evaluation of the validity of the earlier estimates of the exploitation rate for 1977 in Subarea 4 (from the February 1978 Meeting) was not possible at present, although it was noted that these earlier estimates were also not considered reliable because they do not take into account the potential errors introduced by the high growth rate throughout the season.

Since much of the squid caught in Subarea 4 are taken in a joint squid-silver hake fishery, the Subcommittee reviewed new information on the escapement of squid in mesh selection experiments conducted on silver hake in 1977 (Res. Doc. 78/VI/60). The results indicated that, during the period from August to November, 25-30% of the squid would escape through the meshes of a 90-mm mesh bottom trawl and almost none from a 60-mm mesh trawl. However, these percentages would be somewhat higher in the early part of the season (May-July) when the squid are smaller.

An *ad hoc* working group (convened by Dr F. Nagasaki) was set up to further consider the feasibility of effort regulation and to define the data requirements necessary for its implementation. In considering the report of the Working Group (Annex 1), the Subcommittee concluded that it could not provide any further useful advice on an appropriate effort measure than that given by STACRES at its February 1978 Meeting (Part B, this volume). This was mainly due to the lack of detailed catch and effort data (catch per haul) which would allow definition and quantification of effort levels in 1977 in relation to the estimated exploitation rate. Therefore, in considering the management approach recommended by STACRES for 1978, the Subcommittee notes that there is sufficient uncertainty in the estimates of exploitation rate and effort levels in 1977 to warrant a further consideration of new data to be collected during the 1978 fishery as a basis for more precise advice on an appropriate management strategy for 1979. Accordingly, the Subcommittee

recommends (2)

that countries with detailed catch and effort data for the 1977 squid fishery should submit such data to the ICNAF Secretariat and that all countries with squid fisheries in 1978 should collect and report such data on a haul-by-haul basis. This information would permit a comprehensive evaluation of the feasibility of effort regulation for the squid fishery in Subareas 3 and 4.

23. Shrimp in Subarea 1 and Statistical Area 0

Data related to the fishery for shrimp in 1977 were presented and discussed at the Special Meeting of STACRES in November 1977 (Part A, this volume), when advice for management in 1978 was given. The only new information available at the present meeting is updated catch statistics for 1977.

As noted in its report of the April 1977 Meeting (*Redbook* 1977, page 63), the Subcommittee still considers it too risky to advise on conservation measures for 1979, i.e. two years beyond the latest year for which information is available, especially due to the difficulty of predicting recruitment. The Subcommittee therefore considers it more appropriate to assess the stock and advise on conservation measures for 1979 at a meeting near the end of 1978 when data from the 1978 surveys and also from the fishery will be available. The Subcommittee stressed the need for data from trawl and photographic surveys as the basis for estimating the biomass in 1978.

24. Shrimp in Subarea 2 (Res. Doc. 78/VI/28)

The Subcommittee was not requested to advise on the management of shrimp stocks in this area. However, it was noted that new information from USSR surveys (trawling combined with photography) indicate concentrations of shrimp in the region of Harrison Bank, mainly at depths between 400 and 500 m. A biomass estimate of 53,000 tons was indicated for the area surveyed.

IV. FUTURE RESEARCH REQUIREMENTS

During the course of reviewing the state of the various stocks, the Subcommittee noted some instances where data were insufficient to provide updated assessments of the stocks and a number of cases where the provision of additional information would enhance the quality of the assessments and improve the advice for management. The data requirements for these stocks are summarized as follows:

a) The almost complete lack of biological data for cod in Div. 2GH in recent years was noted, and countries fishing in the area are urged to make every effort to sample their commercial catches.

b) Substantially improved sampling of the commercial catches of cod in Div. 3M is needed to provide the basis for an analytical assessment of the stock for comparison with the results of recent general production model analyses.

c) The recent request for advice on the management of the redfish stock in Subarea 1 requires that all available data for this stock, including information on its relationship to the redfish fishery off East Greenland, be compiled and reviewed at the April 1979 Meeting of the Subcommittee.

d) Sampling of the commercial catches of redfish in Div. 3LN has been very inadequate up to 1977, requiring immediate attention by those countries involved in the fishery. Also, an attempt should be made to obtain better agreement on ageing than has been shown by the scanty age samples available in order to facilitate the use of analytical models in assessing this stock.

e) Despite the high level of agreement obtained in ageing silver hake at recent workshops, the problem of first-year age validation is a limiting factor which cannot be resolved by otolith interpretation but requires supporting data on spawning duration and early growth. It was recommended that otolith exchanges be carried out during 1978 and that a manual on silver hake ageing be compiled with provision for updating as required.

f) Concerning the mesh selection of silver hake in Div. 4VWX, it was suggested that a cover be attached to the codend of the trawls used during some future surveys for silver hake, in order to provide additional data on mesh size effects.

g) The lack of data on the distribution of the Greenland halibut stocks in Statistical Area 0 and Subareas 1 to 3 was noted, and it was recommended that research programs aimed at providing information on migrations and stock discrimination be expanded. The need for information on the appropriate mesh size for the Greenland halibut trawl fishery was also indicated.

h) The lack of suitable data for argentine in Div. 4VWX has made it difficult to evaluate the status of this stock.

i) Assessment of the capelin stocks in Subareas 2 and 3 continues to be wrought with the problem of obtaining reliable estimates of the biomass and the strengths of recruiting year-classes. In this regard, the need for pre-recruit surveys was emphasized for the stock in Subarea 2 and Div. 3K. Since the fishery in Div. 3LNO is conducted on pre-spawning and spawning concentrations of capelin, the Subcommittee urges that catch and effort data be collected on a daily basis to allow the calculation of DeLury-type population estimates, and that the collection of biological data be intensified to provide an adequate base for assessment by analytical methods. Such data for 1978 should be available for analysis at a meeting near the end of 1978.

j) With reference to the study on the feasibility of effort regulation as a management strategy for the 1979 squid fishery in Subareas 3 and 4, the Subcommittee recommended that countries with detailed catch and effort data for the squid fishery in 1977 should submit such data to the ICNAF Secretariat as soon as possible and that all countries with squid fisheries in 1978 should collect and report such data on a haul-by-haul basis, so that a comprehensive evaluation of effort regulation can be undertaken at a meeting in late 1978 or early 1979.

k) In view of the difficulty in predicting recruitment to the shrimp fishery in Subarea 1 and Statistical Area 0 too far in advance of the fishing season, the Subcommittee advises that an assessment would be more appropriate late in 1978 when data from the 1978 fishery and surveys will be available.

V. ACKNOWLEDGEMENT

The Chairman expressed his appreciation to the conveners of the working groups and to all participants for their cooperation during the course of the meeting and to the Secretariat for their usual efficient work. The participants expressed their appreciation to Mr A. T. Pinhorn for his guidance during the past 3 years as Chairman of the Subcommittee.

ANNEX 1. REPORT OF *AD HOC* WORKING GROUP ON EVALUATION OF EFFORT REGULATION FOR *ILLEX* IN SUBAREAS 3 AND 4

Convener: F. Nagasaki

The Working Group was set up to review the data submitted at this meeting in response to the recommendation of STACRES at its Special Meeting in February 1978 that countries provide detailed catch and effort data for *Illex* in Subareas 3 and 4 with a view to evaluating the feasibility of an effort regulation for this stock (Part B, this volume). Other participants were T. Amaratunga, G. P. Ennis, G. V. Hurley, and D. E. Waldron. The limited amount of data presented in Res. Doc. 78/VI/49 and in some working papers were reviewed.

At the Special Meeting in February 1978, the exploitation rates of squid in 1977 were estimated to be 0.28 and 0.38 in Subareas 3 and 4 respectively. On the basis of yield-per-recruit and stock-recruitment considerations, the Subcommittee at its Meeting in April 1976 indicated that removals could be about 40% of the squid biomass (*Redbook* 1976, page 112). Thus the rate estimated for the 1977 fishery in Subarea 3 was somewhat below and that for Subarea 4 near the optimum level. However, in view of the crudeness of the methods used, the Working Group agreed that the exploitation rates quoted for 1977 were not very reliable and indicated the need for a refinement of methods to evaluate the biomass.

In order to assess the feasibility of an effort regulation for the squid fishery, it was considered necessary to quantify the effort expended to fish squid. It was concluded, however, that the quantification of effort would be difficult due to the problems associated with (i) intercalibration of effort among the different countries, vessels, gears, etc.; (ii) estimation of effort for squid in a mixed fishery; and (iii) estimation of effort for the inshore catch.

Effective fishing effort is influenced by a wide variety of factors which change with time, e.g. country, vessel size and power, gear size and type, etc., and these factors would have to be continually monitored and intercalibrated in order to quantify fishing effort. The complexities of the inshore fishery would have to be taken into account and the fishing effort quantified on a basis comparable with that for the offshore fisheries. The accuracy of the results is dependent upon the type of data available; for trawl fisheries, the accuracy would be increased if data were reported on a haul-by-haul basis.

Squid are taken not only in squid-directed fisheries but also in mixed fisheries. In the case of mixed fisheries, it is necessary to quantify the fishing effort for squid. In an effort to determine a way of delineating when the fishery was directed toward squid, the Working Group examined weekly catch data available for the 1977 fishery. The data were analyzed from the viewpoint of assuming that the fishery was directed toward squid when the quantity of squid in a weekly catch exceeded a certain proportion of the catch of all species. The results of this analysis for three levels of squid catch (i.e. 80%, 70% and 60%) are summarized in Table 1. The Working Group agreed that this type of classification should be tested with haul-by-haul data in order to determine how much of the effort in mixed fisheries should be allocated to squid.

Table 1. Summary of analysis relevant to squid-directed fisheries in Subarea 4, 1977.

Country	Squid catch (tons)	Squid catch when total catch consisted of			Percentage of fishery with by-catch		
		⩾80% squid	⩾70% squid	⩾60% squid	<20%	<30%	<40%
Bulgaria	2,929	2,678	2,678	2,678	91	91	91
Canada	8,340	6,600	6,932	7,152	79	83	86
Cuba	3,244	2,208	2,302	2,336	68	71	72
France	455	455	455	455	100	100	100
Fed. Rep. Germany	2,775	2,775	2,775	2,775	100	100	100
Italy	2,451	2,451	2,451	2,451	100	100	100
Japan	3,144	2,067	2,285	2,618	66	73	82
Poland	3,214	3,214	3,214	3,214	100	100	100
Romania	1,053	1,053	1,053	1,053	100	100	100
Spain	2,958	2,932	2,958	2,958	99	100	100
USSR	18,233	13,000	13,906	15,370	71	76	84
Total	48,796	39,433	40,009	43,060	81	82	88

Noting that the haul-by-haul data available for 1977 through the joint scientific observer programs conducted by Canada with Cuba, Japan and USSR were not sufficient to quantify the fishing effort for the overall squid fishery, the Working Group recommends that all countries with catch and effort data on a

haul-by-haul basis relevant to the squid fishery in 1977 should submit such data to the Secretariat as soon as possible, and that all countries fishing squid in Subareas 3 and 4 during 1978 should collect such data on a haul-by-haul basis and submit them at the earliest possible time, so that analyses can be carried out and reported to a meeting of STACRES in late 1978 or early 1979.

APPENDIX II. REPORT OF BIOLOGICAL SURVEYS SUBCOMMITTEE

Chairman: W. G. Doubleday Rapporteur: R. Wells

The Subcommittee met during 18-20 May 1978 at Bonn, Federal Republic of Germany, to consider and report on matters referred to it by STACRES (see Part D of this volume for Agenda). Representatives were present at one or more sessions from Canada, Cuba, Denmark, Federal Republic of Germany, German Democratic Republic, Poland, Portugal and USSR, and observers were present from FAO, OECD and the USA. Meeting documents examined include: Res. Doc. 77/XI/65, 67, 70; 78/II/12, 17; 78/VI/23, 24, 27, 28, 29, 30, 33, 36, 38, 39, 41, 43, 45, 59, 64, 69, 76, 77, 78; Sum. Doc. 78/VI/9. Many of these documents had previously been considered by the Assessments Subcommittee and, therefore, only those aspects relevant to the Biological Surveys Subcommittee were discussed here.

The reason for expanding the length of the Subcommittee meeting in 1978 to three days was to permit the detailed examination of survey abundance indices. This topic was discussed for two days and a summary of the discussion is given in Section 1. Section 2 contains the results of discussion of a draft manual for ICNAF groundfish surveys. Sections 3 and 4 constitute the annual review of survey activities in 1977 and 1978, and Section 5 covers other matters relevant to the Subcommittee.

1. Review of Survey Abundance Indices

The Subcommittee was requested by STACRES to review systematically the precision of survey results to date for the ICNAF Area (*ICNAF Redbook* 1977, page 42). This request was interpreted to include the examination of internal measures of precision, such as variance estimates and correlations between survey indices of abundance and other surveys or abundance indices based on commercial catch and effort data. In this regard, the Subcommittee examined relevant material in many of the 1978 meeting documents (see Part D of this volume) and in some of the 1977 research documents.

a) Shrimp (*Pandalus borealis*) in Statistical Area 0 and Subarea 1 (Res. Doc. 77/XI/65, 67, 70)

Photographic surveys for shrimp in Subarea 1 have been carried out in 1975-77 by Denmark and estimates of numbers and biomass with associated variances were available for some strata. Comparison was made with trawl survey results from a 1976 survey and a close correspondence was found. Danish trawl surveys for shrimp in Subarea 1 were also considered, but, due to the problems of coverage, the Subcommittee did not draw any conclusions regarding their accuracy. French trawl survey data, including estimates of variances, for shrimp in Statistical Area 0 in 1977 were reviewed, and the overall coefficient of variation (CV) per tow for the four strata where shrimp were caught was 0.88. Shrimp are known to be distributed widely in the water column so that absolute estimates of abundance from trawl surveys tend to be too low. The relative availability of shrimp has been estimated to vary by a factor of up to 5.

b) Groundfish in Statistical Area 0 (Res. Doc. 78/VI/45)

The results of a groundfish survey by France in Div. 0B were reviewed, including indices of abundance and variances for numbers and weight per tow. Measures of precision are as follows:

Species	Number of sets	Coefficient of variation (CV) Numbers per tow index	Biomass index	Weight per tow
Greenland halibut	62	0.10	0.10	0.59
Redfish	62	0.27	0.20	2.39

c) Groundfish in Subarea 2 and Division 3K (Res. Doc. 78/VI/27, 66)

Catch per hour trawled for cod from USSR surveys in Subarea 2 and Div. 3K was shown to be correlated with the total yield from the commercial fisheries in these areas during 1971-76 ($r = 0.33$). The estimates of pre-recruits at age 3 from these surveys had a correlation of 0.7 with estimates of year-class size at age 4 from virtual population analysis (VPA) and were used in projections by the Assessments Subcommittee in 1978.

Examination of data from Federal Republic of Germany surveys in Div. 2J and 3K showed average within-stratum coefficients of variation for cod and American plaice to be:

Species	CV of weight per tow 1975	1976
Cod	1.08	2.17
American plaice	1.10	1.44

d) Groundfish in Divisions 3L, 3N and 3O (Res. Doc. 78/VI/36, 41, 59)

Excellent correlations were found between Canadian survey estimates of biomass and numbers in Div. 3L and 3N and estimates of stock size from cohort analysis as follows:

Species	Correlation coefficient (r) Biomass	Numbers
American plaice	0.951	0.965
Yellowtail flounder	0.926	0.867

There seemed to be more variation in survey indices of abundance than in the estimates from cohort analysis for yellowtail flounder. It was noted that the correspondence of indices of numbers-at-age was best for ages 7 to 9 and poor for ages 5 and 6, indicating that yellowtail younger than age 7 are not fully available to the survey gear. The slope of the relation between indices for 1975 and 1976 differs from that of earlier years, suggesting possible bias in the selection of starting F for the cohort analysis. The variances of abundance indices for yellowtail flounder surveys in Div. 3N are as follows:

Year	Number of sets	Numbers (000 fish) Number of fish	Lower limit	Upper limit	Biomass (tons) Weight of fish	Lower limit	Upper limit
1971	26	134,845	94,967	174,723	56,035	42,850	69,221
1972	45	243,672	126,683	360,660	99,371	65,796	132,946
1973	48	104,967	67,688	142,245	47,365	29,085	65,644
1974	37	102,553	70,610	134,497	45,477	30,553	60,402
1975	22	121,769	-180,388	423,926	46,886	950	92,821
1976	30	173,015	112,481	233,549	71,641	53,161	90,120
1977	46	182,106	113,489	250,723	76,216	50,134	102,299

Correlations of about 0.6 were found between various estimates of cod abundance (numbers) from Canadian surveys in Div. 3N and catch rates of Spanish pair trawlers. A correlation of 0.88 was found between the catch-per-tow index for all groundfish from Canadian surveys in Div. 3LN and catch-per-day fished by USSR trawlers in 1971-77.

e) Capelin in Divisions 2J, 3K and 3N (Res. Doc. 78/VI/29, 30, 43)

The results of acoustic surveys by Canada and USSR were discussed. Although internal estimates of precision were not available for review at this meeting, it was noted that a joint Canada-USSR experiment planned for 1978 will permit a comparison of estimates in the future. It was also observed that commercial catch rates do not correspond to changes in stock abundance for this species.

f) Groundfish in Division 3M (Res. Doc. 78/VI/27)

The Subcommittee reviewed absolute abundance indices for cod in Div. 3M, based on USSR surveys and a photographic method of estimation of the catchability coefficient of the research trawl. However, comparisons with other indices (and estimates of variance) were not available due to the lack of data to permit a cohort analysis. In this context, the Subcommittee

recommends (10)

that member countries with commercial fisheries in Div. 3M increase the biological sampling of their catches.

Internal estimates of precision were available for a Canadian survey on Flemish Cap in 1978. Due

to a change in vessel and gear, these estimates are not directly comparable with results from Canadian surveys in earlier years. These 1978 estimates based on 134 sets are as follows:

	Stock size estimates			Catch per standard tow		
Species	Number (000)	Lower limit	Upper limit	Mean Number	Lower limit	Upper limit
Redfish (*mentella*)	572,854	362,316	783,393	723.0	457.3	988.8
Redfish (*marinus*)	107,210	14,466	199,954	135.3	18.3	252.4
Cod	79,180	65,700	92,661	99.9	82.9	117.0
American plaice	12,740	5,076	20,405	16.1	6.4	25.8
	Weight (tons)	Lower limit	Upper limit	Weight	Lower limit	Upper limit
Redfish (*mentella*)	271,995	136,249	407,741	343.3	172.0	514.6
Redfish (*marinus*)	88,359	12,741	163,977	111.5	16.1	207.0
Cod	83,424	68,660	98,188	105.3	86.7	123.9
American plaice	7,351	2,572	12,130	9.3	3.3	15.3

g) Squid-*Illex* in Subareas 3 and 4 (Res. Doc. 78/II/12, 17)

The results of a squid survey by France in Subdiv. 3Ps in 1977 was reviewed. The biomass was estimated to be 48,480 tons with a coefficient of variation of 0.31 based on 46 sets. A bias due to the limited availability of squid to the trawling gear was noted. An estimate of squid abundance in Subareas 3 and 4 by expansion of commercial catch rate data was presented by Cuba.

h) Groundfish in Subarea 4 (Res. Doc. 78/VI/76)

A correlation of 0.90 was found between Canadian survey catch-per-unit-effort indices for cod at age 2 in Div. 4T and VPA estimates of year-class size at age 3.

Variance estimates of biomass indices for various groundfish species based on tows within selected strata from *A. T. Cameron* trawl surveys in Div. 4VWX during 1970-77 were presented. In all instances, the standard deviation of catch per tow was proportional to stratum means. The coefficients of variation for the different species are as follows:

Species	Strata	Coefficient of variation of catch per tow	
Cod	47-66	0.35	
	72-77,80-81	0.40	
	85,90-95	0.23	0.33
Haddock	56,63-65	0.36	
	72-77,80-81	0.26	
	85,90-92	0.47	0.36
Redfish	40,46,51-53	0.44	
	60-61,70-71	0.62	0.53
Silver hake	53-56,60-81		0.29
Pollock	80-81,85,90-92		0.54
American plaice	47-51		0.32
Yellowtail	47-48,55-56,58		0.30
White hake	84-85,91-92		0.45
Thorny skate	47-51		0.34

Silver hake abundance indices from USSR trawling surveys in the Emerald Basin were examined. The distribution of the catch per tow was found to be well approximated by the negative binomial distribution. Internal estimates of precision, including standard deviation (SD), coefficient of variation (CV) and confidence limits (mean ± 2SD) are given below:

Year	Catch per haul (numbers) Mean	SD	CV	Confidence limits Lower	Upper	Catch per haul (kg) Mean	SD	CV	Confidence limits Lower	Upper
1972	963	209	0.22	545	1381	101	19	0.19	63	139
1973	866	185	0.21	496	1236	116	22	0.19	72	160
1974	1291	195	0.15	901	1681	205	33	0.16	139	271
1975	2635	558	0.21	1519	3751	340	69	0.20	202	478
1976	1508	330	0.22	848	2168	227	52	0.23	123	331

Correlations between these survey indices and VPA estimates and Canadian research vessel survey estimates were examined but were not significant. It was noted that silver hake had limited availability to the research gear used in the Canadian surveys. Simulation studies showed that the precision of the survey index is ±40% with the current 20 sets, it would be ±25% for 50 hauls, and 200 hauls would be needed for a precision of ±10%, corresponding to a 95% confidence interval.

i) Groundfish surveys in Subarea 5 and Statistical Area 6 (Res. Doc. 78/VI/77)

An analysis of USA groundfish surveys was reviewed. The catch per tow of eelpout and haddock from an experiment on Georges Bank was found to be proportional to distance trawled. The distribution of catch per tow for several sepecies was found to closely follow the negative binomial distribution. Calculations of the optimum length of tow to obtain the maximum precision of survey indices were presented, relating the changes in the coefficient of variation of the catch with the number of tows of a given duration attainable with a fixed total cruise length in days. The optimum towing times (minutes) for yellowtail, eelpout, cod and haddock on Georges Bank were 12, 18, 45 and 2 respectively. It was noted that 30 minutes is a good compromise for the optimum towing time. It was also noted that improved monitoring of trawl performance and length of tow might reduce coefficients of variation by about 15%, which corresponds to a 30% increase in the number of stations. The estimated number of hauls required for specified precision of stratified mean abundance indices ($\log_e$ catch/haul in pounds) for haddock and yellowtail from *Albatross IV* surveys on Georges Bank are as follows:

Level of precision linear scale Percentage change	2 standard deviations	Total number of hauls required approximately proportional allocation Haddock (strata 13-25)	Yellowtail (strata 13,16,19)
±10%	±0.10	>500	>500
±20%	±0.18	338	253
±30%	±0.26	164	120
±50%	±0.40	70	51
±100%	±0.69	23	17

Substantial variation in the ratio of catch per tow between day and night for yellowtail flounder was noted, with a range of 1.0 in 1974 to 5.2 in 1972. This variation was thought to have influenced the abundance index for 1972

Summary. The Subcommittee agreed that, in the two cases considered, pre-recruit abundance indices from surveys were sufficiently accurate for use in assessments and it recognized the need for wider use of such surveys. Availability of young fish to the survey gear was noted as a central area for development of methodology for these surveys.

The Subcommittee noted that, while developments in survey methods, such as photographic estimation of catchability and monitoring of trawl performance and distance towed, may be expected to reduce coefficients of variation of survey abundance indices by perhaps 15% in the foreseeable future, the 95% confidence intervals associated with such indices are likely to remain in the range of ±25-50% unless more than 100 sets are made in the area of distribution of the stock surveyed. This review of survey data has indicated, in many cases, the degree of precision presently available for such survey indices but does not in itself indicate where they should be used in assessments.

Commercial catch and effort statistics are often taken at face value in assessments while the uncertainty of survey indices is stressed. There are substantial variations in commercial catch rates from year to year which do not correspond precisely to changes in abundance for many stocks. The changing and increasingly restrictive regulation of commercial fishing has affected the usefulness of commercial fishery based abundance indices in many cases. The Subcommittee maintains that the usefulness of

survey abundance indices for assessment purposes can only be determined by examination of the sources of variation and bias in available commercial fishery based indices as well. Therefore, the Subcommittee

recommends (4)

that the Assessments Subcommittee examine the accuracy of commercial fishery based indices of abundance at its April 1979 Meeting and determine survey priorities in cooperation with the Biological Surveys Subcommittee.

2. ICNAF Manual for Groundfish Surveys

A draft of Sections II to VII of a manual for groundfish surveys was distributed to participants during the meeting and discussed by the Subcommittee. It was agreed that the stratified-random method of designing groundfish surveys be recommended in the manual as the preferred approach where feasible.

The Subcommittee noted that a device is now in use on Federal Republic of Germany surveys to take sediment samples during trawling. It was also noted that Canadian studies are in progress on the relations between bottom type and species distributions. The Subcommittee agreed that reference to laboratories developing relevant survey methods such as the sediment sampler would assist the reader of the manual in obtaining the best information to support survey design.

The Subcommittee reviewed stratification schemes presented by France for Div. 0B (Res. Doc. 78/VI/64) and by Denmark (Greenland) for Div. 1B. On the basis of the limited state of present knowledge of fish distributions in Statistical Area 0 and Div. 2GH, the Subcommittee agreed to postpone adoption of stratification schemes for these areas. It was noted that further studies are planned by Federal Republic of Germany and Denmark in Subarea 1 and that some results might be available for consideration at the 1979 Annual Meeting.

The USA participant reported that the stratification of Subarea 5 and Statistical Area 6 has been extended to inshore areas of depth less than 15 fathoms. The Subcommittee felt that the inclusion of material on inshore stratification in Section II (D and E) of the manual would benefit scientists undertaking such stratification in other areas, and requested the editor of the manual to contact the Woods Hole Laboratory in this respect.

The Subcommittee noted that stratification schemes are gradually being converted from fathoms to meters by renaming existing stratum boundaries. The Subcommittee also noted the desirability of a common stratum numbering scheme and

recommends (5)

that member countries submit their stratum numbering schemes to the Assistant Executive Secretary with a view to developing a common numbering scheme for consideration at the 1979 Annual Meeting.

The Subcommittee discussed the station selection procedure (Section II, F) and recognized the value of accumulating information on areas of untrawlable bottom. The Subcommittee therefore

recommends (6)

that records be kept of untrawlable units when navigational accuracy permits, and that these records be made available with the master stratification charts.

The Subcommittee emphasized the value of monitoring trawl performance with a view to improving the accuracy of survey abundance indices and strongly

recommends (7)

that member countries develop and implement improved methods of monitoring the performance of research trawls.

The Subcommittee agreed that direct comparison of two vessels fishing side by side was the preferred method of comparative fishing (Section IV, B), but emphasized that the high cost of such experiments in relation to the precision of the results should be carefully considered when planning such experiments.

Discussion of data collection procedures (Section V, A) resulted in suggestions that guidelines be presented on the use of age-length keys, that weights be measured in grams, and that lengths not be grouped beyond the initial unit of measurement recorded on the vessel. In this regard, the Subcommittee

recommends (19)

that the Assistant Executive Secretary compile an updated list of length measurement conventions and clarify sampling standards currently used in the reporting of sampling data.

Discussion of Section VI (A and B) on data processing centered around the uncertainty about the role of the Secretariat in the proposed new Northwest Atlantic Organization. The Subcommittee agreed that the sections of the manual dealing with the ICNAF data bank and with standard forms and procedures be left open until the future role of the Secretariat becomes clear.

The Subcommittee noted the desirability of developing a common coding system for species names for international survey data exchange, and

recommends (20)

that the Assistant Executive Secretary draft a set of species codes for international exchange of survey data for review at the 1979 Annual Meeting.

The Subcommittee agreed that the editor of the manual should circulate a revised draft for review by scientists prior to the planned finalization of the manual at the 1979 Annual Meeting.

3. Review of Survey Activity in 1977

The Subcommittee noted that the surveys listed in Table 1 were carried out in the ICNAF Area in 1977.

Table 1. Inventory of biological surveys conducted in the ICNAF Area during 1977.

	Groundfish surveys using stratification scheme				Coordinated larval and juvenile herring surveys					Other surveys				
Sub-area	Div.	Country	Months	Sets	Div.	Country	Months	Sets	Plank.	Div.	Type	Country	Months	Sets
0	B	FRA(SP)	9-10	62						B	G. halibut	USSR	8-11	15
1	B	DEN(G)	6	9						A	Crabs	DEN(G)	7-8	25
											Shrimp	DEN(G)	4-5,8	31
											Capelin	DEN(G)	9	1
											Plankton	DEN(G)	5,8-9	20
										B	Shrimp (photo)	DEN(G)	7-8	11
											Shrimp	DEN(G)	5,7-8	26
											Capelin	DEN(G)	5	1
											Plankton	DEN(G)	4,7	6
										C	Crabs	DEN(G)	6,9	10
											Shrimp	DEN(G)	2,4-5,7,10	12
											Capelin	DEN(G)	2,4,5,12	9
											Plankton	DEN(G)	7	7
											Groundfish	DEN(G)	2,4-5,10	8
										D	Crabs	DEN(G)	2,6,10-11	29
											Shrimp	DEN(G)	1,3-4,9,12	21
											Capelin	DEN(G)	1-2,4,12	9
											Plankton	DEN(G)	2-4,6-7,9	11
											Groundfish	DEN(G)	1,3-4,9	10
										E	Crabs	DEN(G)	10	20
											Shrimp	DEN(G)	4,10	9
											Plankton	DEN(G)	7	1
											Groundfish	DEN(G)	4,10	6
										D-F	Groundfish	FRG	12	5
2	J	FRG	11-12	46						G	Groundfish	FRA(SP)	10	6
		CAN(N)	11-12	122							G. halibut	GDR	7	1
										H	G. halibut	GDR	6-7,12	4
											R. grenadier	GDR	12	1
										J	Cod	FRA(SP)	1	5
											Cod	GDR	2	1
											Cod	USSR	1-2	25
											G. halibut	USSR	2	5
											Capelin (photo, acoustic,trawl)	USSR	10-11	38
3	K	CAN(N)	11-12	7						K	Cod	FRA(SP)	1	6
	LNO	CAN(N)	5-6	193							Cod	GDR	2	1
	M	CAN(N)	2	36							G. halibut	USSR	1	3
	Ps	CAN(N)	4	103							Witch	USSR	10	5
		FRA(SP)	3-11	94							R. grenadier	USSR	1	8
											Capelin	GDR	12	1

Table 1 (Cont'd.)

Sub-area	Groundfish surveys using stratification scheme				Coordinated larval and juvenile herring surveys					Other surveys				
	Div.	Country	Months	Sets	Div.	Country	Months	Sets	Plank.	Div.	Type	Country	Months	Sets
3										K	Capelin	USSR	10-11	20
											Capelin (photo, acoustic,trawl)	USSR	10-11	30
										L	Cod	FRA(SP)	2	13
											Redfish	USSR	2	7
										M	Cod	USSR	1,3-4	40
											Redfish	USSR	1,4	10
										N	Redfish	USSR	4	15
											Capelin (photo, acoustic,trawl)	USSR	6	45
										O	Redfish	USSR	4	25
										KLMNO	Total trawl survey	USSR	4-6	?
											Juvenile cod (ages 1-3)	USSR	4-7	?
										Pn	Cod	FRA(SP)	2	13
4	T	CAN(M)	9	71	X	CAN(M)	3	98		R	Cod	FRA(SP)	1-2	25
	VWX	CAN(M)	7	145		CAN(M)	8	17		T	Eggs, larvae	CAN(M)	5-6	73
	X	FRG	10	(SA 5 below)		GDR	3	1	1	VWX	Ichthyoplankton	USSR	9-10	120
						FRG	3-4	(see SA 5 below)			S. hake (trawl and acoustics, selectivity)	CUBA	7-8	?
										X	Scallops	CAN(M)	7	(see SA 5 below)
5	YZ,6	FRG	10	78	YZ	GDR	3	84	84	Z	Scallops	CAN(M)	7	148
	Z	POL	2	30	YZ	GDR	4	22	21		Ichthyoplankton	USSR	6-8	300
					YZ,6	FRG	3-4	-	50		Ichthyoplankton	USSR	10	100
						FRG	11	-	135		Trawl survey	USSR	11	50
					Z	POL	2,3	29	106		Herring	POL	10	67
						POL	10	-	148					

4. Proposed Survey Activity in 1978

Surveys carried out to date in 1978 and planned for the remainder of the year are listed in Table 2. Also listed are some Canadian surveys planned for the early part of 1979.

Table 2. Biological surveys planned for the ICNAF Area in 1978 and the early part of 1979.

Country	Type of survey	Area	Dates	Year
Canada (M)	Groundfish	4T	Sep (3 weeks)	1978
	"	4VWX	Jul (4 weeks)	
	"	4VWX	Nov (3 weeks)	
	"	4WX	Mar 11-20	
	"	4X	Apr 6-11	
	Pelagic	4T	Oct (1 week)	
	"	4X	Aug (2 weeks)	
	Larval herring	4X	Apr (2 weeks)	
	" "	4X	Oct (2 weeks)	
	Juvenile herring	4X	Feb 15-Mar 2	
	Mackerel eggs and larvae	4T	Jun (2 weeks)	
	Silver hake and squid	4VWX	Sep-Oct (3 weeks)	
	Plankton	4VWX	Aug-Sep (5 weeks)	
	"	5Z	Oct (2 weeks)	
	Scallop	5Z	Jun-Aug (4 weeks)	
Canada (N)	Groundfish	2GH	Sep 13-Oct 3	1978
	"	2	Jul 21-Sep 1	
	"	2	Nov 3-Dec 1	

Table 2. (Cont'd)

Country	Type of survey	Area	Dates	Year
Canada (N)	Groundfish	2,3K	Feb 17-Mar 13	1978
	"	2,3K	Jul 29-Sep 1	
	"	2J,3K	Aug 1-30	
	"	3LNO	Apr 10-May 2	
	"	3LNO	Apr 20-May 5	
	"	3LNO	May 11-25	
	"	3M	Jan 25-Feb 15	
	" (+ hydrography)	3M	Nov 6-24	
	"	3Ps	Feb 20-Mar 1	
	"	3Ps	Apr 3-14	
	"	3P	Sep 18-Oct 31	
	"	4RST	Jan 5-23	
	"	4RST	Oct 9-31	
	Cod and capelin	3LNO	Jul 6-27	
	" " "	3N	Jun 15-29	
	" " "	3N	Jul 26-Aug 8	
	Capelin	2,3K	Oct 5-Nov 1	
	"	3L	Jan 12-25	
	"	3L	Sep 13-Oct 3	
	"	3LNO	Jun 9-Jul 4	
	"	4	May 3-29	
	Pelagic	3K	Sep 6-Oct 3	
	"	3L	Feb 27-Mar 14	
	"	3L	Apr 11-May 1	
	"	3L,3Ps	Jan 5-27	
	"	3L,3Ps	Nov 7-Dec 8	
	"	3Ps	Feb 2-18	
	"	4RST	Apr 5-May 3	
	Multispecies	3LNO	May 5-17	
	Salmon	3K	Jun 12-Jul 7	
	"	3Ps	May 6-25	
	" (high seas)	3	May 1-18	
	Arctic char	2	Jul 30-Aug 25	
	Crabs, ichthyoplankton	3L	Mar 30-Apr 7	
	" "	3L	Jul 11-15	
	" "	3L	Sep 4-8	
	" "	3L	Nov 6-11	
	" " , scallops	3L	Feb 13-23	
	" " "	3L	May 29-Jun 8	
	Scallops	3L	Mar 20-23	
	"	3L	May 4-8	
	"	3L	Sep 1-2	
	"	3L	Oct 9-13	
	"	3L	Dec 12-14	
	"	3P	Feb 24-Mar 30	
	Shrimp	2	Sep 13-Oct 3	
	"	3P	Feb 24-Mar 30	
	Squid	3L	Oct 17-Nov 2	
	Seals	4	Mar 25-Apr 7	
	Acoustics	3L	Jun 13-28	
	"	3Ps	Jan 31-Feb 15	
	Biological oceanography	2+3	Jul 25-Aug 18	
Cuba	Groundfish	3M	Jun 1-13	1978
	Acoustic and trawling	3LNO	Jun 15-Jul 15	
Denmark (G)	Shrimp (trawling)	1A	Aug	1978
	" "	1B	Jul-Aug, Oct-Nov	
	" "	1C	Jul-Aug, Oct-Nov	
	Shrimp (photographic)	1ABCD	Jul-Aug	
	Shrimp and groundfish (trawling)	1C	Mar, Jul-Nov	
	" " " "	1D	Apr, Jul-Nov	
	" " " "	1E	Feb, Apr, Jul-Nov	
	Capelin (pelagic trawling)	1D	Quarterly	
	Plankton	1BCD	Jul	

Table 2. (Cont'd)

Country	Type of survey	Area	Dates	Year
Denmark (G)	Plankton	1D	Feb-Jul, Oct-Nov	1978
	Sandeels (trawling and echo-survey)	1ABCD	May-Sep	
Fed. Rep. Germany	Groundfish	1C-F	Dec	1978
	Groundfish (random-stratified)	2J	Nov-Dec	
	Bottom trawl (random-stratified)	4X,5YZ	Sep-Oct	
	Young herring trawl survey	4X,5Z,6	Feb-Apr	
	Larval herring	4X,5YZ	Oct-Nov	
France (SP)	Groundfish	3Ps	Mar 5-25	1978
	"	3Ps	Oct 10-30	
	Cod	2J,3K	Jan 27-Feb 5	
	"	3L	Feb 10-17	
	"	3P	Feb 20-26	
	"	4R	Jan 12-21	
	Tuna	3LNO	Aug 31-Sep 29	
German Dem. Rep.	Groundfish (cod)	2HJ,3K	Jan-Mar	1978
	" (G. halibut)	2HJ,3KL	May-Jun	
	" (R. grenadier)	2J,3KL	Jul-Aug	
	" "	0	Dec	
	" (stratified surveys)	0,1,2,3	Sep-Nov	
	Pelagic (capelin)	2,3	Aug-Sep	
Poland	Environmental project	3M	Apr	1978
	Groundfish	5Z	Mar	
	Larval herring	5Z	Sep	
USSR	Groundfish (cod, G. halibut, A. plaice, R. grenadier, etc.)	0,2GHJ	Oct-Dec	1978
	Capelin pre-recruit, ichthyoplankton, hydrology, hydrochemistry	2J,3KLNO	Apr-Jul	
	Groundfish trawling	2J,3KLMNO	May-Jul	
	Young cod trawl survey	2J,3KLMNO	May-Jul	
	Capelin (abundance and biomass)	3KLNO	Apr-Jul	
	Ichthyoplankton	4VWX	Aug-Sep	
	"	5	Jun-Aug, Oct	
	Silver hake trawl surveys	4VWX	Oct-Nov	
	Mackerel trawl survey	5	Feb-Mar	
	Groundfish trawl survey	5	Sep	
Canada (N)	Groundfish	2	Feb 21-Mar 14	1979
	"	3M	Jan 19-Feb 19	
	"	3Ps	Feb 15-Mar 6	
	"	3Ps	Mar 16-31	
	"	4RST	Jan 4-17	
	Pelagic	3L	Mar 5-22	
	"	3L,Ps	Jan 10-Feb 1	
	"	3Ps	Feb 5-23	
	Capelin	3L	Jan 4-19	
	Scallop	3L	Jan 31-Feb 3	
	Crab and plankton	3L	Jan 22-28	
	" " "	3L	Mar 1-7	

5. Other Matters

a) Photographic methods of estimating catchability (Res. Doc. 78/VI/24)

A method of estimating catchability coefficients for survey bottom trawls, using underwater cameras on a false headrope, was reviewed. The Subcommittee noted that the method had promise in permitting direct comparisons of efficiency of different gears and the calculation of absolute abundance estimates.

b) Shrimp in Subarea 2 (Res. Doc. 78/VI/28)

The Subcommittee noted concentrations of shrimp were detected in a preliminary survey near Harrison Bank in Subarea 2 in 1977.

c) Greenland halibut (Res. Doc. 78/VI/38, 39)

Groundfish surveys by France in Statistical Area 0 and by Canada and Federal Republic of Germany in Div. 2J, 3K and 3L indicated that larger specimens of Greenland halibut were found in the deeper water. The Subcommittee noted the value of such results from research vessel surveys in defining possible zones of regulation for commercial fisheries.

d) Herring surveys (Res. Doc. 78/VI/69, 78)

Cooperative research vessel surveys with USA by Federal Republic of Germany and German Democratic Republic for herring in Div. 4X, 5Y and 5Z in 1977 indicated greatly reduced abundance of herring. The Subcommittee noted that commercial fishery statistics also confirmed the unavailability of herring in the offshore areas.

e) Pilot study of processing survey data by the Secretariat

The Subcommittee was informed that data from two cruises by Federal Republic of Germany, including set details and number and weight per tow by species but excluding length frequencies and individual biological observations, have been received by the Secretariat but have not yet been keypunched. It is anticipated that all of the available data will be available and processed before the 1979 Annual Meeting. Slight differences were noted between the forms used for the pilot study and those illustrated in the draft survey manual. The Subcommittee agreed that these would be resolved when completion of the pilot study gave experience on which to base recommendations. The Subcommittee welcomed the progress reported on compiling the data for the project.

APPENDIX III. REPORT OF STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: J. Messtorff Rapporteur: L. P. D. Gertenbach

The Subcommittee met at Bonn, Federal Republic of Germany, on 25 May 1978 to consider and report on matters referred to it by STACRES (See Part D of this volume for Agenda). Representatives attended from Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Japan, Norway, Poland, Portugal, Spain, and USSR, and observers were present from FAO and Eurostat.

1. Report of 9th Session of the CWP

The Secretary of the CWP (L. P. D. Gertenbach) presented the Report of the 9th Session of the CWP which was held during 17-23 August 1977 at ICNAF Headquarters, Dartmouth, Canada (Sum. Doc. 78/VI/2). He reviewed the discussions and recommendations under the main sections of the report as follows: (a) procedural matters; (b) agency programs and publications, with particular reference to ICNAF; (c) classification of Atlantic fishing areas; (d) classification, codification and nomenclatural standardization of species items; (e) formulation of basic statistical concepts; (f) fishing fleet and gear statistics; (g) STATLANT forms and instructions for their completion; (h) identification of standard elements to be considered for incorporation in fishing logbooks and records; (i) processing of data; and (j) country nomenclature. It was noted that matters and recommendations of direct relevance to ICNAF were extracted and presented separately in Sum. Doc. 78/VI/22.

The CWP Secretary pointed out that the 10th Session of the CWP is provisionally, at the joint invitation of ICCAT and ICSEAF, scheduled for the period 26 June-4 July 1979 at Madrid, Spain. The Subcommittee noted that ICNAF should, as in the past, continue to have three representatives at that session, and

recommends (9)

that ICNAF participation in the 10th Session of the CWP consist of the Chairman of the Statistics and Sampling Subcommittee, the Assistant Executive Secretary, and a representative to be appointed by Canada.

The Subcommittee noted with interest that the CWP, following a lengthy and thorough debate on the reporting of catches decided "that the flag of the vessel should, for the time being be considered as the paramount indication of nationality and should only be overridden when it is obvious that the wording of the chartering and joint operation contracts indicates otherwise or when inter-relationships are too complicated to settle." Some members of the Subcommittee indicated that the flag of the vessel might not be appropriate as a nationality indicator where vessels from one country are contracted to fish from the quantities reserved for another country. It was suggested that such catches might be attributed to the country for which the fish were reserved and not to the flag country. The Subcommittee recognized that solutions to this problem, of vital significance in the reporting and publication of statistical data, would have to be based on a very careful study of the various aspects, and that this would require time as more experience of the different aspects of the problem is gained. The Subcommittee agreed, as a temporary measure, that the Assistant Executive Secretary and the Secretary of the CWP keep developments of this problem under constant review through correspondence with the national authorities of the various countries to ensure that double-reporting as well as under-reporting of catches is avoided, and document experiences, problems and proposed solutions for the 1979 Meetings of the Subcommittee and the CWP.

The Subcommittee was informed that Canada has designed fishing logbooks covering three separate types of records (catches, production and transfers) for distribution to the countries whose fishing vessels will be fishing within the Canadian 200-mile zone in 1979. In preparing these logbooks, the Canadian authorities took into account the CWP recommendations regarding standard elements for fishing sheets and logbooks. Several members of the Subcommittee expressed an interest in these logbooks, and the Subcommittee requested that the ICNAF Secretariat obtain sample copies of the forms for distribution to Member Countries and Eurostat through its Circular Letter series.

The CWP Secretary explained that the CWP, at its 9th Session, decided to develop a 3-alpha identifier for the North Atlantic species to be used by both ICNAF and ICES in their publications and by countries requiring such species identifiers for logbook purposes. The Subcommittee noted that ICES had adopted the use of the 3-alpha code for its purposes and that the ICNAF Secretariat had completed the coding of all of the species items in the ICNAF List of Species (Sum. Doc. 78/VI/22). It was indicated that work was in progress on the assignment of 3-letter identifiers to the entire list of commercial species in the Northeast Atlantic. The Subcommittee

recommends (8)

that the list of 3-alpha species identifiers developed for the Northwest Atlantic (Annex 1) be adopted for general use, with the understanding that the list will be supplemented as soon as possible to cover all of the commercial species in the North Atlantic.

The Subcommittee noted that the CWP through collaboration with other regional agencies intends to continue the development of the 3-alpha species identification system for the whole of the Atlantic. The system could even be extended to other oceans as well if supplemented by the 2-digit identifiers of the FAO Major Fishing Areas.

2. ICNAF Statistical Activities

The Assistant Executive Secretary reviewed the research and statistical activities of the Secretariat with reference to a summary of these activities in Sum. Doc. 78/VI/24.

a) ICNAF Statistical Bulletin

The Subcommittee noted that Vol. 26 for 1976 was published in December 1977. As in past years, much of the delay after the 30 June deadline for the receipt of data was due to the late submission of basic data on STATLANT 21B forms by a few countries. Since it is important that the catch and effort data be as complete as possible for computer compilation of the various tables, the Subcommittee noted that nothing much could be done to expedite the publication of the Bulletin until the perennial problem of late reporting is overcome.

b) Historical (10-year) catches of selected species

These data, presented in Sum. Doc. 78/VI/6 were reviewed. The Subcommittee agreed that these tabulations are most useful and requested that the Secretariat should continue to issue these 10-year series of catch data by species, stock area and country.

c) Advance statistics for assessment purposes

The Assistant Executive Secretary indicated that preliminary catch data by month, gear and division are required very early in the year to facilitate the work of the Assessments Subcommittee at its April Meeting. Very specific and detailed instructions for the reporting of these data are issued together with stocks of forms to be used. In addition, the request requires the reporting of biological sampling data for selected species. It was noted that only about one-half of the member countries bothered to submit their 1977 data in early 1978 and that some of the reports contained catch data for stock areas rather than by division and subdivision. Instead of the expected improvements in statistical reporting, there was a general deterioration from 1977 to 1978. The Subcommittee stressed the importance of these advance statistics to the work of the Assessments Subcommittee and urged that countries improve their reporting of data when the requirements are specified for the 1979 Meeting of the Assessments Subcommittee.

d) Statistics on discards

The Subcommittee noted that the CWP devoted considerable attention to the problems relating to the collection and reporting of discards statistics by national offices (Sum. Doc. 78/VI/2). The Subcommittee also noted the scanty amount of discard data reported for 1976 (Sum. Doc. 78/VI/21) and for 1977 (Sum. Doc. 78/VI/23), despite specific recommendations from the 1976 and 1977 Annual Meetings that countries make a special effort to report on the extent of discarding in its trawl fisheries. The available data on discards for 1976 and 1977 show that the discarded quantities of fish appear to be small in the fisheries of those few countries which submitted information. The Subcommittee welcomed the effort made to determine the extent of discarding in the Canadian offshore fishery in Subarea 3 (Res. Doc. 78/VI/67) and indicated that this study might serve as a useful guide for others to follow in their studies of the discard problem. In this regard, the Subcommittee was informed that the problem of discards was being given serious attention by Denmark in the Subarea 1 shrimp fishery, that Spain would be providing data on discards for 1977 and expected to improve the collection of such data in future years, that Canada was studying the problem of discards in its fisheries in Subarea 4, and that there was no discarding from USSR vessels due to the presence of fish meal reduction facilities. The Subcommittee agreed that a "change in strategy" was necessary. It was proposed that the usual annual request for discard data be discontinued but that the Secretariat make a special effort through correspondence with the appropriate authority in each country to obtain information on the significance of discarding by all or portions of its fishing fleet. It was also proposed that the presence or absence of a meal plant be included with the information required for the list of fishing vessels. The Subcommittee agreed that the Secretariat should pursue these proposals.

e) Adequacy of national data reporting

The Assistant Executive Secretary informed the Subcommittee about an apparent general deteriora-

tion in the reporting of statistical data up to the present time in 1978. Despite the 15 April 1978 deadline for the receipt of STATLANT 21A nominal catch statistics for 1977, the number of returns received by the Secretariat by 15 May 1978 was insufficient to warrant the preparation of the usual advance release of 1977 nominal catches of all species by division and country. Instead, the provisional 1977 data were compiled in summary form by subarea only (Sum. Doc. 78/VI/28). Some of the data used were derived from sources other than the STATLANT 21A reports and were not suitable for compilation by division and subdivision. The perennial lack of attention to reporting deadlines on the part of some countries continues to cause undue delays in the publication of statistical reports.

The Canadian representative reported that a comparative study of data on catches in the 200-m mile zone from three different sources indicated discrepancies of as much as 1,000 tons for some stocks, which suggests a lack of consistency in reporting by some countries and thus casts some doubt on the quality of the statistics. The Subcommittee considered it useful to obtain from each member country a detailed description of its national system of statistical collection and processing. It was observed that ICES, Eurostat, and FAO have recognized the need for such national descriptions as part of an overall review of the quality, coverage and consistency of the data provided through these national systems. The Subcommittee

recommends (21)

that each member country submit to the Secretariat prior to the 1979 Annual Meeting a detailed description of its national system of collecting and processing fisheries statistics.

f) Review of STATLANT forms and instructions for their completion

The Subcommittee was informed that no significant changes were proposed in the STATLANT 21A and 21B forms or in the instructions for completing the forms.

3. Review of ICNAF Sampling Program

a) Sampling Yearbook, Vol. 20 for 1975

The Assistant Executive Secretary reported that this volume was published in December 1977 following the receipt of revisions to the provisional lists for 1975 (Sum. Doc. 77/VI/5). The provisional lists for 1976 are contained in Sum. Doc. 78/VI/4. Scientists are urged to check these lists against national files and report any revisions and additions to the Secretariat as soon as possible.

The Subcommittee noted that the Secretariat had computerized the data for 1973 to 1976 and have been supplying computer printouts of the data to scientists and laboratories upon request. An example of the type of computer output is given in *ICNAF Redbook* 1977, page 70.

b) Adequacy of sampling data

The Subcommittee reviewed Sum. Doc. 78/VI/11, which provides information on the sampling efficiency for most of the major fisheries in the Northwest Atlantic for 1976. Some slight improvement in sampling efficiency was noted, but it was pointed out that sampling was still very inadequate for many stocks. The Subcommittee noted the usefulness of the information provided in this document and requested that the Secretariat continue to compile the material, but on a monthly basis rather than quarterly. The Assistant Executive Secretary observed that this change in presentation of the material would not involve additional work.

The Subcommittee noted that the other three subcommittees (Assessments, Biological Surveys, and Environmental) have all indicated the need for improvements in the sampling of the commercial fisheries. In particular, the Subcommittee

recommends (10)

that member countries fishing the following stocks make a special effort to sample their commercial catches in 1978 and subsequent years: (i) cod in Div. 2G and 2H; (ii) cod in Div. 3M; (iii) redfish in Div. 3M; (iv) redfish in Div. 3L and 3N; and (v) argentine in Div. 4V, 4W and 4X.

The Subcommittee noted, with reference to Sum. Doc. 78/VI/11, that there were many instances of inadequate or the complete lack of sampling by several countries with significant fisheries in the Northwest Atlantic, and urges that each country examine its sampling program with a view to improving the spatial and temporal coverage in relation to its commercial fisheries.

c) Review of requirements for reporting sampling data

The Subcommittee reviewed the requirements for reporting sampling data, noting the standards used for reporting data (up to 1977) would have to be significantly modified for 1978 and future years. It was indicated that Canada had, in the autumn of 1977, prepared a sampling form for completion by countries fishing within its 200-mile zone. The Assistant Executive Secretary indicated that the Secretariat had received a large number of such forms containing 1978 data for individual samples. He pointed out that an intermediate transcription of the data was required in order to prepare the data for computer processing. The Canadian representative indicated that the form is still in the provisional phase and that suggestions for improvement would be welcomed. It was felt that the same type of form should be used for reporting data from both inside and outside the 200-mile zone. Noting the benefits accruing to all countries through the use of a standardized format of reporting sampling data for the whole of the Northwest Atlantic, the Subcommittee

recommends (11)

i) that an ad hoc Working Group be convened by Dr W. G. Doubleday (Canada), consisting of a representative from each of Canada, an EEC member state, a member country of ICNAF which is neither a coastal state in the Northwest Atlantic nor an EEC member state, the ICNAF Secretariat, and the Chairman of the Statistics and Sampling Subcommittee;

ii) that the United States of America be invited to participate in the Working Group; and

iii) that the terms of reference of the Working Group be as follows:

- *review of the present situation,*
- *review of coastal states' positions regarding requirements for sampling data,*
- *review of the proposed NAFO Convention in relation to research and statistics,*
- *evaluation of the need for standardized reporting of individual samples,*
- *implications on the Secretariat of reporting and processing of individual samples,*
- *implications on member countries,*
- *availability of sampling data through the Secretariat,*
- *design of forms and procedures.*

The Subcommittee agreed that the Working Group should meet as soon as feasible, possibly at the time of a mid-term STACRES meeting, and report directly to STACRES if desired. Member countries are invited to participate if they so desire.

There was general consensus that the Secretariat with its direct access to a large computer through its inhouse terminal could serve as the depository for sampling data for the Northwest Atlantic, and it was agreed that the Secretariat continue to maintain and update, as required, its current base of sampling data (including data for 1977) in accordance with previously established standard reporting procedures.

4. List of Fishing Vessels

The Subcommittee noted that the Secretariat had compiled and issued the list of fishing vessels for 1976 (Sum. Doc. 78/VI/5) in accordance with the procedure recommended by STACRES. The Assistant Executive Secretary pointed out that the list was incomplete in that no reports were received from Denmark (F), Iceland, Romania, Spain and USA. He indicated that the request for the 1977 data was issued early in 1978 and that these data would be published in the *ICNAF List of Vessels* series in accordance with the recommendation of STACRES at the 1977 Annual Meeting (*ICNAF Redbook* 1977, pages 41 and 69). Since practically all fishing vessels are now diesel powered, the Subcommittee agreed that the column "Engine Type" could be deleted and footnotes used to indicate deviations from the use of diesel power. Noting that the presence or absence of a reduction plant on fishing vessels could provide general information on discarding practices, the Subcommittee

recommends (12)

that a column in the List of Vessels be provided to indicate the presence or absence of reduction facilities on each vessel.

The Subcommittee was informed that all countries fishing within the Canadian 200-mile zone provide the coastal state authorities with the details about each vessel licenced to fish within these waters. To avoid much duplication in reporting, the Subcommittee requested the Secretariat to investigate the possibility of obtaining the annual lists of vessels of the various countries fishing within the 200-mile zones directly from the coastal state authorities and the lists of vessels fishing outside the 200-mile zones directly from the countries involved.

5. International Observer Programs

The Subcommittee was informed of several programs conducted in 1977, and it noted the importance of establishing which of the collaborating countries should be assigned the responsibility of submitting the relevant data to the Secretariat for incorporation in its data base. After considering the possible alternatives, the Subcommittee suggested that the bilateral agreements between the countries involved should include clauses specifying the country to be responsible for reporting so as to ensure that the results of such observer programs are submitted to the Secretariat.

6. Review of Relevant Research Documents

The Subcommittee noted that several research documents contained material of direct interest to its activities. It briefly reviewed the relevant sections of Res. Doc. 78/VI/3, 4, 5, 6, 8, 49 and 55, noting that these papers had already been considered in other subcommittees. In particular, the Subcommittee noted that STACRES at its Special Meeting in February 1978 (Part B, this volume) had agreed to the adoption of the standards and procedures outlined in Res. Doc. 78/VI/5 as a general guide for the biological sampling of *Illex*.

7. Other Matters

a) The Subcommittee noted that STACRES at its Special Meeting in November 1977 had agreed to the extension of Statistical Area 0 to latitude 78°10'N, with Div. 0B corresponding to the old Statistical Area 0 and the area to the north of 66°15'N and to the west of Subarea 1 to be named Div. 0A. It was also noted that the western boundary of Statistical Area 0 now extends northward along the coasts of Baffin, Bylot, Devon and Ellesmere Islands and follows the 80°W longitude meridian in the waters between these islands.

b) The Subcommittee requested the Secretariat to compile in a document the details about sampling standards adopted by STACRES over the years so that the information would be available for use by the various subcommittees in a compact form.

8. Acknowledgement

The Chairman expressed his appreciation to representatives and observers, and especially to Mr Gertenbach, Secretary of the CWP, for their active participation in the activities of the Subcommittee.

ANNEX 1. LIST OF COMMERCIAL SPECIES ITEMS FOR THE NORTHWEST ATLANTIC AND THEIR 3-ALPHA IDENTIFIERS

In the following list of Northwest Atlantic species items, the 3-alpha identifiers adopted by STACRES for general use are given in the second column. The extension of the list of 3-alpha identifiers to cover all commercial species in the North Atlantic is in progress, and the Secretary of the CWP (Coordinating Working Party for Atlantic Fisheries Statistics) plans to extend such a list to include the whole of the Atlantic Ocean. The 3-digit codes listed in the first column were designed only for use by the Secretariat in data-processing and are unique for the ICNAF list of species.

COMPUTER CODE	3-ALPHA IDENTIFIER	ENGLISH NAME	SCIENTIFIC NAME
***		PRINCIPAL GROUNDFISH	
101	COD	ATLANTIC COD	GADUS MORHUA
102	HAD	HADDOCK	MELANOGRAMMUS AEGLEFINUS
103	RED	ATLANTIC REDFISHES	SEBASTES SPP.
104	HKS	SILVER HAKE	MERLUCCIUS BILINEARIS
105	HKR	RED HAKE	UROPHYCIS CHUSS
106	POK	POLLOCK (=SAITHE)	POLLACHIUS VIRENS
***		FLATFISHES	
112	PLA	AMERICAN PLAICE	HIPPOGLOSSOIDES PLATESSOIDES
114	WIT	WITCH FLOUNDER	GLYPTOCEPHALUS CYNOGLOSSUS
116	YEL	YELLOWTAIL FLOUNDER	LIMANDA FERRUGINEA
118	GHL	GREENLAND HALIBUT	REINHARDTIUS HIPPOGLOSSOIDES
120	HAL	ATLANTIC HALIBUT	HIPPOGLOSSUS HIPPOGLOSSUS
122	FLW	WINTER FLOUNDER	PSEUDOPLEURONECTES AMERICANUS
124	FLS	SUMMER FLOUNDER	PARALICHTHYS DENTATUS
125	FLD	WINDOWPANE FLOUNDER	SCOPHTHALMUS AQUOSUS
129	FLX	FLATFISHES (NS)	PLEURONECTIFORMES
***		OTHER GROUNDFISH	
132	ANG	AMERICAN ANGLER=GOOSEFISH	LOPHIUS AMERICANUS
136	SRA	ATLANTIC SEAROBINS	PRIONOTUS SPP.
138	TOM	ATLANTIC TOMCOD	MICROGADUS TOMCOD
142	CUN	CUNNER	TAUTOGOLABRUS ADSPERSUS
144	USK	CUSK (=TUSK)	BROSME BROSME
148	GRC	GREENLAND COD	GADUS OGAC
152	LIN	LING	MOLVA MOLVA
154	LUM	LUMPFISH (=LUMPSUCKER)	CYCLOPTERUS LUMPUS
158	KGF	NORTHERN KINGFISH	MENTICIRRHUS SAXATILIS
160	PUF	NORTHERN PUFFER	SPHOEROIDES MACULATUS
164	OPT	OCEAN POUT	MACROZOARCES AMERICANUS
166	POC	POLAR COD	BOREOGADUS SAIDA
168	RNG	ROUNDNOSE GRENADIER	MACROURUS RUPESTRIS
172	SAN	SANDEELS (=SAND LANCES)	AMMODYTES SPP.
174	SCU	SCULPINS	MYOXOCEPHALUS SPP.
176	SCP	SCUP	STENOTOMUS CHRYSOPS
180	TAU	TAUTOG	TAUTOGA ONITIS
182	TIL	TILEFISH	LOPHOLATILUS CHAMAELEONTICEPS
186	HKW	WHITE HAKE	UROPHYCIS TENUIS
188	CAT	WOLFFISHES (=CATFISHES)	ANARHICHAS SPP.
199	GRO	GROUNDFISH (NS)	...
***		PRINCIPAL PELAGIC FISH	
202	HER	ATLANTIC HERRING	CLUPEA HARENGUS
204	MAC	ATLANTIC MACKEREL	SCOMBER SCOMBRUS

COMPUTER CODE	3-ALPHA IDENTIFIER	ENGLISH NAME	SCIENTIFIC NAME
***		OTHER PELAGIC FISH	
212	BUT	ATLANTIC BUTTERFISH	PEPRILUS TRIACANTHUS
216	MEN	ATLANTIC MENHADEN	BREVOORTIA TYRANNUS
220	SAU	ATLANTIC SAURY	SCOMBERESOX SAURUS
224	ANC	BAY ANCHOVY	ANCHOA MITCHILLI
228	BLU	BLUEFISH	POMATOMUS SALTATRIX
232	CVJ	CREVALLE JACK	CARANX HIPPOS
236	FRI	FRIGATE TUNA	AUXIS THAZARD
240	KGM	KING MACKEREL	SCOMBEROMORUS CAVALLA
244	SSM	SPOTTED SPANISH MACKEREL	SCOMBEROMORUS MACULATUS
252	SFA	SAILFISH	ISTIOPHORUS PLATYPTERUS
256	MLW	WHITE MARLIN	TETRAPTURUS ALBIDUS
260	MLB	BLUE MARLIN	MAKAIRA NIGRICANS
264	SWO	SWORDFISH	XIPHIAS GLADIUS
272	ALB	ALBACORE TUNA	THUNNUS ALALUNGA
274	BON	ATLANTIC BONITO	SARDA SARDA
276	LTA	LITTLE TUNA	EUTHYNNUS ALLETTERATUS
278	BET	BIGEYE TUNA	THUNNUS OBESUS
280	BLF	NORTHERN BLUEFIN TUNA	THUNNUS THYNNUS
282	SKJ	SKIPJACK TUNA	KATSUWONUS PELAMIS
284	YEF	YELLOWFIN TUNA	THUNNUS ALBACARES
289	TUN	TUNAS (NS)	SCOMBRIDAE
299	PEL	PELAGIC FISH (NS)	...
***		OTHER FISH	
302	ALE	ALEWIFE	ALOSA PSEUDOHARENGUS
304	AMB	AMBERJACKS	SERIOLA SPP.
306	COA	AMERICAN CONGER	CONGER OCEANICUS
308	EEL	AMERICAN EEL	ANGUILLA ROSTRATA
310	SHA	AMERICAN SHAD	ALOSA SAPIDISSIMA
312	ARG	ATLANTIC ARGENTINE	ARGENTINA SILUS
314	CRO	ATLANTIC CROAKER	MICROPOGON UNDULATUS
316	NFA	ATLANTIC NEEDLEFISH	STRONGYLURA MARINA
318	SAL	ATLANTIC SALMON	SALMO SALAR
320	SSA	ATLANTIC SILVERSIDE	MENIDIA MENIDIA
322	THA	ATLANTIC THREAD HERRING	OPISTHONEMA OGLINUM
330	BDM	BLACK DRUM	POGONIAS CROMIS
332	BSB	BLACK SEABASS	CENTROPRISTIS STRIATA
334	BBH	BLUEBACK HERRING	ALOSA AESTIVALIS
340	CAP	CAPELIN	MALLOTUS VILLOSUS
342	CHR	CHARS (NS)	SALVELINUS SPP.
344	COB	COBIA	RACHYCENTRON CANADUM
346	POM	COMMON POMPANO	TRACHINOTUS CAROLINUS
354	SHG	GIZZARD SHAD	DOROSOMA CEPEDIANUM
356	GRU	GRUNTS(=GRUNTERS)	POMADASYIDAE
360	SHH	HICKORY SHAD	ALOSA MEDIOCRIS
370	MUL	MULLETS	MUGILIDAE
380	HVF	NORTH ATL. HARVESTFISH	PEPRILUS ALEPIDOTUS (=PARU)
390	PIG	PIGFISH	ORTHOPRISTIS CHRYSOPTERA
400	SME	RAINBOW SMELT	OSMERUS MORDAX
402	RDM	RED DRUM	SCIAENOPS OCELLATA
404	RPG	RED PORGY	PAGRUS PAGRUS (=SEDECIM)
406	RSC	ROUGH SCAD	TRACHURUS LATHAMI
410	PES	SAND PERCH	DIPLECTRUM FORMOSUM
412	SPH	SHEEPSHEAD	ARCHOSARGUS PROBATOCEPHALUS
414	SPT	SPOT CROAKER	LEIOSTOMUS XANTHURUS
416	SWF	SPOTTED WEAKFISH	CYNOSCION NEBULOSUS
418	STG	SQUETEAGUE	CYNOSCION REGALIS
420	STB	STRIPED BASS	MORONE SAXATILIS
422	STU	STURGEONS	ACIPENSERIDAE

COMPUTER CODE	3-ALPHA IDENTIFIER	ENGLISH NAME	SCIENTIFIC NAME
430	TAR	TARPON	MEGALOPS ATLANTICA
432	TRO	TROUTS (NS)	SALMO SPP.
440	PEW	WHITE PERCH	MORONE AMERICANA
452	DGS	SPINY (=PICKED) DOGFISH	SQUALUS ACANTHIAS
459	DGX	DOGFISHES(NS)	SQUALIDAE
462	POR	PORBEAGLE	LAMNA NASUS
469	SHX	LARGE SHARKS (NS)	SQUALIFORMES
479	SKA	SKATES (NS)	RAJA SPP.
499	VFF	FINFISHES(NS)	...
***		INVERTEBRATES	
502	SQL	LONG-FINNED SQUID(LOLIGO)	LOLIGO PEALEI
504	SQI	SHORT-FINNED SQUID(ILLEX)	ILLEX ILLECEBROSUS
509	SQU	SQUIDS (NS)	LOLIGINIDAE, OMMASTREPHIDAE
512	CLR	ATLANTIC RAZOR CLAM	ENSIS DIRECTUS
514	CLH	HARD CLAM	MERCENARIA MERCENARIA
516	CLQ	OCEAN QUAHOG	ARCTICA ISLANDICA
518	CLS	SOFT CLAM	MYA ARENARIA
520	CLB	SURF CLAM	SPISULA SOLIDISSIMA
529	CLA	CLAMS (NS)	PRIONODESMACEA,TELEODESMACEA
532	SCB	BAY SCALLOP	ARGOPECTEN IRRADIANS
534	SCC	CALICO SCALLOP	ARGOPECTEN GIBBUS
536	SCA	SEA SCALLOP	PLACOPECTEN MAGELLANICUS
539	SCX	SCALLOPS (NS)	PECTINIDAE
542	OYC	AMERICAN CUPPED OYSTER	CRASSOSTREA VIRGINICA
552	MUS	BLUE MUSSEL	MYTILUS EDULIS
562	CON	CONCHS	STROMBUS AND BUSYCON SPP.
564	PER	PERIWINKLES	LITTORINA SPP.
589	MOL	MARINE MOLLUSCS (NS)	MOLLUSCA
602	CRK	ATLANTIC ROCK CRAB	CANCER IRRORATUS
604	CRB	BLUE CRAB	CALLINECTES SAPIDUS
606	CRG	GREEN CRAB	CARCINUS MAENAS
608	CRJ	JONAH CRAB	CANCER BOREALIS
610	CRQ	QUEEN CRAB	CHIONOECETES OPILIO
612	CRR	RED CRAB	GERYON QUINQUEDENS
619	CRA	MARINE CRABS(NS)	...
622	LOB	NORTHERN LOBSTER	HOMARUS AMERICANUS
632	PRA	NORTHERN DEEPWATER PRAWN	PANDALUS BOREALIS
639	PAN	PINK SHRIMPS (=PRAWNS)	PANDALUS SPP.
649	CRU	MARINE CRUSTACEANS (NS)	CRUSTACEA
652	URC	AMERICAN SEA-URCHIN	STRONGYLOCENTROTUS SPP.
669	WOR	MARINE WORMS (NS)	POLYCHAETA
672	HSC	HORSESHOE CRAB	LIMULUS POLYPHEMUS
699	INV	MARINE INVERTEBRATES (NS)	INVERTEBRATA
***		SEAWEEDS	
702	SWB	BROWN SEAWEEDS	PHAEOPHYCEAE
704	SWR	RED SEAWEEDS	RHODOPHYCEAE
709	SWX	SEAWEEDS (NS)	ALGAE

APPENDIX IV. REPORT OF ENVIRONMENTAL SUBCOMMITTEE

Chairman: E. J. Sandeman

Rapporteurs: S. Akenhead, J. J. Gagnon
R. W. Trites, T. C. Wolford

The Subcommittee met at Bonn, Federal Republic of Germany, during 23-25 May 1978 to consider and report on the various matters referred to it by STACRES (see Part D of this volume for Agenda). Prior to this meeting, the Flemish Cap *ad hoc* Working Group met (22 May) to review progress to date and research plans for 1978 and 1979, and its report is appended as Annex 1.

1. Results of Meeting of Flemish Cap *ad hoc* Working Group

Research activity in 1977 and early 1978 was reviewed and it was noted that the research completed was more extensive than had been envisaged, with results being reported for vessels from Canada, Poland, USSR and USA. In reviewing new oceanographic data, it was noted that a satellite-tracking buoy on the Flemish Cap revealed an anticyclonic gyre with a period of about 20 days (Res. Doc. 78/VI/80). This suggested that, if synopticity was to be achieved, maximum survey duration for hydrographic and ichthyoplankton stations should not exceed about 5 days. The plankton and oceanographic station grid was reexamined in the light of these new observations, and it was agreed that, although the proposed grid (20 nautical miles between stations) could be regarded as the desired target, it might be necessary to modify this during some cruises to achieve coverage of the area in the time available. It was agreed that both temperature and salinity measurements should be made throughout the grid.

The Subcommittee agreed that the frequent occupation of the 47°N latitude section was a necessary part of the Flemish Cap program, and agreement was reached on a section traversing the Flemish Cap in a northwest-southwest direction (Table 1). The Subcommittee also agreed that USSR Section 7A would provide a satisfactory description of the Labrador Current influence on the Flemish Cap system and indicated the desirability of occupying this section when possible (Table 2).

Table 1. List of proposed positions on the NW/SE Flemish Cap section.

Position		Approximate	Position		Approximate
Latitude	Longitude	depth (m)	Latitude	Longitude	depth (m)
49°24'N	45°52'W	3100	47°19'N	44°51'W	175
48°56'N	45°42'W	2250	47°00'N	44°51'W	130
48°36'N	45°31'W	1400	46°41'N	44°30'W	250
48°17'N	45°21'W	800	46°21'N	44°21'W	3500
47°57'N	45°11'W	310	46°02'N	44°11'W	4150
47°38'N	45°01'W	260	45°43'N	44°02'W	4800

Table 2. Approximate positions for USSR Section 7A. (Positions taken from R/V *Protsion* cruise, 23 April-17 June 1970, Stations 102-116.)

Position		Position		Position	
Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
49°20'N	46°19'W	48°06'N	47°46'W	47°39'N	48°30'W
48°58'N	46°42'W	48°00'N	47°55'W	47°24'N	48°55'W
48°38'N	47°05'W	47°56'N	48°03'W	47°05'N	49°26'W
48°17'N	47°28'W	47°51'N	48°10'W	46°40'N	50°08'W
48°11'N	47°37'W	47°47'N	48°18'W	46°20'N	50°44'W

Survey plans for 1978-79 were reviewed, indicating the active participation of Canada, Cuba, Poland, USSR and USA in the program (Table 3). Preliminary plans for 1979 indicate that a rather satisfactory research vessel coverage will be achieved throughout the periods of spawning and early larval stages of cod. Investigations will be focused on the adults and on the ichthyoplankton communities as well as achieving a satisfactory description of the oceanographic regime in the area. Some discussion was devoted to methodology and the intercalibration of the different equipment to be used. Although it was not possible to develop detailed survey procedures during this meeting, it was agreed that participating research vessels should, if possible, come to St. John's, Newfoundland, for consultation with

Canadian scientists before starting the survey program. This would allow better coordination of survey plans and procedures, intercalibration of equipment, and the dissemination of current oceanographic data available from MEDS.

Table 3. Preliminary survey plans for Flemish Cap[1], 1979.

	Biomass	Plankton	Hydrography	Special Studies
Jan	-	-	-	Canada (current meters, drifting buoys)
Feb	Canada	Canada	Canada, USA	USSR (gear comparisons)
Mar	-	-	-	-
Apr	USSR	-	-	USSR
May	-	Canada, USSR Poland	Canada, USSR Poland, (Cuba)?	-
Jun	USSR, Cuba	USSR	Canada, USSR	-
Jul	USSR	Canada, USSR	Canada, USSR	USSR
Aug	-	USA	USA	-
Nov	-	-	Canada	Canada (diurnal migration)

[1] The USSR research vessel *Persey III* may be available in the autumn of 1979 but dates could not be provided at this time.

The Subcommittee endorsed the view of the Working Group that oceanographic data should be made available to participating scientists as soon as possible, and therefore

recommends (13)

that all countries participating in the Flemish Cap Project transmit temperature and salinity data by radio using the Integrated Global Ocean Station System (IGOSS).

The Subcommittee noted the Working Group's concern that analytical assessments of the commercial fish stocks on Flemish Cap have not been possible due to the lack of adequate sampling data, and

recommends (14)

that countries fishing the Flemish Cap area make a special effort to obtain biological sampling data from the commercial fishery.

2. Report of Progress on Gulf of Maine-Georges Bank Project on Herring

The Subcommittee was informed that Dr Grosslein, Task Force Leader of the Larval Herring Program, expressed his regrets for being unable to attend the present meeting. However, his provision of briefing material to the Chairman of the Subcommittee was a valuable aid to discussion on this topic. Additionally, a number of research documents were reviewed (Res. Doc. 78/VI/20, 69, 73, 78, 79).

The larval herring program, which has been carried out on an international cooperative basis since 1971, was continued along similar lines in 1977. An important aspect of the program has been the repeated occupation of a network of oceanographic stations which includes the sampling of herring larvae. The production of larvae (<10 mm long) on Georges Bank and Nantucket Shoals was an order of magnitude greater in 1973 and 1974 than in 1971 and 1972, intermediate in 1975, and virtually nil in 1976. Production in 1977 was low but not as low as in 1976.

A major international multi-disciplinary, multi-ship larval herring patch experiment is planned for mid October-early November 1978 in the Georges Bank area. Patch studies of this nature involve identifying on the spawning ground and following a relatively small and isolated patch of larval herring to provide real-time (of the order of hours and days) estimates of larval growth, mortality and dispersion relative to short-term variations in the physical and biological environment. The study will initially focus on Georges Bank during the first 10-12 days. During this period, current meters will be moored at 6 sites and areal and temporal measurements will be taken to define the basic physical oceanographic features of the northern edge of Georges Bank. Other ships will be simultaneously carrying out a broad-scale search for larvae. Highest priority search areas will be on the northeast part of Georges Bank and on the Nantucket Shoals. If a larval patch is located, intensive vertical and horizontal

sampling will ensue, measuring as many of the biological and physical properties as feasible. The intensive small-scale measurements will be undertaken by several ships (*Albatross IV, Dawson, Lady Hammond* and *Anton Dohrn*). It is anticipated that relevant information on the broad-scale larval distribution and physical features will be obtained by five additional vessels operating in the Georges Bank-Gulf of Maine areas during the period in which the patch experiment is being carried out.

The task force leader for the patch experiment is Dr Gregory Lough of the Northeast Fisheries Center, Woods Hole, Mass., who can supply copies of the detailed study plan for the experiment.

3. Review of Environmental Conditions in the ICNAF Area during 1977

At the 1977 Annual Meeting, it was agreed that the annual review of environmental conditions would be more valuable if a unified document could be prepared prior to the meeting. Accordingly, the desire was expressed that MEDS should prepare the assessment of 1977 conditions for the presentation to the 1978 Meeting. It was recognized that this would require the prompt submission of environmental data to MEDS and a rapid analysis of the data in order for MEDS to meet the desired schedule for reporting. Although MEDS has not found it possible to achieve this for 1977, a start was made and limited data summations were produced and presented in a working paper. The Subcommittee welcomed the progress made by MEDS toward the desired goal and expressed its continued interest in and support for the project.

The following highlights of environmental conditions in the ICNAF Area in 1977 are based on information extracted from various meeting documents, working papers and oral presentations.

a) Subarea 1

Environmental conditions were investigated by Denmark (Sum. Doc. 78/VI/12) and Federal Republic of Germany (Res. Doc. 78/VI/65). Danish data, collected throughout 1977 along standard oceanographic sections on Fyllas Bank, Lille Hellefiske Bank and off Holsteinsborg, indicate that temperature conditions were above normal in July, with values 0.61°C higher than the mean for the relatively warm 1950-66 period. Temperatures up to 2.5°C were observed on the northern banks. The strong inflow of Irminger Current water, which usually occurs in November-December, was already present in September. Above-normal temperatures were also observed in January and February 1978 along the Fyllas Bank section. Data from the survey by Federal Republic of Germany in November 1976 indicated rather warm conditions off West Greenland at the time. However, the deep layers, which are strongly influenced by the warm component of the West Greenland Current, were up to 0.76°C colder than normal. It should be noted that the Danish observations in 1977 confirmed the forecast of USSR scientists that summer temperatures in 1977 should be above normal (*ICNAF Redbook* 1977, page 79).

b) Subarea 2

Environmental data were presented by USSR (Res. Doc. 78/VI/70, 71), Canada (Sum. Doc. 78/VI/20), and Federal Republic of Germany (Res. Doc. 78/VI/81). USSR temperature measurements of the Labrador Current were carried out in the spring, summer and autumn of 1977. Comparisons both with the long-term average and with the 1976 temperatures revealed positive anomalies ranging from 0.2°C to 1.9°C in the Baffin Island and Labrador areas. Maximum positive anomalies were found in the 50-200 m layer, apparently caused by the inflow of warm Atlantic water to the shelf and slope off Baffin Island and Labrador. Temperature and salinity observations by Federal Republic of Germany in early December 1977 showed a warming of the Labrador Current up to 1.6°C above the calculated mean temperatures. The maximum positive anomalies, both in temperature and salinity, were observed in the 50-200 m layer, and are in agreement with conditions reported by USSR scientists for the autumn of 1977. Canadian environmental research activities consisted of a study of the Labrador Current from Hudson Strait to Belle Isle Strait, including the mooring of 4 current meters across Nain Bank to the outer slope of the continental shelf to cover the period from October 1977 to the summer of 1978. Nineteen temperature, salinity, oxygen and nutrient sections across the shelf to the outer slope between Hudson Strait and Belle Isle Strait were occupied. Along the Seal Island section in early August, the surface and 10 m temperatures (except for the two most seaward stations) were lower than those for 1976 and considerably lower than the 1951-71 average. At the most seaward stations, the temperatures were higher in 1977, indicating that the inflow of the Irminger Current was much stronger than in previous years.

c) Subarea 3

Environmental data were reported by USSR, Canada and USA, with special attention to conditions on Flemish Cap in Div. 3M (Sum. Doc. 78/VI/9, 20; Res. Doc. 78/VI/23, 70, 71, 72). All reports indicated a larger-than-normal volume of warm water in the bottom or deep layers during 1977, with only short-term negative anomalies for water along the southern slope of the Grand Bank. USSR surveys in late April and early July 1977 confirmed the existence of an anticyclonic gyre over the southern and central parts of the Flemish Cap. This gyre was also observed by a

satellite-tracking, undrogued, drifting buoy (Res. Doc. 78/VI/80). The gyre displayed a circular track with periodicity of 20 days. The buoy eventually left the bank in a southeasterly direction and was recovered in Ireland. An anticyclonic eddy covering most of the southern part of the Grand Bank was observed in June-July 1977. Water transport in April-May exceeded the long-term norm. Below normal salinities were observed from April to June 1977.

d) Subareas 4 and 5

Environmental data for 1977 were reported by Canada, Cuba, Federal Republic of Germany, German Democratic Republic, Poland, USSR and USA (Sum. Doc. 78/VI/9, 20, 29; Res. Doc. 78/VI/78, 79). Oceanographic events in Subareas 4 and 5 appear to be influenced to a large extent by the offshore slope water front, the warm-core Gulf Stream eddies and meteorological conditions. Although very few data were reported for the northeastern part of Subarea 4, the available observations indicated that the temperatures of the deep water in the Laurentian Channel were often above 6°C and among the highest ever recorded. An unusually large number of warm-core Gulf Stream eddies passed through the slope water adjacent to the continental shelf in the Scotian Shelf and Georges Bank areas, as well as in areas further to the south. An incursion of surface slope water on the southwest edge of the Scotian Shelf and into the Northeast Channel occurred in September 1977. A mixture of this water entered the Bay of Fundy-Gulf of Maine system.

The strong cooling conditions during the winter of 1976-77 produced slightly (about 1°C) cooler-than-usual temperatures in the upper water layers of the Gulf of Maine. However, the most significant difference between 1977 and previous years was a decrease in the volume of warm saline slope water (>8°C) introduced into the Gulf of Maine at depths of 180 m and greater. In 1976, 8°C water existed below 150 m in every transect, whereas in 1977 these temperatures were not evident during March to October. This reduced inflow of slope water may have caused the surface salinities, as observed in 1977, to be less (0.2 to 1.0 ‰) than those in 1976. The high salinity on Georges Bank during the winter of 1976/77, which in February was more than 1 ‰ greater than the average, was the highest ever recorded (>34 ‰). It is thought that this was the result of wind-driven transport of water with a higher salinity than was present in the Gulf of Maine.

The Northeast Fisheries Center at Woods Hole, Mass., is conducting a 2-year experiment in the Northeast Channel with an array of moored current meters. During the initial 6-month period, maximum velocities were >115 cm/sec at 100 m and >80 cm/sec at the bottom. Mean current velocities varied from 2 to 10 cm/sec, and all were directed into the Gulf of Maine nearly along the axis of the Channel. The coherence between axial current at 100 m and surface wind stress was significant for periods of 4-10 days and was 180° out of phase, indicating that offshore wind stress drives a deep inward return flow with no significant phase lag.

4. Marine Environmental Data Service (MEDS)

a) Progress report for 1977/78

Approximately 1,200 fully processed temperature-salinity oceanographic stations collected during the 1977 calendar year were entered into the ICNAF data bank. These data were collected by Canada, German Democratic Republic, Poland and USSR. Cruise tracks, standard section vertical plots, plan-view area cruise plots, temperature-salinity diagrams and geopotential anomaly plots of these data were reviewed by the Subcommittee. The MEDS representative indicated that historical data collected by the Polish research vessel *Wieczno* during larval herring surveys in Subarea 5 from 1970 to 1977 had recently been received. Also, he acknowledged receipt of real-time oceanographic data for May 1978 from the USSR vessel *Protsion*.

The main efforts by MEDS during 1977 and early 1978 were concentrated on reviewing a possible mechanism for rapid exchange of oceanographic data via the Integrated Global Ocean Station System (IGOSS). During a cruise of the *Dawson* (181077028), a total of 11 BATHY and 2 TESAC messages were sent to the nearest marine radio station and were successfully relayed to Maritime Command Headquarters, Meteorological and Oceanographic Centre (METOC) in Halifax, Nova Scotia. These messages were not relayed onto the Global Telecommunications System (GTS). With the cooperation of Polish scientists, a member of the MEDS staff participated in a recent cruise of the research vessel *Wieczno* (67WI178004, 18 April-1 May 1978) and coded 80 BATHY messages which were transmitted to the coastal radio station at St. John's, Newfoundland. Forty-four messages were confirmed as received at METOC (Halifax) and relayed onto the GTS. The loss of some messages was mainly attributed to errors in initialization (e.g. 55XX instead of JJXX) and improper ground routing of teletype information. The MEDS representative suggested that vessels sending BATHY or TESAC messages to Canadian East Coast or Eastern Arctic marine radio stations should include the heading "FOR WMF".

The Subcommittee noted that quality control procedures during the input of oceanographic data must be rigid in order to achieve the highest possible quality of output. The continuing lack

of success by MEDS in acquiring all physical oceanographic data for the ICNAF Area was discussed at some length. The single most important gap was identified as the USSR data. The problem appears to be within the MEDS/World Data Centre A/World Data Center B chain, since it was reported that all of the USSR data have been submitted to World Data Center B. The subcommittee resolved that a concerted effort should be made to determine the cause of the problem and to rectify it. It was agreed that a team of three representatives (Mr Gagnon, Dr Wolford, and a USSR representative to be named) should be established to investigate the problem and provide a written report for consideration by the Subcommittee at the 1979 Annual Meeting. It was agreed that high priority should be given to resolving the problem.

The problems involved in producing a unified review of environmental conditions in the preceding year for distribution prior to the Annual Meeting were discussed. It was indicated that all data for the preceding year would have to be submitted to MEDS no later than 1 March. The members of the Subcommittee agreed to make every effort to meet this deadline, although, in the case of USSR, the data would be submitted via World Data Center B rather than directly to MEDS. Since USSR data are normally submitted to World Data Center B within 10 days from the end of a cruise, MEDS should have no difficulty in obtaining the data by the 1 March deadline, provided that the current exchange difficulties through the data centers can be overcome.

b) Data products presently produced and envisaged

In order to provide synoptic oceanographic information for the Flemish Cap area, the first objective of MEDS will be to install a link to the Global Telecommunications System (GTS) at its headquarters in Ottawa, Canada, in order to access all BATHY and TESAC information. This link is scheduled to be in operation in the autumn of 1978 in coordination with FGCE buoy data acquisition at MEDS. During the Flemish Cap Project, MEDS will maintain a data base of all BATHY and TESAC information transmitted for the area. Limited relatime quality control checks consisting of range-rate and parameter limits will be performed on the incoming data.

In a realtime mode (one or two days after receipt of BATHY and TESAC messages), MEDS will produce:

i) station report computer listings of the observed, calculated and interpolated parameters; and

ii) graphic displays as follows:

- parameter versus depth plots,
- parameter versus parameter plots, and
- horizontally-contoured parameter at depth plots for selected groups of stations.

In a non-realtime mode (one or two days after completion of the cruise, i.e. receipt of last message), MEDS will produce:

i) plot of the cruise track;

ii) temperature versus salinity plot of all data collected during the cruise;

iii) bottom temperature contoured plot;

iv) horizontally-contoured parameters-at-depth plots, with emphasis on sea-surface temperature plots, for inter-comparison with IGOSS charts; and

v) vertically-contoured section plots of data collected along proposed sections.

The Subcommittee suggested that water mass analysis for the entire ICNAF Area should be undertaken, noting that this might provide another useful data product during the Flemish Cap Project.

c) National representatives for data exchange

The Subcommittee was informed of a number of changes in the list of national representatives responsible for submitting oceanographic data to MEDS. The updated list is as follows: Cuba (J. Gomez); Denmark (P. Kanneworff); France (G. Stanislas); Federal Republic of Germany (D. Kohnke); German Democratic Republic (B. Schreiber); Japan (F. Nagasaki); Norway (R. Leinebo); Poland (A. Piotrowski); USSR (V. Ponomorenko); UK (P. Edwards); and USA (R. Ochinero).

d) Experimental use of ROMBI forms

Due to the lack of participation by member countries, the Subcommittee agreed to discontinue any further attempts to obtain summaries of biological data on ROMBI forms.

e) Annual inventory of oceanographic stations

The inventory form, approved for use at the 1977 Annual Meeting, was distributed by the Secretariat to all member countries. To date, responses have been received from Canada, Federal Republic of Germany, German Democratic Republic, Poland, USSR and USA, and the data for 1977 are summarized by subarea in Table 4. A total of 2,561 stations were occupied where temperature and salinity measurements were taken. In addition the inventory reports indicated a total of 1,630 stations where temperature only was measured. The inventory is undoubtedly incomplete due to the absence of reports from some countries, which are known to have collected data in the ICNAF Areas as can be inferred from scanning research reports and other meeting documents.

Table 4. Summary of information compiled from inventories of oceanographic stations submitted to MEDS for 1977.

Subarea	Country	Season	Type of data	Total stations
1	Fed. Rep. Germany	Oct-Dec	T, S	5
2	Fed. Rep. Germany	Oct-Dec	T, S	44
2	Canada	Oct-Dec	T, S	125
2, 3	USSR	Jan-Mar	T, S	35
3	USSR	Apr-Jun	T, S	306
3	Canada	Jul-Sep	T, S	83
3	USSR	Jul-Sep	T, S	92
3, 6	Canada	Oct-Dec	T, S	80
4	Canada	Jan-Mar	T, S	92
4	Canada	Apr-Jun	T, S	396
4	Canada	Oct-Dec	T, S	12
4, 5	Fed. Rep. Germany	Jan-Mar	T, S	52
4, 5	German Dem. Rep.	Jan-Mar	T	83
4, 5	USA	Apr-Jun	T, S	30
4, 5	Canada	Jul-Sep	T, S	591
4, 5	USA	Jul-Sep	T, S	18
4, 5	USSR	Jul-Sep	T, S	120
4, 5	USA	Oct-Dec	T, S	91
4, 5, 6	USSR	Oct-Dec	T, S	142
5	USA	Jan-Mar	T, S	104
5	Poland	Oct-Dec	T, S	60
		Total	(T, S)	1561

The Subcommittee encouraged the continued use of these forms. However, a revised form was approved for use in reporting data for the current calendar year, and copies will be distributed by the Secretariat as soon as they are received from MEDS.

5. Standard Oceanographic Sections and Stations

New charts for the west coast of Greenland (available from Greenland Geological Survey, Østervoldgade 10, DK-1350 Copenhagen K, Denmark) and having 10-m contours indicate that the listed depths for some of the stations off West Greenland are erroneous. Mr Kanneworff agreed to provide the Secretariat with corrections so that an update of the List of Standard Sections and Stations published in *Selected Papers* No. 3 can be prepared and distributed.

6. Plankton Studies

a) Continuous plankton recorder results for 1976 and 1977 (Res. Doc. 78/VI/68, 75)

The plankton recorder series for 1976 and 1977, summaries of which were prepared by the UK Institute of Marine Research, continued to provide interesting information for Subareas 1, 2 and 3 (sampling in Subareas 4 and 5 was low). The rather warm saline water in the autumn of 1977 produced a particularly rich autumn bloom of phytoplankton. The copepod development in Subareas 1 and 2 in 1977 was at least a month later than usual, and numbers were low in Subarea 3. In 1976, copepods were abundant in Subarea 3 and production in Subareas 1 and 2 was also good.

b) Report of Scotian Shelf Ichthyoplankton Workshop (Res. Doc. 78/VI/21)

Canadian scientists are developing an extensive ichthyoplankton program for the Scotian Shelf,

and a report of an international planning workshop was reviewed (Res. Doc. 78/VI/21). Intensive sampling, using recently developed technology including submersible particle counters, is planned on about 8 cruises per year. In addition to this multi-species monitoring program, a larval silver hake patch study is being considered. The Subcommittee noted that plankton monitoring several times a year with standard sampling techniques now covers almost all of Subareas 4 and 5, and anticipates valuable information from these investigations.

c) Other plankton studies (Res. Doc. 78/VI/18)

The Subcommittee reviewed the report of a 162-station plankton survey of the Scotian Shelf carried out in the autumn of 1977 through a joint USSR-Canada program, emphasizing silver hake eggs and larvae. The distribution of the eggs correspond well to observed spawning locations, and the larvae, which were more widespread, seemed to be associated with high seston volumes. Both the silver hake larvae and the seston were probably associated with areas of upwelling water.

7. Other Matters

A study of the feeding of the short-finned squid (*Illex illecebrosus*) and the long-finned squid (*Loligo pealei*) (Res. Doc. 78/VI/74) confirmed that these species are predators, with crustaceans and fish forming a large part of the diet of smaller and larger squid respectively. On Georges Bank, the daily ration of *Illex* with mantle lengths of 19-25 cm was 5.8% of the body weight. On the Nantucket Shoals, the daily ration of *Loligo* with mantle lengths of 8-15 cm and 16-30 cm was 3.8% and 3.2% of body weight respectively.

8. Future Meeting of the Working Group

The Subcommittee agreed that the *ad hoc* Working Group on the Flemish Cap Project should meet in advance of the 1978 Annual Meeting, preferably just before or just after the 1979 Meeting of the Assessments Subcommittee and at the same place. The desirability of having physical oceanographers, who are actually involved in the Flemish Cap Project, attend the next meeting of the Working Group was expressed.

9. Acknowledgements

The Subcommittee expressed its appreciation for the support of ICNAF Secretariat, and the Chairman expressed the thanks of the Subcommittee to the Flemish Cap Working Group and particularly to its Task Force Leader, Mr R. Wells.

ANNEX 1. REPORT OF *AD HOC* WORKING GROUP ON FLEMISH CAP PROJECT

Convener: R. Wells

Rapporteur: S. A. Akenhead

The Working Group met at Bonn, Federal Republic of Germany, during 22-23 May 1978 to review progress on studies conducted on Flemish Cap in 1977-78 and to consider future plans.

1. Review of Survey Activity in 1977 and early 1978

Canada conducted random-stratified groundfish surveys on Flemish Cap in January-February 1977 and 1978, at which times the standard 47°N oceanographic section was occupied. This section was also occupied in August 1977 during the regular hydrographic cruise in Subarea 3 and again in October 1977 during the course of a plankton-hydrographic cruise. USSR research in 1977 included a total groundfish survey, a juvenile fish survey and plankton and hydrographic surveys. Extensive oceanographic work was conducted by USA (Coast Guard) in 1977 and the early part of 1978. The Polish research vessel *Wieczno* conducted a plankton-hydrographic cruise in April 1978, when oceanographic data were transmitted successfully by radio into the IGOSS system.

2. Review of Research Documents

a) Ichthyoplankton on Flemish Cap (Res. Doc. 78/VI/18)

The analysis involved about 500 ichthyoplankton samples collected by vertical plankton net tows in March-April of 1959-63, 1966 and 1970. Eggs, larvae and fry of 23 species were recorded for the area, with cod eggs and larvae, redfish larvae and American plaice eggs being the most abundant. Distribution of these species in various stages of development tended to confirm the location of spawning concentrations as observed in the commercial fisheries. The Working Group noted that small numbers of capelin larvae were observed on Flemish Cap and considered that this might be due to difficulties in species identification. The Working Group was pleased to note that USSR scientists are preparing a guide to the identification of eggs and larvae.

b) Effect of water dynamics on recruitment of cod (Res. Doc. 78/VI/23)

Geostrophic circulation patterns on the Flemish Cap, derived from USSR and USA data, confirm the presence of an anti-cyclonic gyre. The intensity of horizontal and vertical water circulation on the central part of the bank during the period of development of cod eggs and larvae was shown to be one of the main abiotic factors determining the size of cod year-classes, the abundance of which at age 2 was determined from USSR young fish surveys. The analysis seemed to imply upwelling on the central part of the bank, whereas an anti-cyclonic gyre would theoretically tend to produce downwelling. The role of bottom topography and wind fields in the formation of upwelling was discussed. The Working Group noted that, in the Northwest Atlantic, the success of year-classes for many fish stocks of the same species is often in phase, which implies that large-scale oceanographic events play a major role in the success of year-classes of fish.

c) Surface plankton on Flemish Cap (Res. Doc. 78/VI/72)

This study was based on the analysis of 152 plankton samples collected from 0-50 m on the standard oceanographic 47°N section in March-June of 1970-77. In the spring, the phytoplankton consists of a diatomaceous complex and in summer a mixed diatomaceous-peridinian community, the latter being affected by the stratification of the photic layer. Zooplankton is represented by a broad complex of animals the species composition of which tends to be rather constant from year to year.

d) General biological and oceanographic consideration (Res. Doc. 78/VI/80)

The paper reviews the general biological and oceanographic system on Flemish Cap. New information indicated the presence of an anti-cyclonic gyre on the central part of the bank. The Working Group noted the various hypotheses as they relate to the primary problem of determining the causes of variability in year-class strength of cod.

3. Oceanography of Flemish Cap

The Working Group reviewed some of the features known about the oceanography of Flemish Cap. A satellite-tracked buoy which had revealed a 20-day period gyre on the bank (Res. Doc. 78/VI/80) was undrogued and therefore influenced by winds. Nevertheless, it remained on the Flemish Cap for more than 30 days and completed one and one-half rotations before moving away to the southeast. It crossed the Atlantic to Ireland and was returned in about 10 months. Eight of these buoys with drogues will be released on the Flemish Cap by Canada during 1978-79, and a considerable amount of information is expected to be available at the time of the 1979 Annual Meeting. It was agreed that vessels of participating countries could be used on an opportunistic basis to assist in the deployment of these buoys.

The discussion about the general features of the currents in the vicinity of Flemish Cap indicated that bathymetry had the main influence on the positioning of the Labrador Current. The branch of the Labrador Current to the east of Flemish Cap is not a permanent feature (e.g. it was not present in 1966). The calculated volume transports carried out by the US Coast Guard in connection with its ice patrol work are very variable, but it was noted that this may possibly be an artifact of the technique (e.g. effects of station positioning). Data on total transport for the North Atlantic Current are not readily obtainable from the oceanographic sections occupied by the US Coast Guard during ice patrol work. It was noted that data from the area near the tail of the Grand Bank could possibly be used to determine the location of the western part of the North Atlantic Current. An interesting feature of the North Atlantic Current has been observed to the south of Flemish Cap immediately to the west of the Newfoundland Rise. In one survey, the Current was observed to be shedding small eddies which moved off to the southeast. These eddies are much smaller than those implicated in the oceanography of the Scotian Shelf. Confirmation of the history of this phenomenon in the vicinity of Flemish Cap cannot be made from US Coast Guard sections, as these do not cover the area well and the temporal resolution of their dynamic height calculations is too large. It was considered that these eddies should be observable through satellite photography.

4. Timeliness of Surveys and Standardization of Gear and Techniques

The Working Group noted that surveys should be conducted at the appropriate time of the year and that the gear should be standardized whenever possible. In any case, it was agreed that gear calibration studies should be carried out so that comparisons between surveys can be made. In the case of the total groundfish surveys by USSR, it was noted that the random-stratified design is under active consideration by PINRO scientists, although an historical series of data has been built up from line surveys. It was agreed that comparative surveys by USSR and Canada would be made in the near future to allow comparisons of absolute abundances and estimates of precision. The details of such a study would be determined in bilateral discussions. A similar case exists for the USSR ichthyoplankton series. The problem of comparability of the historic data series in which cone nets were used with data obtained using techniques developed for the coordinated larval herring surveys on Georges Bank could be approached by gear comparisons during one survey by USSR. It was suggested that scientists on vessels participating in the Flemish Cap Project might, when possible, discuss survey results and inter-calibration of gear at the St. John's Laboratory, at which time oceanographic data products from MEDS could be available.

5. Sampling of Commercial Catches

The Working Group noted that analytical assessments of the cod and redfish stocks on the Flemish Cap have not been possible due to the scarcity of commercial sampling data, and

recommends (14)

that countries fishing on the Flemish Cap make a special effort to obtain biological sampling data from their commercial fisheries.

6. Hydrographic and Plankton Surveys

a) Oceanographic transects

The Working Group reaffirmed the necessity of frequent occupation of the ICNAF standard oceanographic section along the 47°N latitude line. Agreement was reached on the desirability of occupying a section traversing the Flemish Cap in a NW/SE direction (Res. Doc. 78/VI/80). It was also agreed that USSR Section 7A should be occupied whenever possible, as the data would provide a satisfactory description of the influence of the Labrador Current on the Flemish Cap system. Approximate positions of the stations on these sections are listed in Tables 1 and 2 of the report of the Environment Subcommittee (page 93).

b) Plankton and oceanographic grid

The grid of stations proposed at the Murmansk Meeting of the Working Group (*Redbook* 1977, pages 84-85) was re-examined and some modification is shown in Res. Doc. 78/VI/80. In order to achieve synopticity in the 20-day regime of the anti-cyclonic gyre, it was indicated that each period of occupying the ichthyoplankton stations should not exceed 5 days. Although complete coverage of the proposed grid of stations (20 nautical miles apart) should be regarded as the desired target, it was noted that some modification of the plan might be necessary on some cruises in order to achieve coverage of the area in the time available. After the 5-day ichthyoplankton survey, the vessel could return to areas of interest for more detailed studies. The Working Group agreed that temperature and salinity measurements should be taken at all stations in the grid.

7. Rapid Exchange of Survey Data

The Working Group agreed that oceanographic data obtained during the Felmish Cap Project should be made

available to MEDS as quickly as possible. An experiment on the Polish research vessel *Wieczno* demonstrated the feasibility of transmitting data by radio using the Integrated Global Ocean Station System (IGOSS). Furthermore, MEDS has demonstrated the ability to provide for distribution appropriate graphic displays of data within one or two days after receipt of the data. Accordingly, the Working Group

recommends (13)

that all participants in the Flemish Cap Project transmit temperature and salinity data by radio using the Integrated Global Ocean Station System.

8. Future Research Plans

a) Canada. The St. John's Laboratory plans to continue the January series of random-stratified groundfish surveys. An extensive program of deploying satellite-tracked buoys is planned with an attempt to maintain two buoys on the Flemish Cap throughout the year. Up to 8 drogued buoys will be deployed, and a replacement made whenever one drifts off the bank. Cooperation in deploying the buoys may be required. The buoys are not to be recovered upon leaving the Flemish Cap area as they will then yield valuable information on the North Atlantic currents. Four current meter arrays will be placed at selection positions on the Flemish Cap (A, B, C and D of Fig. 8 in Res. Doc. 78/VI/80) in January 1979 and recovered in June. One array will then be replaced for a further 6-month period. All arrays will have current meters at 50 m and 100 m depths. Array D will also have a meter at 350 m and an 11 sensor thermistor chain from 310 to 400 m. Array C will have a current meter at 20 m and 11 thermistors from 20 m to 50 m. The standard 47°N hydrographic section will be occupied in July and August of each year. A study of diurnal variation in availability of groundfish on Flemish Cap is scheduled for 6-24 November 1978 and hydrographic data will be collected on this cruise.

b) Cuba. A research vessel will occupy the 47°N section in June 1978 and conduct a random-stratified groundfish survey on Flemish Cap. No plankton work is planned.

c) Poland. Although a firm commitment cannot be made at this time, it is anticipated that surveys, like the R/V *Wieczno* cruise of April 1978 but perhaps of longer duration, will be undertaken at about the same time in 1979 and successive years.

d) USA. In addition to the routine monitoring program by vessels of the US Coast Guard Oceanographic Unit, on each scheduled trip in February and August 1979, 15 days will be available for work on the Flemish Cap. It is possible that satellite-tracked buoys will be released, and plankton work will be undertaken in conjunction with hydrographic studies. In August 1978, 16 current meters in 9 arrays will be placed along Coast Guard Sections 3 and 4 and seaward of Section 3, to remain there for one year.

e) USSR. The scope of the work proposed for 1979 will be the same as that in 1978. This will include the total groundfish survey and the usual juvenile survey (begun in 1959), as well as hydrology, hydrochemistry and ichthyoplankton work. A study of trawl catchability may be conducted on the Flemish Cap and a survey specifically for redfish may be made. Four trips by four different vessels will be made in the spring, summer, autumn and winter periods.

9. Future Working Group Meetings

The Working Group agreed that an appropriate time for its next meeting might be just before or just after the April 1979 Meeting of the Assessments Subcommittee and at the same place. The desirability of having physical oceanographics, who are actually involved in the Flemish Cap Project, in attendance at the next meeting of the Working Group was noted.

PART D

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         - Argentine (4VWX)
         - Capelin (2+3K, 3LNOPs)
      iii) Stocks in the northern part of the ICNAF Area as suggested by Canada (Com. Doc. 78/VI/3) and agreed to by the EEC (Com. Doc. 78/VI/5):
         - Greenland halibut (0+1)
         - Roundnose grenadier (0+1)
         - Shrimp (0+1)
      iv) Stocks lying completely within the EEC 200-mile fisheries zone for which EEC requests scientific advice for management (Com. Doc. 78/VI/5):
         - Cod (SA 1)
         - Redfish (SA 1)
      v) As recommended by STACRES at the Meeting in Havana, Cuba, in February 1978 (see Part B this volume), regulatory measures for the squid fisheries in 1979 will also be considered. STACRES recommended "that the feasibility of an effort regulation in 1979 be further examined, requiring the submission by all countries of detailed catch and effort data for *Illex* in Subareas 3 and 4, with a view to further analysis and discussion at the April 1978 Meeting of the Assessments Subcommittee". Scientists are referred to Circular Letter 77/46 for the details of the requirements for submission of catch and effort statistics on squid
   c) Other matters.

3. Biological Surveys (Chairman: W. G. Doubleday)

   a) Systematic review of the precision of survey results from detailed data and studies to be provided by scientists of member countries (Circular Letter 78/19)
   b) Review of survey activity in 1977 and proposed survey activity in 1978 (groundfish and pelagics)
   c) Processing of survey data
   d) Progress in preparing the Manual on Groundfish Surveys
   e) Other matters

4. Statistics and Sampling (Chairman: J. Messtorff)

   a) Report of 9th session of CWP, held at ICNAF Headquarters in August 1977 (Sum. Doc. 78/VI/2)
   b) ICNAF statistical activities, 1977/78
      i) Statistical Bulletin, Vol. 26 for 1976
      ii) Historical catches of selected species by stock area and country (10-year series) (Sum. Doc. 78/VI/6)
      iii) Advance monthly statistics for selected species, 1977
      iv) Statistics on discards
      v) Adequacy of national reporting of fishery statistics
      vi) Review of STATLANT and other statistical forms and deadlines for submission
   c) ICNAF sampling program, 1977/78
      i) Sampling yearbook, Vol. 21 for 1976 (Sum. Doc. 78/VI/4)
      ii) Adequacy of sampling and national reporting of sampling data

iii) Review of requirements for sampling data, including forms, and deadlines for submission
iv) Implementation of sampling data base

d) List of vessels for 1976 (Sum. Doc. 78/VI/5), and triennial publication of the List of Vessels for 1977 (Circular Letter 78/24)
e) Scientific observer program (progress reports and disposition of data)
f) Review of relevant research documents
g) Other matters

5. Environmental (Chairman: E. J. Sandeman)

a) Report of Working Group on Flemish Cap Project (R. Wells, Convener)
b) Report of progress on Gulf of Maine-Georges Bank Project (related to herring)
c) Review of environmental conditions in ICNAF Area during 1977
d) Marine Environmental Data Service (MEDS)
i) Progress report for 1977/78
ii) Data products presently produced and envisaged
iii) National representatives for data exchange
iv) Experimental use of ROMBI forms
e) Standard oceanographic sections and stations (published in *Selected Papers* No. 3)
f) Plankton studies
i) Continuous plankton recorder results for 1976 and 1977
ii) Report of Scotian Shelf Ichthyoplankton Program Workshop (Res. Doc. 78/VI/21)
iii) Other plankton studies (Res. Doc. 78/VI/18)
g) Other matters

6. Ageing Techniques and Validation Studies

a) Report of ageing workshop on silver hake held at Dartmouth, N. S., Canada, 28 March-1 April 1978 (J. Hunt, Convener) (*Redbook* 1977, page 44; Circular Letters 78/11 and 78/14)
b) Consideration of guidelines for cod otolith interpretation, ensuing from "Report of ageing workshop on cod held at St. John's, Nfld., Canada, in February 1977 (Sum. Doc. 77/VI/12)" (*Redbook* 1977, page 44)
c) Need for further workshops and/or otolith exchange programs
d) Review of papers on validation studies
e) Other matters

7. Gear and Selectivity Studies

8. Review of Tagging Activities

a) International herring tagging program
b) Review of other tagging activities

9. Collaboration with Other Organizations

a) Status of publication of results of Greenland Salmon Tagging Experiment
b) Symposium on Biological Basis of Pelagic Fish Stock Management, to be held at Aberdeen, Scotland, 3-7 July 1978
c) Second Symposium on Early Life History of Fish, proposed by ICES for 1979
d) Special Session on the Theory and Application of Sampling Systems and Statistical Data Analysis in Fisheries Science, to be held during 66th Statutory Meeting of ICES, Copenhagen, October 1978
e) Ninth Session of the Coordinating Working Party on Atlantic Fisheries Statistics (CWP), held at ICNAF Headquarters, Dartmouth, Canada, 17-23 August 1977 (Sum. Doc. 78/VI/2)

10. Steering and Publications

a) Review of Subcommittee membership
b) Review of meeting timetable and agenda
c) Organization and operation of STACRES and its Subcommittees
d) Review of ICNAF publications
e) Review of editorial policy relating to Research Bulletin and Selected Papers series
f) Consideration of research documents for publication in *Selected Papers* No. 5
g) Consideration of reports of cod and silver hake ageing workshops for publication in *Selected Papers* series
h) Other matters

11. Other matters

12. Mid-year Meetings in 1978/79 and 1979 Annual Meeting of STACRES

13. Election of Officers

14. Adjournment

II. LIST OF STACRES RECOMMENDATIONS, 1977/78

III. LIST OF SUMMARY AND RESEARCH DOCUMENTS - 1977 (CONTINUED)[1]

SUMMARY DOCUMENTS

Sum. Doc.	Ser. No.	
77/XI/36	5130	ICNAF Secretariat. Three-alpha code for use in logbooks to identify North Atlantic species names (4 pages).
77/XI/37	5134	ICNAF Secretariat. Standard elements for fishing sheets and logbooks (2 pages).

RESEARCH DOCUMENTS

Res. Doc.	Ser. No.	
77/XI/56	5131	Sergeant, D. E. A new approach to estimating harp seal production (8 pages).
77/XI/57	5132	Sergeant, D. E. Research on hooded seals in the western North Atlantic in 1977 (8 pages).
77/XI/58	5133	Sergeant, D. E. Studies on harp seals of the western North Atlantic population in 1977 (16 pages).
77/XI/59	5135	Bergflødt, B. The sealing season and Norwegian seal investigations off Newfoundland-Labrador in 1977 (9 pages).
77/XI/60	5136	Document withdrawn.
77/XI/61	5138	Ulltang, Ø., and P. Øynes. Norwegian investigations on the deep sea shrimp (*Pandalus borealis*) in West Greenland waters, 1977 (12 pages).
77/XI/62 (Rev.)	5139	Lavigne, D. M., S. Innes, and W. Barchard. The 1977 census of western Atlantic harp seal, *Pagophilus groenlandicus* (57 pages).
77/XI/63	5140	Capstick, C. K., D. M. Lavigne, and S. Innes. Comparison of on-ice counts of harp seal pups with counts from 35-mm ultraviolet aerial photography (19 pages).
77/XI/64	5141	Mohn, R. K. Critical analysis of two harp seal population models (10 pages).
77/XI/65	5142	Kanneworff, P. Estimated density of shrimp (*Pandalus borealis*) in Greenland waters, 1975-77, and calculation of biomass on the offshore fishing grounds, Div. 1A-1B, based on bottom photography (17 pages).
77/XI/66	5143	Kapel, F. O. An estimate of the composition of the catch of harp seal in West Greenland, 1972-1975 (8 pages).
77/XI/67	5144	Carlsson, D. M., Sv. Aa. Horsted, and P. Kanneworff. Review of Danish trawl surveys on the offshore West Greenland shrimp grounds in 1977, and a comparison with material from previous years (27 pages).
77/XI/68 (Rev.)	5145	Lett, P. F., D. F. Gray, and R. Mohn. New estimates of harp seal production on the Front and in the Gulf of St. Lawrence and their impact on herd management (26 pages).
77/XI/69	5146	Hoydal, K., and H. Lassen. Catch per unit effort in the Faroese prawn (*Pandalus borealis*) fishery in ICNAF Subarea 1, 1975-77 (26 pages).
77/XI/70	5147	Minet, J. P., A. Forest, and J. B. Perodou. New biological data on the shrimp, *Pandalus borealis*, in the Baffin Island waters (ICNAF Statistical Area 0) (16 pages).

[1] These 1977 documents were issued after *Redbook* 1977 was published.

IV. LIST OF SUMMARY AND RESEARCH DOCUMENTS - 1978

SUMMARY DOCUMENTS

Sum. Doc.	Ser. No.	
78/VI/1	5149	ICNAF. Report of Standing Committee on Research and Statistics (STACRES), Special Meeting on Shrimp and Seal Stocks, November 1977 (19 pages).
78/VI/2	5150	CWP. Report of the Ninth Session of the Coordinating Working Party on Atlantic Fishery Statistics (CWP), August 1977 (40 pages).
78/VI/3	5171	ICNAF. Report of Standing Committee on Research and Statistics (STACRES), Special Meeting on Squid, February 1978 (15 pages) + Corrigendum (1 page).
78/VI/4	5175	ICNAF Secretariat. Provisional lists of sampling data for 1976 (28 pages).
78/VI/5	5176	ICNAF Secretariat. List of Fishing Vessels 50 GRT and over, 1976 (21 pages).
78/VI/6	5177	ICNAF Secretariat. Historical catches of selected species by stock area and country for the period 1967-76 (38 pages).
78/VI/7	5178	ICNAF Secretariat. Extracts from Resolutions passed at the 1977 ICES Meeting relevant to the research and statistical activities of ICNAF (1 page).
78/VI/8	5180	NEAFC. Northeast Atlantic Fisheries Commission, Special Meeting of the Commission, November 1977: Press Notice (1 page).
78/VI/9	5196	Konstantinov, K. G., and A. S. Noskov. Report of USSR investigations in the ICNAF Area, 1977 (28 pages).
78/VI/10	5211	ICNAF. Report of Silver Hake Ageing Workshop, Dartmouth, Nova Scotia, Canada, 28-31 March 1978 (10 pages).
78/VI/11	5213	ICNAF Secretariat. Efficiency of sampling the major fisheries of the Northwest Atlantic in 1976 (15 pages).
78/VI/12	5215	Hoydal, K., and Sv. Aa. Horsted. Danish Research Report, 1977 (6 pages) + Addendum (14 pages).
78/VI/13	5218	Lourdes M. Godinho, M. Portuguese Research Report, 1977 (10 pages) + Corrigendum (1 page).
78/VI/14	5222	Danke, L., R. Eggers, and N. Schultz. GDR Research Report, 1977 (8 pages).
78/VI/15	5223	Paciorkowski, A. Polish Research Report, 1977 (8 pages).
78/VI/16	5235	ICNAF. Report of Assessments Subcommittee, 4-11 April 1978 (30 pages) + Addendum (6 pages).
78/VI/17	5246	ICNAF Secretariat. Provisional sealing statistics for the Northwest Atlantic, 1977 (2 pages).
78/VI/18	5253	ICNAF Secretariat. Provisional index and list of titles for ICNAF publications and Meeting Documents, 1976 (48 pages).
78/VI/19	5251	ICNAF Secretariat. Tagging activities reported by member countries for 1977 (6 pages).
78/VI/20	5254	Sandeman, E. J., and J. S. Scott. Canadian Research Report, 1977 (14 pages).
78/VI/21	5255	ICNAF Secretariat. Statistics on discards, 1976 (5 pages).
78/VI/22	5256	ICNAF Secretariat. Major CWP recommendations of direct importance to ICNAF (6 pages).
78/VI/23	5258	ICNAF Secretariat. Annual return of information on discards, 1977 (16 pages) + Addendum (2 pages).
78/VI/24	5259	ICNAF Secretariat. Report on ICNAF statistical program, publications and ADP processing (19 pages).

Sum. Doc.	Ser. No.	
78/VI/25	5260	ICNAF Secretariat. Notes on statistical items for the Northwest Atlantic (FAO Major Fishing Area 21) (9 pages).
78/VI/26 (Rev.)	5261	ICNAF Secretariat. Nominal catches (1967-76) by country and stock area, with TACs and allocations (1974-78) for species and stocks reviewed by the Assessments Subcommittee in April 1978 (57 pages).
78/VI/27	5263	Chevalier, R. French Research Reprot (Saint Pierre et Miquelon), 1977 (4 pages).
78/VI/28 (Rev.)	5268	ICNAF Secretariat. Provisional nominal catches in the Northwest Atlantic, 1977 (51 pages).
78/VI/29	5270	Varea, J. A., and A. Mari. Cuban Research Report, 1977 (8 pages).
78/VI/30	5271	Nagasaki, F. Japanese Research Report, 1977 (2 pages).
78/VI/31	5274	Messtorff, J., and H. Dornheim. Federal Republic of Germany Research Report, 1977 (16 pages).
78/VI/32	5291	Gibson, Jon A. United States Research Report, 1977 (18 pages).
78/VI/33	5292	ICNAF Secretariat. Provisional Index and List of Titles for ICNAF Publications and Meeting Documents, 1975.

RESEARCH DOCUMENTS

Res. Doc.	Ser. No.	
78/II/1 (Rev.)	5153	Durward, R. D., T. Amaratunga, and R. K. O'Dor. Matuation index and fecundity for female *Illex illecebrosus* (LeSueur, 1821) (12 pages).
78/II/2	5154	Amaratunga, T., R. D. Durward, M. Roberge, and L. Wood. Population structure of *Illex illecebrosus* in the Scotian Shelf fishing areas in 1977 (12 pages).
78/II/3 (Rev.)	5155	Amaratunga, T., M. Roberge, and L. Wood. A study of the 1977 international catch statistics for the squid, *Illex illecebrosus*, fishery in ICNAF Subareas 3 and 4 (15 pages).
78/II/4 (Rev.)	5156	Amaratunga, T., M. Roberge, and L. Wood. The 1977 Canadian offshore catch statistics of the squid, *Illex illecebrosus*, fishery in ICNAF Subareas 3 and 4 (7 pages).
78/II/5 (Rev.)	5157	Amaratunga, T., and R. D. Durward. Field guide for data collection for the squid *Illex illecebrosus* (12 pages).
78/II/6	5158	Collins, P. W., and G. P. Ennis. Breakdown of inshore Newfoundland squid catches, 1975-77 with length and sex composition from commercial samples (13 pages).
78/II/7	5159	Ennis, G. P., and P. W. Collins. Food and feeding of the short-finned squid (*Illex illecebrosus*) during its seasonal occurrence inshore at Newfoundland and a brief review of the trophic relationships of the species (9 pages).
78/II/8	5160	Tibbetts-Lange, A. M. Catch, effort and biological data from the 1977 directed squid fishery in the US Fishery Conservation zone (12 pages).
78/II/9 (Rev.)	5161	Waldron, D. E. Catch compositions during the 1977 Scotian Shelf international fishery with emphasis on the silver hake and squid (*Illex*) fisheries (23 pages).
78/II/10	5162	Lipinski, M. Stock assessment of *Illex illecebrosus* (LeSueur, 1821) in ICNAF Div. 4W determined by area-density method (7 pages).
78/II/11	5163	Burukovsky, R. N., and Yu. M. Froerman. On the state of short-finned squid (*Illex illecebrosus*) stocks in some areas of the Northwest Atlantic in 1977 (5 pages).
78/II/12	5164	Chevalier, R. Biomass estimates of squid, *Illex illecebrosus*, in Subdiv. 3Ps (3 pages).
78/II/13	5165	Lloris, D. Observations on the Spanish *Illex* fishery in Subarea 4 (6 pages).

Res. Doc.	Ser. No.	
78/II/14	5166	Waldron, D. E., and D. F. Gray. The effects of gear type on the Japanese squid (*Illex illecebrosus*) fishery (12 pages).
78/II/15	5167	Lipinski, M. The age of squids, *Illex illecebrosus* (LeSueur, 1821), from their statoliths (5 pages).
78/II/16	5168	Kono, H. Report of the joint survey on by-catch in Japanese *Illex* trawl fishery, 1977 (15 pages).
78/II/17	5169	Mari, A., J. J. Terre, and R. Dominguez. Stock assessment of *Illex illecebrosus* in ICNAF Subareas 3 and 4 (10 pages).
78/VI/18	5172	Serebryakov, V. P. Ichthyoplankton from the Flemish Cap Bank (9 pages).
78/VI/19	5173	Mesnil, B. Resolution of the catch equation by a simple iterative method (5 pages).
78/VI/20	5174	Giedz, M. Stages of maturity of gonads in herring from Georges Bank (6 pages).
78/VI/21	5179	Department of Fisheries and Environment, Marine Fish Division, B. I. O. Report on the First Scotian Shelf Ichthyoplankton Program (SSIP) Workshop, 29 August to 3 September 1977, St. Andrews, N. B. (30 pages).
78/VI/22	5182	Dommasnes, A., Ø. Ulltang, and G. Sangolt. Norwegian capelin fishery and capelin investigations in Newfoundland waters in 1977 (7 pages).
78/VI/23	5184	Kudlo, B. P., and V. D. Boytsov. The effect of water dynamics on the size of the recruitment of the Flemish Cap Bank cod stock (10 pages).
78/VI/24	5185	Chumakov, A. K., and L. I. Serebrov. The determination of the catchability coefficient of bottom trawl for cod and Greenland halibut (8 pages).
78/VI/25	5186	Chekhova, V. A. Reliability of total trawl survey data (4 pages).
78/VI/26	5187	Postolaky, A. I. Method of forecasting the stock condition and catches of cod in the Labrador and Newfoundland Bank areas (9 pages).
78/VI/27	5188	Chekhova, V. A., A. K. Chumakov, and A. I. Postolaky. Preliminary assessment of abundance and biomass of cod on Flemish Cap based on data from trawl surveys in 1972-1977 (14 pages).
78/VI/28	5189	Serebrov, L. I. On the shrimp concentrations to the south of the Harrison Bank in ICNAF Subarea 2 (5 pages).
78/VI/29	5190	Klochkov, D. N., and A. S. Seliverstov. Assessment of abundance and biomass of the spawning stock of capelin in ICNAF Division 3N in summer of 1977 (6 pages).
78/VI/30	5191	Bakanev, V. S., and A. S. Seliverstov. Capelin investigations in the waters off southern Labrador (Division 2J) and on the north Newfoundland Bank (Division 3K) in the Autumn of 1977 (11 pages).
78/VI/31	5192	Noskov, A. S. Estimation of stock size and allowable catch of silver hake off Nova Scotia (Divisions 4VWX) for 1979 (4 pages).
78/VI/32	5193	Noskov, A. S., V. P. Karaulovsky, A. N. Romanchenko, and A. I. Sherstiukov. Distribution and abundance of silver hake eggs and larvae and environmental conditions off Nova Scotia in September-October 1977 (11 pages).
78/VI/33	5194	Rikhter, V. A., and A. M. Pankratov. An estimate of total allowable catch of red hake from Georges Bank (Subdiv. 5Ze) for 1979 (4 pages).
78/VI/34	5195	Motuzenko, B. K., and S. F. Kashin. On selectivity of bottom trawls in the Northwest Atlantic (Division 4W) (10 pages).
78/VI/35	5197	Pitt, T. K. American plaice in ICNAF Divisions 3LNO, a stock assessment update (14 pages).
78/VI/36	5198	Pitt, T. K. Abundance indices for American plaice and yellowtail from stratified random surveys on the Grand Bank (8 pages).

Res. Doc.	Ser. No.	
78/VI/37	5199	Bowering, W. R. An analysis of the northern witch flounder stock, ICNAF Divisions 2J, 3K and 3L (7 pages).
78/VI/38	5200	Bowering, W. R. The distribution of Greenland halibut in Statistical Area 0 (6 pages).
78/VI/39	5201	Bowering, W. R. The exploitation of the Greenland halibut stock complex of ICNAF Subarea 2 and Divisions 3KL (14 pages).
78/VI/40	5202	Bowering, W. R. A cohort analysis of the ICNAF Divisions 3NO witch stock (7 pages).
78/VI/41	5203	Pitt, T. K. An assessment update of yellowtail from ICNAF Divisions 3LNO (6 pages).
78/VI/42	5204	Hunt, J. J., and P. J. Stuart. Back calculation of silver hake length at age from otoliths (14 pages).
78/VI/43 (Rev.)	5205	Miller, D. S., J. E. Carscadden, and B. Bennett. An acoustic estimate of Capelin (*Mallotus villosus*) biomass, ICNAF Divisions 2J and 3K, October and November 1977 (7 pages).
78/VI/44	5206	Horsted, Sv. Aa. Subarea 1 cod: data for 1976-77 and first months of 1978, and estimates of biomass and yield, 1978-80 (38 pages) + Corrigendum (1 page).
78/VI/45	5207	Forest, A., J. P. Minet, and J. P. Perodou. Results of groundfish survey on Baffin Island Shelf (ICNAF Statistical Division 0B) (10 pages).
78/VI/46	5208	McKone, W. D. Assessment of Divisions 3LN redfish (10 pages).
78/VI/47	5209	Parsons, D. G., P. J. Veitch, and W. E. Legge. Some characteristics of the roundnose grenadier fisheries in ICNAF Subareas 0 + 1 and 2 + 3 (9 pages).
78/VI/48	5210	McKone, W. D. An update of Flemish Cap redfish assessment (7 pages).
78/VI/49 (Rev.)	5212	Amaratunga, T., M. Roberge, and L. Wood. Catch/effort statistics of the Canadian squid (*Illex illecebrosus*) fishery in Subarea 4 in 1977 (11 pages).
78/VI/50	5214	Isakov, V. I. On occurrence and distribution of mackerel in the Nova Scotian Shelf area in winter (7 pages).
78/VI/51	5216	Mari, A., and R. Dominguez. An update of Flemish Cap cod assessment (4 pages) + Corrigendum (1 page).
78/VI/52	5217	Carscadden, J. E., D. S. Miller, and G. H. Winters. Biological aspects of the Div. 3NO capelin stock in 1977 and a capelin sequential abundance model (20 pages).
78/VI/53	5219	Chumakov, A. K., I. S. Shafram, and V. L. Tretjak. Assessment of Greenland halibut abundance and biomass in Statistical Area 0 and Subarea 1 with application of the virtual population method (8 pages).
78/VI/54	5220	Borrmann, H. Stock assessment of roundnose grenadier in the Northwest Atlantic (8 pages).
78/VI/55	5221	Mari, A., and B. Saba. Length-weight relationship for silver hake on the Scotian Shelf (5 pages).
78/VI/56	5224	Mari, A., and R. Dominguez. An evaluation of the status of ICNAF Div. 3M redfish (5 pages).
78/VI/57	5225	Wells, R. Status of the cod stock on Flemish Cap (6 pages).
78/VI/58	5226	Tavares, A. M. An assessment of the Div. 3M cod stock (4 pages).
78/VI/59	5227	Bishop, C. A., and R. Wells. Status of the cod stock in Div. 3NO (7 pages).
78/VI/60	5228	Clay, D. The selection of silver hake (*Merluccius bilinearis*) on the Scotian Shelf (a final report on two joint cruises in 1977) (22 pages).
78/VI/61	5229	Hurley, G. V., and D. E. Waldron. 1977 population estimates for squid (*Illex illecebrosus*) in ICNAF Subarea 4 (10 pages).

Res. Doc.	Ser. No.	
78/VI/62	5230	Halliday, R. G., P. F. Lett, and D. Clay. Silver hake (*Merluccius bilinearis*) in ICNAF Div. 4VWX: a stock assessment and estimate of the total allowable catch (TAC) for 1979 (13 pages).
78/VI/63	5231	Mari, A. Selection of silver hake by kapron codends of trawl nets (6 pages).
78/VI/64	5232	Minet, J. P., A. Forest, and J. B. Perodou. Stratification scheme for ICNAF Statistical Division 0B (2 pages).
78/VI/65	5233	Stein, M. Hydrographic conditions off West Greenland during November 1976 (10 pages).
78/VI/66	5236	Wells, R. Status of the cod stock in Divisions 2J, 3KL (10 pages).
78/VI/67	5237	Stevenson, S. C. A descriptive report on the discarding of fish by the Canadian offshore fishery in ICNAF Subareas 2 and 3 (14 pages).
78/VI/68	5238	Robinson, G. A. The Continuous Plankton Recorder Survey: plankton in the ICNAF Area in 1976 (6 pages).
78/VI/69	5239	Dornheim, H., and T. R. Azarovitz. Results of the joint FRG-US bottom trawl survey, R/V *Anton Dohrn*, 11-28 October 1977 in ICNAF Subareas 4 and 5 (5 pages).
78/VI/70	5241	Burmakin, V. V., and V. S. Sterhkov. Water temperatures in Newfoundland, Labrador, and Baffin Island areas in 1977 (10 pages).
78/VI/71	5242	Kudlo, B. P., and V. D. Boytsov. Dynamics and salinity in waters in the Newfoundland area in 1976-77 (6 pages).
78/VI/72	5243	Plekhanova, N. V., and V. M. Ryzhov. Peculiarities of distribution of surface plankton in water masses of Flemish Cap Bank in the spring-summer period of 1970-1977 (9 pages).
78/VI/73	5244	Noskov, A. S., V. I. Vinogradov, and L. G. Ptitsina. The studies of the feeding habits of larval herring (*Clupea harengus*) in the Georges Bank area, 1965-1975 (14 pages).
78/VI/74	5245	Vinogradov, V. I., and A. S. Noskov. The study of feeding of short-finned, *Illex illecebrosus*, and long-finned, *Loligo pealei*, squids at Nova Scotia and New England in 1974 and 1975 (11 pages).
78/VI/75	5249	Robinson, G. A. The Continuous Plankton Recorder survey: plankton in the ICNAF Area in 1977 (6 pages).
78/VI/76	5262	Gasjukov, P. S., and R. S. Dorovskikh. On estimating the accuracy of silver hake abundance indices derived from the Soviet research vessel trawling surveys of the Emerald Deep area in 1972-1976 (18 pages).
78/VI/77	5264	Pennington, M. R., and M. D. Grosslein. Accuracy of abundance indices based on stratified-random trawl surveys (42 pages).
78/VI/78	5265	Schultz, N. GDR results of the juvenile herring surveys in ICNAF Div. 4X, 5Y, 5Z, and Statistical Area 6 in the spring of 1975, 1976, and 1977 (herring and mackerel) (39 pages).
78/VI/79	5266	Trites, R. W. Some physical oceanographic features relevant to larval herring distribution on Georges Bank (19 pages).
78/VI/80	5267	Akenhead, S. A. Report of the Canadian Planning Group of the Flemish Cap International Experiment Meeting, St. John's, Newfoundland, 12-14 September 1977 (52 pages).
78/VI/81	5269	Stein, M. Hydrographic conditions on Hamilton Inlet Bank (Div. 2J) in early December 1977 (7 pages).
78/VI/82	5272	Lussiaa-Berdou, J. P., and J. Dube. An assessment of the Subdiv. 3Pn-Div. 4RS cod stock (8 pages).
78/VI/83	5293	Belzile, L. Report on the discarding of fish in the Canadian offshore fishery in ICNAF Subareas 4 and 5.

V. PARTICIPANTS IN SCIENTIFIC MEETINGS HELD DURING 1977/78

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