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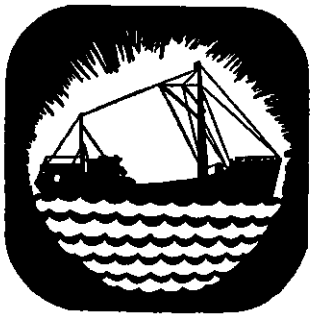

REDBOOK 1979

STANDING COMMITTEE ON RESEARCH AND STATISTICS

PROCEEDINGS
OF
SPECIAL MEETING NOVEMBER 1978
SPECIAL MEETING FEBRUARY 1979
ANNUAL MEETING MAY-JUNE 1979

Dartmouth • Canada
July 1979

Preface

Redbook 1979 contains the reports of the Standing Committee on Research and Statistics (STACRES) from meetings held at Bergen, Norway, during 13-17 November 1978, at Tokyo, Japan, during 14-21 February 1979, and at Dartmouth, Canada, during 22-26 May and 5 June 1979. A meeting of the Assessments Subcommittee was held at St. John's, Newfoundland, Canada, during 28 March-9 April 1979 and its report is included as Appendix I to the report of the 1979 Annual Meeting.

The meetings of STACRES, reported in Parts A and B of this volume, were special meetings held at the request of coastal states for advice on the scientific basis for the management of certain stocks within or overlapping the national fisheries zones in Statistical Area 0 and Subareas 1 to 4. Part C contains the report of the 1978 Annual Meeting of STACRES and corresponds to Proceedings No. 1 of the 1979 Annual Meeting of the Commission. Part D contains the agenda for meetings of STACRES held since the 1978 Annual Meeting, a list of STACRES recommendations from the November 1978, February 1979 and May-June 1979 meetings, a list of research documents issued in the last half of 1978 after Redbook 1978 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 1978 to June 1979. There were no meetings of Scientific Advisers to Panels during 1978/79.

10 July 1979

V. M. Hodder
Assistant Executive Secretary

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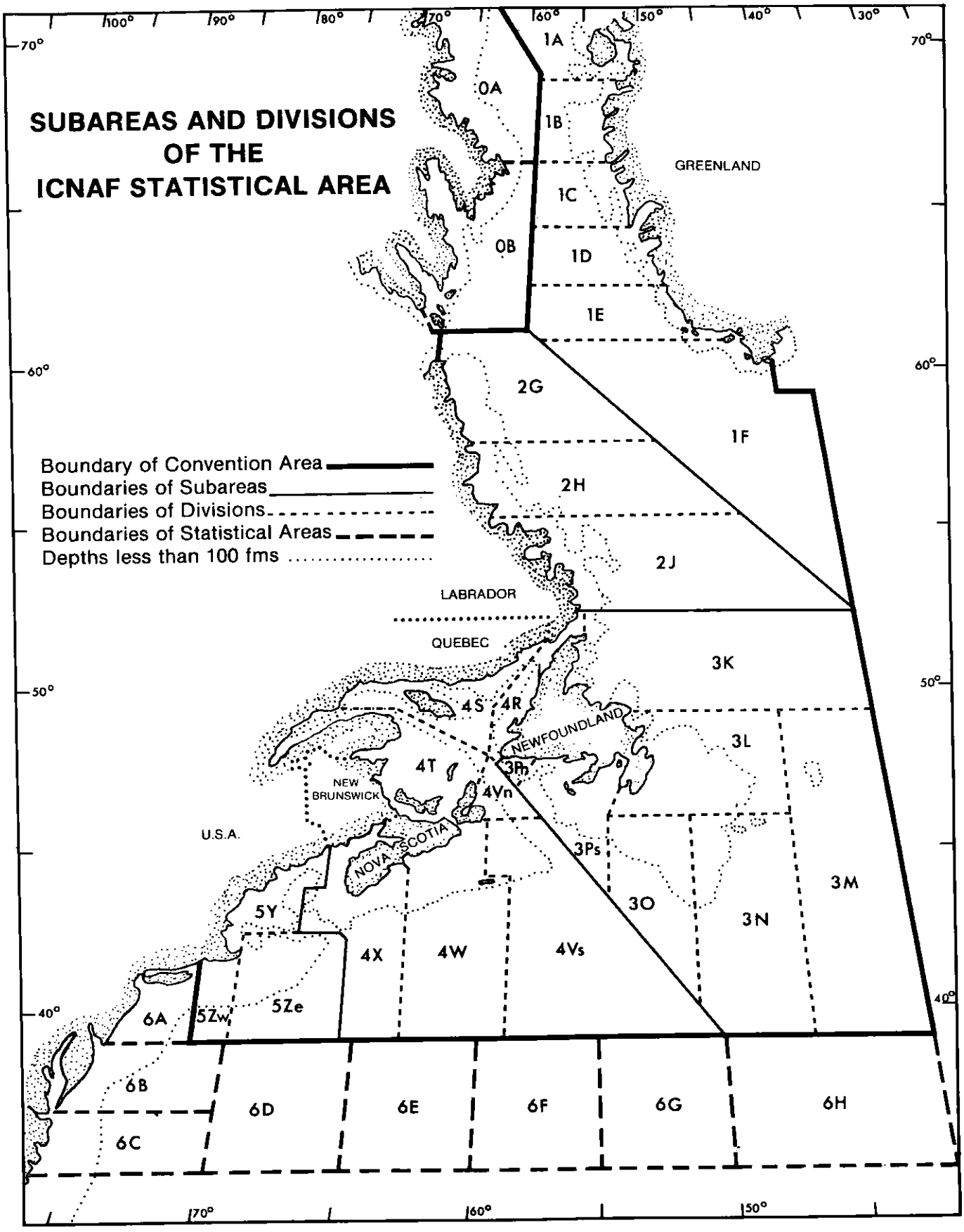
SUBAREAS AND DIVISIONS
OF THE
ICNAF STATISTICAL AREA
Boundary of Convention Area
Boundaries of Subareas
Boundaries of Divisions
Boundaries of Statistical Areas
Depths less than 100 fms
GREENLAND
LABRADOR
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
U.S.A.
1A
1B
1C
1D
1E
1F
0A
0B
2G
2H
2J
3K
3L
3M
3N
3O
3Ps
3Pn
4R
4S
4T
4Vn
4Vs
4W
4X
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5Ze
5Zw
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6H
100°
90°
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50°
40°
30°

PART A

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

Special Meeting on Seals and Shrimps, November 1978

CONTENTS

[1] Distributed previously as *ICNAF Sum. Doc.* 79/VI/1.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Special Meeting on Seals and Shrimp, November 1978

Chairman: G. H. Winters

Rapporteur: V. M. Hodder

STACRES met at the Institute of Marine Research, Bergen, Norway, during 13-17 November 1978 to (a) provide advice for the management of the harp and hooded seal stocks, as requested by Canada (Com. Doc. 78/VI/13), and (b) assess the status of the shrimp (*Pandalus borealis*) stocks in Subarea 1 and Statistical Area 0, as requested by Canada and the European Economic Community (EEC) (Com. Doc. 78/VI/3 and 5; *ICNAF Redbook* 1978, page 39). The agenda for the meeting is given in Part D (this volume). In the absence of the Chairman (Dr E. C. Lopez-Veiga, Spain), the participants unanimously agreed that Dr G. H. Winters (Canada) act as Chairman for this meeting. Scientists attended from Canada, Denmark, France, Norway, USSR and USA.

Meetings of the *ad hoc* Working Group on Seals (convened by A. W. Mansfield) and on Shrimp (convened by Ø. Ulltang) were held concurrently during 14-16 November, and their reports as approved by STACRES are given in Appendices I and II respectively. In addition, the *ad hoc* Working Group on Standardization of Reporting Procedures for Sampling Data (convened by W. G. Doubleday), which was established by STACRES at its 1978 Annual Meeting (*ICNAF Redbook* 1978, pages 41-42) met during 13-16 November, and its report as adopted by STACRES is given in Appendix III. Brief summaries of these reports, together with other matters considered by STACRES, are given below.

1. Assessment of Seal Stocks (App. I)

a) Harp seals

A new estimate of natural mortality (M) of 0.10 is identical to the value used in the 1977 assessment. A difference in pregnancy rate between females sampled early and late in pregnancy, evidently a result of intra-uterine mortality, indicated that only late-term pregnancy rates should be considered in population models. However, data were not now sufficient to warrant using a value different from 0.92, the average value of all pregnancy rates so far estimated. No density-dependence in the late-term pregnancy rate was evident in the data available. A slightly increased median age of whelping (4.9 years) was noted, but this could be explained by intra-uterine mortality and sampling error.

Pup production estimates were available from catch-effort data, tagging-recapture data and sequential population analysis. Estimates ranged from 338,000 to 378,000, the latter value being subject to significant downward revision if further tagged young-of-the-year seals are recaptured. Projections for 1979 indicated pup productions ranging from 345,000 at a stock size of 1.32 million to 358,000 at a stock size of 1.4 million. Under a continuing total allowable catch (TAC) of 180,000 (80% pups), one analysis predicted an increase in pup production and stock size of 2% per year over the 1979-83 period. A second analysis, assuming density-dependence of up to three vital rates, predicted increases from a starting population population of 1.40 million in 1979 to 1.55-1.73 million in 1988.

Replacement yield, defined as the catch which maintains the same stock size from one year to the next, was estimated to range from 198,000 to 205,000 in 1979. Estimates of sustainable yield ranged from 214,000 to 240,000, depending on the ratio of the number of pups to the number of older seals killed. With catches of this magnitude, the stock size would be expected to decrease for a period of 5-6 years until the strong year-classes from 1972 onwards enter the breeding stock.

The evidence for separate Gulf and Front herds still remains equivocal. Tag returns indicate that there is a large admixture of immature animals but generally a separation of adults. In view of this, it would be prudent to divide the catch between the two areas in proportion to the estimated herd sizes to avoid the risk of temporary depletion of one herd. All evidence indicates that the Northwest Atlantic harp seal population is continuing to increase, after declining to its lowest level of about one million animals in 1972.

b) Hooded seals

The limited amount of data available makes the estimates of stock size, production and sustainable yield uncertain. A new sequential population analysis indicated that the stock size of females has been relatively stable since the 1960's, varying between 48,000 and 55,000, whereas a similar analysis in 1977 based on slightly different assumptions indicated an increase in the stock size of age 1+ females from 53,000 to 77,000 over the same period. Pup production, based on the most recent estimate of stock size, appears to have fluctuated between 24,000 and 30,000

since the 1960's and is projected to be 28,500 in 1979. The sustainable yield is estimated at 12,500 pups, 1,100 adult females and 1,400 adult males, assuming that the proportion of adult females in the catch is maintained at the present level of 7.5% or less.

The great difference in the two estimates of population size, based on essentially the same data, underscores the need for a conservative policy in harvesting hooded seals. Since the best estimate of sustainable yield appears to be between 15,000 and 20,000, STACRES advises that it would not be prudent to increase the TAC from the present level of 15,000. The lack of adequate data for assessment purposes provides ample justification for substantially increasing the research effort on hooded seals.

2. Assessment of Shrimp Stocks (App. II)

The shrimp fishery was brought under quota regulation in 1977 with a TAC of 36,000 tons for the offshore grounds in Subarea 1. The total nominal catch of shrimp in Subarea 1 was about 42,000 tons in 1977, of which 34,000 tons were taken on the offshore grounds. For 1978, the TAC was set at 40,000 tons for Subarea 1 (offshore) and Statistical Area 0. It seems unlikely that the overall TAC will be fully utilized in 1978, as the total catch in the management areas amounted to only 22,000 tons up to the end of September. New information from surveys in Statistical Area 0 revealed that the only commercially-valuable shrimp concentrations were located in the boundary area of Statistical Area 0 and Subarea 1. Within Subarea 1, both research and commercial data for 1978 are consistent with earlier observations that the highest levels of offshore abundance occur in Div. 1B.

Catch-per-unit-effort data for fisheries by Denmark (F), Denmark (G), France and Norway indicate decreasing catch rates from 1976 to 1978, with the largest decline from 1977 to 1978. The very high catch rates experienced periodically by Norwegian and Faroes vessels in Div. 1B during the first half of the years 1975 to 1977 were not obtained in 1978, although the large Greenland trawlers had higher catch rates in May 1978 than in the first quarter of the year. The differing catch rates in the first half of 1978 were due in part at least to ice conditions which limited the fishing activities of some vessels, while other vessels, among them the Greenland trawlers, were able to fish among the drift ice. For the period of July-September, when fishing activities were not affected by ice, catch-per-unit-effort data indicate an overall gradual decline in catch rate of about 32% from 1976 to 1978. The results of photographic surveys and the catch-per-unit-effort data indicated that the fishable biomass of shrimp decreased by about 20% from 1977 to 1978.

The observed decline in biomass was not unexpected, because the exploitation of a new resource normally starts with a relatively high catch rate which declines as the biomass is reduced by fishing and ultimately results in a lower level of catch rate at the sustainable level of fishing. In view of the evidence pointing to a decreasing biomass, it was generally agreed that a more cautious approach should be taken in advising a TAC for 1979 than previously. Various points of view were noted in evaluating the degree of reduction in TAC to be advised for 1979. Considering the observed 20% decline in biomass from 1977 to 1978 as one reference point, STACRES agreed that a reduction in TAC of 20% should be regarded as the minimum advisable reduction. However, concern was expressed that the catch rate (although declining) may have been maintained at high levels due to the continued searching for and the progressive exploitation of new shrimp concentrations during the 1975-78 period, thus indicating the need for a larger reduction in the TAC of about 32% based on the decline in catch rate from 1976 to 1978. Further justification for a cautious management regime in 1979 relates to the observations during the photographic surveys in 1978 of numerous small shrimp which will recruit to the fishable biomass in 1979 but will mainly occur in the catches as male shrimp at the lower part of the size distribution, whereas by 1980 this group will occur as larger female shrimp and thus may contribute to improved fishing prospects in that year.

Taking into consideration the range of viewpoints discussed by the Working Group, STACRES agreed with the conclusions regarding a TAC for 1979, and accordingly advises that the 1979 TAC for shrimp should be set at a level in the range of 20-32% below the advised 1978 TAC of 40,000 tons (including discards) from the biomass on the offshore grounds in Subarea 1, including that portion of the biomass in Statistical Area 0 which is an extension of the biomass found in Div. 1A and 1B. This implies a TAC in the range of 27,200-32,000 tons for 1979. No attempt was made to determine a TAC for the remainder of Statistical Area 0.

STACRES noted that the advice involving a range of TAC for 1979 reflects the necessity of having much better data than are now available to adequately assess the current state of the stock, and endorsed the recommendations of the Working Group (Appendix II) concerning the need for (i) extensive trawl and photographic surveys in order to update the estimate of the minimum trawlable biomass of shrimp in Subarea 1 beyond the 1976 reference point, and (ii) an extensive observer program on a year-round basis to monitor the shrimp fishery and collect detailed information on catch per unit effort, size composition, by-catches and discards.

3. Standardization of Reporting Procedures for Sampling Data (App. III)

STACRES noted that the Working Group had reviewed present standards and practices in the reporting of commercial catch samples. It was pointed out that the sampling requirements and observer programs of some of the coastal states have substantially increased the quantity and detail of data collected in a large part of the ICNAF Area, but have resulted in deviation from uniform reporting procedures. It was noted that the coastal states' representatives favoured the reporting of individual samples to the ICNAF Secretariat, and a review of the proposed NAFO Convention indicated a continuing role for the Secretariat in maintaining a sampling data base. It was agreed that standardized reporting of sampling data was desirable throughout the ICNAF (NAFO) Area, and STACRES therefore

recommends (1)

that individual length samples of commercial catches and the corresponding age-length keys be made available to the ICNAF (NAFO) Secretariat for ultimate incorporation into its sampling data base.

STACRES noted that the reporting of individual samples would increase the key-punching workload of the Secretariat, unless the data are received in machine-readable form. The cost of maintaining the data base is not expected to be substantially increased. STACRES noted further that data for individual samples may be accompanied by detailed information of a confidential nature, and therefore

recommends (2)

i) that an inventory of the sampling data be published annually;

ii) that the data be made available to the members of STACRES at present and to members of the Scientific Council of NAFO in the future; and

iii) that further distribution of the data be subject to the approval of the country on whose vessels the samples were collected and also to the approval of the coastal state for samples taken within a national fishing zone.

STACRES accepted the form for the reporting of length frequency samples, as proposed by the Working Group (see App. III, Annex 1), and

recommends (3)

that the form be used for the reporting of length samples to the ICNAF Secretariat from 1 January 1979.

STACRES noted that time at this meeting did not permit the development of a form for the reporting of age samples, although a list of contents was proposed. STACRES accordingly

recommends (4)

that the ICNAF Secretariat design a draft form for reporting age samples based on the contents listed in Appendix III to this report and circulate it to members of STACRES for comment prior to its consideration and possible adoption by STACRES at its Special Meeting in February 1979.

STACRES recognized the practical difficulties of obtaining suitable age-length keys corresponding to individual length samples, and

recommends (5)

that data from samples taken for ageing not be combined for periods exceeding one calendar month or for areas greater than one ICNAF division (or subdivision, where applicable).

4. Other Matters

a) Future scientific meetings

STACRES reviewed the scheduling of meetings for the first half of 1979 and confirmed the following:

i) Special Meeting of STACRES on Capelin and Squid will be held at Tokyo, Japan, during 14-21 February 1979.

ii) Regular spring meeting of the Assessments Subcommittee will be held at St. John's, Newfoundland, Canada, during 28 March-9 April 1979, a portion of this period being allotted for a meeting of the Biological Surveys Subcommittee and a joint meeting of the two subcommittees.

iii) The Second International Symposium on the Early Life History of Fish (ICES/ICNAF/FAO) will be

held at Woods Hole, Massachusetts, USA, during 2-5 April 1979.

iv) The Annual Meeting of STACRES and its Subcommittees will be held at ICNAF Headquarters, Dartmouth, Nova Scotia, Canada, during 22-29 May 1979.

b) Publication of papers on shrimp

STACRES noted that *ICNAF Selected Papers* No. 4, containing 11 scientific papers on shrimp presented at meetings in 1976, was now available, and expressed appreciation to the Secretariat for its efficiency in producing this publication.

5. Acknowledgement

The Chairman expressed his appreciation to the Director and Staff of the Institute of Marine Research for the service and facilities provided for the meeting and for their generous hospitality, to all participants including the conveners of the working groups and the rapporteurs for their interest and cooperation during the course of the meeting and finally to the Secretariat for their usual efficient work. STACRES expressed its thanks to Dr G. H. Winters for agreeing to preside over this meeting upon very short notice.

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

Convener: A. W. Mansfield Rapporteur: C. E. Button

The *ad hoc* Working Group on Seals met during 14-16 November 1978 to review the status of the harp and hooded seal populations in the Northwest Atlantic, as requested by Canada (Com. Doc. 78/VI/13; *ICNAF Meet. Proc.* 1978, No. 7, page 37). Representatives attended from Canada (W. D. Bowen, C. E. Button, W. G. Doubleday, P. F. Lett, A. W. Mansfield, D. E. Sergeant and G. H. Winters), Denmark (F. O. Kapel), and Norway (B. Bergflødt and T. Øritsland). The Working Group reviewed the information presented in several working papers and the following research documents: 77/XI/68 (revised); 78/XI/84, 85, 86, 90, 91, 92 and 98.

1. Conservation of Harp Seals

a) Research in 1978

Canada reported on the results of studies on tagging and recapture, age composition of catches, maturity, fecundity, mixing of the Front and Gulf herds (Res. Doc. 78/XI/85), estimates of pup production from catch and effort data, sustainable yield (Res. Doc. 77/XI/68), the influence of density-dependent processes on population dynamics (Res. Doc. 78/XI/84), and genetic variability between herds of harp seals in the Northwest Atlantic (Res. Doc. 78/XI/90). Norway reported on the recapture of previously tagged seals and the status of age frequency analyses of specimens collected at the Front in 1977 and 1978 (Res. Doc. 78/XI/92). Denmark presented historical and recent data on the catches of seals at West Greenland (Res. Doc. 78/XI/98).

b) Population assessment

i) Vital rates

Natural mortality (M) was calculated at 0.10 (standard error 0.03) (Res. Doc. 78/XI/84), which is identical to the value used by the Working Group at its Meeting in November 1977 (*ICNAF Redbook* 1978, page 17). The Working Group agreed that this rate applied to age 1+ animals, but noted possible density-dependence of M for age-group 0, as suggested for some other pinnipeds.

Attention was drawn to a reduction in pregnancy rate between early- and late-term samples, attributable to normal intra-uterine losses (Res. Doc. 78/XI/85). The calculated late-term pregnancy rate (0.90) was based on data including four animals reported as immature, which the Working Group agreed should be excluded. Removing these anomalous data gives an estimated pregnancy rate of 0.94 for late-term females in 1978. The Working Group agreed that a late-term pregnancy rate of 0.92, calculated by averaging all available historical data, was the best estimate for use in subsequent calculations. Density-dependence in the late-term pregnancy rate was not evident in data available to the Working Group.

A median age of whelping of 4.9 years was estimated from late-pregnancy samples from the Gulf in 1978 (Res. Doc. 78/XI/85). This compares with an estimate of 4.6 years from early-pregnancy samples taken at the Front in 1976. Intra-uterine loss and sampling error could both contribute to the observed difference.

ii) Pup production

An update of catch/effort analyses (Winters, 1978)[1] to include 1978 data resulted in an estimated mean pup production of 213,000 animals at the Front over the 1965-78 period and a production of 199,000 animals in 1978. The Working Group noted that the late availability of the northern patch of harp seals to inshore sealers at the Front in 1978, and the method of calculation, would tend to produce an underestimate of production. A sequential population analysis estimated total production in the Northwest Atlantic in 1978 of 338,000 animals (Winters, 1978)[1].

Pup production in the Gulf was estimated by a sequential population method (Res. Doc. 77/XI/68 (revised)) to be 103,000 in 1978, the mean pup production being estimated at 98,000 for the 1972-78 period.

Calculations, based on tagging-recapture data from the 1978 study (Res. Doc. 78/XI/85), gave a mean estimate of pup production of 121,000 in the Gulf (excluding the northern Gulf Mecatina patch) and 257,000 at the Front, for a total production of 378,000 pups. The Working Group noted that the exclusion of data for the Mecatina patch from the calculations

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[1] Winters, G. H. 1978. Production, mortality, and sustainable yield of Northwest Atlantic harp seals (*Pagophilus groenlandicus*). J. Fish. Res. Bd. Canada, 35(9): 1249-1261.

would tend to reduce the estimate of total production, and that any late reporting of a small number of tags from Newfoundland would result in a significant downward revision of the estimate.

iii) Stock relationships

Evidence presented in 1978 confirms previous observations on interbreeding of harp seal herds at the Front and in the Gulf. Observations of the proportion of younger whelping females during 1976-78 and maturity data do not support the hypotheses of Front and Gulf herd segregation (Res. Doc. 78/XI/85). The author of this document reported the first confirmed recoveries from the Front of adult seals tagged as pups in the Gulf in 1969.

Studies reported in Res. Doc. 78/XI/90 indicate that the Gulf and Front herds were indistinguishable using tissue enzyme electrophoresis, thus implying interbreeding of seals from the two areas. The Working Group suggested that the authors calculate the rate of interbreeding required to explain their observations and also noted the need for further estimates of cross-over. The degree of interbreeding, or cross-over, between the Front and Gulf herds cannot be quantified from existing data. Therefore, the Working Group advises that the total catch of harp seals in the Gulf and at the Front be subdivided in proportion to the estimated herd sizes in these areas to avoid the risk of temporary depletion of one herd.

iv) Stock size and pup production in 1979

Winters (1978)[1], by assuming a catch of 180,000 animals (80% pups) in 1978 with mortality distributed over age-groups according to recent patterns and a pregnancy rate of 0.92, estimated the age 1+ population in the Northwest Atlantic in 1979 to be 1.32 million animals with a pup production of 345,000. Using the model applied in Res. Doc. 77/XI/68 (revised) with a provisional 1978 catch of 163,000, a pregnancy rate of 0.92, a density-dependent maturity ogive incorporating the most recent data, and a historical catch distribution over all age-groups, the age 1+ population in 1978 was estimated to be 1.4 million animals with a pup production of 358,000.

v) Trends in stock size under varying TACs

In the following calculations, the TACs were assumed to be equal to the actual catch. For a TAC of 180,000 animals (80% pups) with mortality distributed over age-groups according to recent patterns, Winters (1978)[1] predicted an increase in pup production and population size of 2% per year over the 1979-83 period. The simulation in Res. Doc. 78/XI/84 was used to project the 1979 population size forward to 1988, giving a TAC of 180,000 under three options of density-dependent vital rates. The three options are (1) density-dependent whelping, (2) density-dependent whelping and pregnancy, and (3) density-dependent whelping, pregnancy and pup mortality. The resulting projections of population size (millions of animals) for an annual catch of 180,000 are as follows:

	Population size (millions)		
	Option 1	Option 2	Option 3
1979	1.397	1.397	1.397
1980	1.414	1.421	1.411
1981	1.440	1.455	1.430
1982	1.469	1.489	1.446
1983	1.504	1.528	1.467
1984	1.542	1.571	1.488
1985	1.581	1.613	1.507
1986	1.612	1.653	1.522
1987	1.653	1.691	1.533
1988	1.692	1.733	1.548

For a TAC of 200,000 animals, the stock size would stabilize in 1979 and increase slowly thereafter. Future trends in stock size for TACs corresponding to estimated sustainable yields are considered in the following section.

vi) Sustainable yield

Estimates of sustainable yield were developed based on the sequential population analysis of Winters (1978)[1] and new calculations presented at this meeting. Vital rates used in the analysis were 0.10 for natural mortality and 0.92 for the pregnancy rate.

Assuming a pup production of 335,000 animals, a catch consisting of 80% pups and 20% age 1+ seals, and mortality distributed over age-groups according to recent patterns, Winters (1978)[1] estimated the sustainable yield to be 220,000 under equilibrium conditions.

On the basis of calculations presented at this meeting and a pup production of 358,000, the sustainable yield in 1979 ranged from 214,000 to 240,000 animals, depending upon the ratio of pups to age 1+ animals in the catch and the allocation of catch to large vessels, small vessels and landsmen. Replacement yield, defined as the catch which would maintain the population from year to year, was estimated at 198,000 to 205,000 for 1979 under the same assumptions.

For a TAC in the range of 220,000-240,000 animals, which is estimated to be within the limits of sustainable yield for pup production of 335,000-358,000 respectively, the stock size would decrease for a period of 5 to 6 years until the strong year-classes of 1972 and onwards entered the breeding stock.

c) Future research on harp seals

The Working group acknowledged the promising results from the 1978 tagging experiment and indicated a desire that such work be continued. In addition, the need for further data on age composition of the catch, fertility rates and mean age of whelping was emphasized. The Working Group accordingly

recommends (6)

i) that a tagging experiment be carried out on harp seals in the Front and Gulf areas in 1979;

ii) that age and reproductive samples, segregated by sex, be collected from the large vessel catches of age 1+ harp seals in the Front and Gulf areas in 1979; and

iii) that a re-examination of ovaries previously collected be carried out and that fresh samples from the winter catch of late pregnancy animals be collected for anatomical examination.

2. Conservation of Hooded Seals

a) Research in 1978

Canada reported the results of hooded seal tagging and branding activities in 1972-78 (Res. Doc. 78/XI/86), presented an assessment of stock size, pup production and sustainable yield (Res. Doc. 78/XI/91), and noted the results of an aerial survey in Davis Strait in 1978 and studies on the use of immobilizing drugs in tagging adults. Norway reported on the collection of age samples from the Front area (Res. Doc. 78/XI/92). Denmark presented historical and recent catch statistics and trends for the Greenland area (Res. Doc. 78/XI/98).

b) Population assessment

The variety of recent data and the short time series available for hooded seals limits the precision and confidence of estimates of current stock size, production and sustainable yield. The estimation of parameters, presented in Res. Doc. 78/XI/91, was considered by the Working Group in the light of these uncertainties.

i) Vital rates

Catch curve analysis of female hooded seals from Norwegian samples collected during 1971-76 produced a mean estimate of total mortality of 0.27 (range 0.19-0.35) for the 1960-75 period, and natural mortality was estimated at 0.135 (Res. Doc. 78/XI/91).

ii) Stock size

A sequential population analysis of the herd exploited off Newfoundland indicated that the population of age 1+ females has been relatively stable since the early 1960's, fluctuating between 48,000 and 55,000 animals (Res. Doc. 78/XI/91). These calculations indicate that regulations limiting the percentage of adult females in the total catch since 1976 are increasing the breeding potential of the stock.

iii) Pup production

Functional regression analyses of survival index data, as computed from Norwegian sampling data (1971-76) of age 5 females, produced a mean pup production of 27,000 for the 1966-71 year-classes (Res. Doc. 78/XI/91). This compares with an estimated production of 25,000 animals calculated from survival indices of age 5 females for the 1966-72 year-classes (Res. Doc. 77/XI/57), and a production of 32,000 animals estimated by the same method for age-

groups 5-10 and year-classes 1966-70 (Res. Doc. 75/122). The present study indicates that pup production has fluctuated within the narrow range of 24,000-30,000 since the early 1960's and is projected to be 28,500 in 1979.

iv) Sustainable yield

Under equilibrium conditions with vital rates and pup production in 1979 as specified above, a sustainable yield of 12,500 pups, 1,100 adult females and 1,400 adult males was estimated (assuming the continuation of the 7.5% limit of adult females in the catch in 1979). The analysis indicates that this stock has been exploited at approximately the sustainable yield level since the early 1960's.

The Working Group agreed that survival indices at age 5 (as used in Res. Doc. 78/XI/91) may be more reliable than those for older ages due to variation in cumulative hunting mortality and sampling error, but indicated survival indices for older animals should not be disregarded. Consequently, the Working Group concluded that the results presented in Res. Doc. 78/XI/91 could not be accepted as providing the best possible analysis of available data. In view of the lack of additional data beyond those considered in previous years, the Working Group concluded that the best estimate of sustainable yield, based on existing data, lies between 15,000 and 20,000 animals, and therefore advises that the TAC of 15,000 animals should remain unchanged for 1979.

c) Future research on hooded seals

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

recommends (7)

i) that analyses of material and data collected on fecundity, maturity and age composition of hooded seals be completed as soon as possible;

ii) that a review of present knowledge on stock identification and interrelationships, including analysis of tag recoveries, be undertaken as soon as possible;

iii) that a minimum of 500 age and reproductive samples from adult females be collected at the Front in 1979;

iv) that sufficiently detailed information be collected about the hunt in 1979 to permit a catch-effort analysis; and

v) that the tagging of hooded seals on an opportunistic basis be continued in 1979.

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

Convener: Ø. Ulltang

Rapporteur: Sv. Aa. Horsted

The *ad hoc* Working Group on Shrimp met during 14-16 November 1978 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 at the time of the Meeting of the Assessments Subcommittee in April 1978 at the request of Canada and the European Economic Community (ICNAF Com. Doc. 78/VI/3 and 78/VI/5), but recommended by STACRES to be considered near the end of the year when information about the major part of the 1978 fishery would be available (*ICNAF Redbook* 1978, page 39; *ICNAF Meet. Proc.* 1978, No. 7, page 37). Scientists attended from Canada, Denmark (Greenland and Faroes laboratories), France, Norway and USA. The Working Group reviewed the most recent data on the fisheries in 1978 and new information relating to the biology, abundance and distribution of shrimp presented in Res. Doc. 78/XI/87, 88, 89, 93, 94, 95, 96 and 97, and several working papers.

1. Fishery Trends

Nominal catches of shrimp in Subarea 1 and Statistical Area 0 (Table 1) increased from less than 10,000 tons prior to 1973 to 50,000 tons in 1976. The 1977 fishery was regulated by a total allowable catch (TAC) of 36,000 tons (including discards) for the offshore grounds of Subarea 1, with a breakdown over four management areas, and provisional catch statistics for 1977 indicate a nominal catch of nearly 42,000 tons (including the inshore fishery) in Subarea 1 and 457 tons for Statistical Area 0.

Table 1. Nominal catches (metric tons) of shrimp (*Pandalus borealis*) in Statistical Area 0 and Subarea 1, 1970-78.

Area	Country	1970	1971	1972	1973	1974	1975	1976	1977	1978[2]	
SA 0	DEN-F	-	-	-	-	-	-	-	239	669	(Sep)
	DEN-M	-	-	-	-	-	-	-	68	80	(Sep)
	FRA-M	-	-	-	-	-	-	-	-	8	(Sep)
	NORWAY	-	-	-	-	-	-	65	150	618	(Oct)
	SPAIN	-	-	-	-	-	-	327	-	-	
	TOTAL SA 0	-	-	-	-	-	-	392	457	1,375[3]	
SA 1	DEN-F	130	496	755	1,371	2,023	5,300	11,179	12,612	5,995	(Sep)
	DEN-G (a)[1]	8,264	8,741	7,342	7,950	10,064	8,700	7,300	7,800	6,569	(Sep)
	(b)	165	200	150	185	180	1,089	2,478	7,136	4,166	
	DEN-M	-	-	-	196	308	1,142	2,717	5,842	2,722	(Sep)
	FRA-M	-	-	-	-	-	-	803	934	559	(Sep)
	FRG	-	-	-	-	-	-	-	31	...	
	JAPAN	-	-	-	-	-	-	146	-	-	
	NORWAY	-	-	1,409	2,940	5,917	8,678	11,658	7,353	7,047	(Oct)
	SPAIN	-	-	-	-	-	6,948	6,925	-	-	
	USSR	-	-	-	-	3,517	6,033	6,468	-	-	
	TOTAL SA 1	8,559	9,437	9,656	12,642	22,009	37,890	49,674	41,708	27,058	
	OFFSHORE	295	696	2,314	4,692	11,945	29,190	42,374	33,902	20,489	

[1] a = inshore, b = offshore grounds.
[2] Preliminary statistics to end of month indicated in parentheses.
[3] West of median line in Canadian zone.

The fishery in 1978 was regulated by an overall TAC for Subarea 1 (offshore) and Statistical Area 0 of 40,000 tons, of which 5,000 tons are allocated to the Canadian fishing zone, while the 35,000 tons on the Greenlandic side of the median line are broken down over four management areas, as in 1977. Preliminary catch statistics for January-September 1978 indicate that the total catch in the management

areas of Subarea 1 and Statistical Area 0 was about 22,000 tons, with the inshore catch in Subarea 1 being about 7,000 tons. It seems doubtful that the whole TAC for the regulated areas will be taken in 1978 and further comment on this is given in Section 6 below.

2. Distribution (Res. Doc. 78/XI/87, 88, 89, 94, 95, 96)

Statistical Divisions 0A and 0B. New information on the distribution of shrimp was presented by Canada. Shrimp catch rates from two surveys in August-September 1978 indicate low abundance in Div. 0A and 0B. Exploratory fishing by Denmark during the same period (unpublished data) corroborates these results. The best catches were obtained between 64°30' and 65°30'N in depths of 290-310 m. These fall within the range of highest concentrations of shrimp reported for a survey in 1977 (Res. Doc. 77/XI/70). The only areas of commercially important shrimp concentrations were encountered on both sides of the Canada-Greenland median line in Statistical Area 0 and Subarea 1 in areas where the traditional fishery exists. It was pointed out, however, that the coverage by these surveys was minimal and that the possibility of commercially-productive shrimp concentrations being missed cannot be ruled out.

Investigations on vertical movement and diel availability of shrimp, based on percentage of ovigerous females in catches at different times of the day, resulted in hourly corrective factors to a maximum of 2.47. This maximum figure falls within the range obtained from commercial data in previous studies (Res. Doc. 76/VI/113, 76/XII/149 and 150).

Subarea 1. For the area off West Greenland, Denmark reported that a Greenland trawler made an exploratory trip in September 1978 to offshore grounds in Div. 1A between Disko Island and Upernavik. Nineteen hauls were made, but, apart from one haul northwest of Disko Island (within the 12-nautical mile zone), none produced catch rates attractive to commercial fishing, most hauls yielding less than 100 kg per hour fishing. Also, the average size of the shrimp was somewhat smaller (95-206 specimens per kg) in this area than on the main shrimp grounds in Div. 1B.

Research and commercial data for 1978 are consistent with earlier observations, indicating the highest levels of offshore abundance in Div. 1B. Commercial data showed the same seasonal northward shift in fishing activity in this division as that noted in 1976 and 1977. This shift could be due partly to ice conditions in the area, but it is also observed later in the year when ice is no longer a limiting factor in the choice of fishing grounds. Moreover, throughout the three years (1976-78), there seems to be a tendency toward a general northward displacement inside Div. 1B superimposing the seasonal shift in fishing activity. Thus, in the latter half of 1978, much of the fishing activity seems to have occurred in the area around 68°N latitude, the border line between the management area off Disko Bay and the area west of Store Hellefiske Bank. The extremely high densities of shrimp, observed on the basis of high catch rates in the commercial fishery in the first half of 1976 and 1977 in the southern part of Div. 1B were not observed to the same extent in 1978. This may be due to ice being a limiting factor in the first part of 1978 but may also be due to differences in the pattern of shrimp occurrence and abundance between the years.

A photographic survey, conducted by Denmark (Res. Doc. 78/XI/89), confirmed the general distribution of shrimp in Div. 1A and 1B. More small (pre-recruit) shrimp were observed at some of the photographic stations than in the previous year, and one of the stations in the deep to the north of Store Hellefiske Bank was outstanding from other stations in the same area by showing an unusually high density of very small shrimp (of a size which would escape through the meshes of a (legal) commercial trawl). This is the first time that such small shrimp were observed in the main offshore area.

The Working Group took note of information in Res. Doc. 78/XI/96 which describes the proportion inside the 12-nautical mile zone of those shrimp grounds which have been considered as "offshore" grounds in the assessment of shrimp in Subarea 1. In terms of area, not more than 6% of the total "offshore" grounds are distributed inside the 12-mile zone. To indicate the possible distribution of "offshore" shrimp biomass in relation to the 12-nautical mile line requires knowledge and/or assumption of shrimp density on either side of the line for each specific ground in question. Assuming a uniform density of shrimp on each ground, about 7% of the "offshore" shrimp biomass on the Greenland side of the Canada-Greenland median line may be distributed inside the 12-nautical mile fishing zone. For the present management area between 64°15'N and 68°00'N, about 5% of the shrimp biomass may be distributed inside the zone under the aforementioned assumption.

3. Biology (Res. Doc. 78/XI/87, 89, 93, 95)

Observations relating to the occurrence of pre-recruit shrimp were mentioned in the preceding section. Further observations on the diurnal vertical migration of shrimp were made on Canadian surveys and on a French trawler. Samples taken at various times of the 24-hour period showed ovigerous females to have much less tendency to diurnal vertical movement than smaller shrimp. It seems necessary to take this observation into account in sampling schemes and in analyses of samples.

New information on the occurrence of shrimp larvae in Davis Strait and of currents over the shrimp grounds off West Greenland is given in Res. Doc. 78/XI/93. Whereas a general northward drift of shrimp larvae (and fish larvae) seems to occur over the West Greenland Shelf, thus supplying some larval recruitment from the southern spawning stocks to the stock in Div. 1B, the spawning stock in Div. 1B itself seems to be very important for the recruitment of shrimp to this area, since the net drift by currents decreases significantly from south to north and also, in the northern part of Div. 1B, from surface to bottom. There are also strong indications that the area to the west and southwest of Disko Bay produces shrimp larvae, many of which drift into Disko Bay. Some of the larvae produced in Disko Bay may drift out of the Bay mainly to areas west and northwest of Disko Island.

4. Catch and Effort Data (Res. Doc. 78/XI/94, 95, 97)

Catch and effort data were available for fisheries by Denmark (Faroes and Greenland), France and Norway. Data for the Norwegian fleet fishing in Div. 1B showed a decreasing trend in annual mean catch rates from 1975 to 1977. In each of the three years mentioned, very high catch rates were obtained in one or another period during the first half of the year, with catch rates significantly lower in the last half of the year. Norwegian data for 1978 indicate much lower catch rates in the first half of the year than in any of the previous years, but the catch rates after June were more similar to but generally somewhat lower than those in the second half of the previous years. The trends in catch rates for the Faroese fleet in the same area and period were very similar to those observed for Norwegian vessels.

Data for the Greenlandic fleet of large trawlers, covering the period from June 1976 to September 1978 in Div. 1B, showed the same seasonal decline in catch rates in 1976 and 1977 as that described above, although not so drastic seasonal changes as indicated by Norwegian data. The catch rate for Greenlandic trawlers in January-April 1978 was considerably less than for the same period in 1977, thus showing the same change as observed in the catch rates of Faroese and Norwegian trawlers. However, whereas Norwegian vessels did not show any noteworthy improvement in catch rate after April and up to September 1978, the catch rate of Greenlandic trawlers was higher in May 1978 than in the first quarter of the year, but declined after July, as in previous years. Since the three fleets mentioned very often fish close to each other, one would expect to find reasonably close agreement in their catch rates. However, ice conditions was a limiting factor for the fishery in the first half of 1978. This may explain why fishing in the first four months occurred mainly in Holsteinsborg Deep, as also shown by the fishing activity of a French trawler. In May, the fleets appeared to move to the main fishing area at the western slope of Store Hellefiske Bank, but ice may still have hampered fishing operations at that time for some vessels. Consequently, those vessels which are most able to conduct fishing in drift ice, among these the Greenland trawlers, were less influenced by the ice than other vessels.

Danish (Faroese and Greenlandic) and French data for 1978 show that after April the fishing activity in Div. 1B was spread over a rather wide area. The tendency to search for better fishing seems to have been greater in 1978 than in previous years when in any given period most of the shrimp-fishing fleet was concentrated in a very small area. The best catch rates were obtained around 67°30'N but there was a greater tendency than in previous years to fish around 68°N.

As indicated above for Div. 1B, catch rates have generally been much higher in the first half than in the second half of the year. However, on the average, catch rates seem to have declined over the last three years. Due to the apparent atypical situation in the first half of 1978, average catch rates based on preliminary data for 1978 are not directly comparable with those for previous years. However, using the data for the July-September period when ice should not influence fishing operations, the following unweighted mean catch-per-unit-effort values (kg/hr) are obtained for Div. 1B:

Year	Norwegian trawlers	Greenland trawlers
1975	393	No fishing
1976	404	746
1977	336	566
1978	269	453

Catch and effort data for other divisions are more limited. Norwegian data for Div. 1C and 1D indicate a decrease in catch rate from 1977 to 1978 in all months for which comparison can be made. The decrease is about 28% for Div. 1C and about 39% for Div. 1D. There is no overlap on a monthly basis between 1977 and 1978 for the very limited amount of data available for Div. 1A, and there seems to have been virtually no shrimp fishing activity in Div. 1E and 1F. Also, the available commercial data on catch rates in Statistical Area 0 are so limited that comparison between 1977 and 1978 cannot be made at present.

5. Biomass Estimates (Res. Doc. 78/XI/87, 88, 89)

Direct biomass estimates based on trawl surveys and a stratification scheme were provided by Canada for shrimp grounds in Statistical Area 0 and part of Subarea 1. Despite correction of data for diel variability of shrimp in a survey in August 1978 (Res. Doc. 78/XI/87), the estimated minimum trawlable biomass did not exceed 35,000 tons for an area including part of the commercially-important shrimp grounds in Div. 1B and 1C, the southernmost part of Div. 0A and all of Div. 0B. The second survey in September 1978 (Res. Doc. 78/XI/88) indicated an estimate of 3,500 tons in Div. 0B in depths between 276 and 550 m. These estimates are used only as supportive evidence that areas to the west of the traditional shrimp grounds are commercially unproductive, not so much because of the relatively low biomass as because of the wide distribution of this biomass and thereby the low densities.

Denmark provided biomass estimates on the basis of stratified bottom photography of the grounds in Div. 1B. Although the photographic survey generally covered the same area as in 1977, the distribution of stations was somewhat different. Due to variation in density between the various strata, it is not possible to directly compare biomass estimates for strata covered in 1977 with those obtained for other strata in the 1978 survey. However, indirect comparison through data from the 1976 trawl survey does indicate a decrease of about 20% in biomass from 1977 to 1978. As indicated in Section 2 above, the photographs taken in 1978 show more small shrimp than those taken in 1977.

6. Total Allowable Catch

At its meeting in November 1977, the Working Group considered the mean fishable biomass of shrimp in Subarea 1 for 1977 to be at the same level as that estimated for 1976 and consequently did not change its advice on a TAC for 1978 from that for 1977. However, present analyses of available data point to a decrease in the fishable biomass since 1976. Catch-per-unit-effort data indicate an overall gradual decline in catch rate (with great seasonal variation) of about 32% from 1976 to 1978, and evidence from photographic and trawl survey data suggest a decrease in the fishable biomass of about 20% from 1977 to 1978. It was therefore the general consensus of the Working Group that a somewhat lower catch level would be advisable for 1979. The Working Group agreed to use the same approach to arrive at advice on a TAC as in the two previous years, i.e. the spawning (hatching) stock size should not be reduced below 50% of the virgin stock. However, in the absence of any firm conclusion on the absolute mean fishable biomass in 1978, the matter was discussed in relation to previous observations, with several points being raised reflecting uncertainties both in the interpretation of data and in the degree of caution which members of the Working Group felt should be taken.

Part of the discussion focussed on the change in size distribution of shrimp from 1977 to 1978 as observed in the photographic survey data. The greater abundance of small shrimp in 1978 suggests a relatively strong year-class, which would recruit to the fishable stock during 1979 but occur mainly as male shrimp at the lower part of the normal commercial size distribution. By 1980, this group would occur mainly as female shrimp in the upper part of the size distribution. Although recruitment prospects during 1979 seem to be good, the information available is too scanty to predict a relationship between pre-recruits and subsequent recruitment. The Working Group, therefore, considered it advisable to be cautious in proposing a TAC for 1979, noting the prospect of improved fishing on larger shrimp in 1980.

The Working Group also discussed whether the likely shortfall of 1978 catches compared to the 1978 TAC should influence the advice for 1979. Since most of these shrimp (not caught in 1978) would not contribute to the stock in 1979 under the present assumption of high natural mortality after first spawning (hatching), it was agreed that the shortfall should not influence the advice on a TAC for 1979. However, it was emphasized that the shortfall in 1978 implies a higher spawning (hatching) potential at the beginning of 1979 than would otherwise be the case.

The Working Group recognized that the exploitation of a new resource normally starts by producing relatively high catch rates but that the exploitation will decrease the biomass and subsequently result in lower catch rates at the sustainable level of fishing, and indicated that this fact should be recognized by fishermen and administrators. In the West Greenland area, it is likely that this basic effect of fishing on the stocks would be less evident from catch statistics, since environmental factors may cause great year-to-year variation in larval survival and subsequent recruitment. In any case, the observed decline in catch rates is not unexpected and fishing activity will have to be adjusted accordingly. In considering the degree of reduction to be advised for 1979, the Working Group considered that one reference point might be the observed decrease of about 20% in stock biomass from 1977 to 1978, implying a corresponding decrease in the TAC. Since the basic approach in the model used for the first assessments in 1976 and 1977 was considered to be rather cautious in terms of spawning stock conservation, and since the initial estimate of fishable biomass in 1976 was a minimum estimate, the Working Group agreed that a 20% reduction in the TAC was a reference point to be regarded as the minimum advisable reduction.

Concern was expressed, however, that the gradual change of fishing activity by areas during the 1975-78 period indicated the maintenance of a relatively high level of annual catch (although decreasing from

1976 to 1978) due to the continued searching for and progressive exploitation of new shrimp concentrations during these years. Consequently, the advisability of a greater reduction in fishing activity than that inferred in the preceding paragraph was considered, with the view that, if this was not done now, a relatively larger reduction might have to be applied in the future. From this point of view, since catch rates have declined by about 32% from 1976 to 1978, a corresponding reduction in TAC might be considered advisable, taking also into consideration the need for conservative action regarding the many new recruits which are expected to enter the fishery in 1979 and 1980.

Although advice involving a range of TAC is difficult for decision by management, the Working Group agreed that the range of reduction (20-32%) in TAC reflects the present knowledge and the various points of view raised during the discussion. It also reflects the necessity of having much better data than are currently available where advice of great significance for the fisheries is to be given. The Working Group accordingly advises that the 1979 TAC for shrimp should be set at a level in the range of 20-32% below the advised 1978 TAC of 40,000 tons (including discards) for the offshore shrimp grounds in Subarea 1.

No new arguments were presented for or against the breakdown of the TAC by management areas, reference being made by the Working Group to previous discussions on this matter and on the possible interrelationships between shrimp on offshore grounds and those in Disko Bay (*ICNAF Redbook* 1977, page 16; 1978, page 13). The Working Group did, however, note that, of the shrimp grounds and biomass found in Statistical Area 0, only those in direct contact with the grounds in Div. 1A and 1B are to be taken into account as covering the stock for which the advice on a TAC is given (*ICNAF Redbook* 1978, page 13).

7. Discarding of Shrimp

Some shrimp are known to be discarded for various reasons and probably with a high degree of variation among vessels. Discards may consist of shrimp too small to be processed and/or marketed, soft-shelled shrimp (just moulted) which cannot be used for some products, and so-called "black-headed" shrimp which cannot be mixed with whole frozen shrimp but can be used for peeled shrimp products. Occasionally an entire haul may be discarded if the net is filled with mud, but this source of discarding is probably negligible.

The "black-headed" phenomenon in shrimp may occur in specific areas and seasons, but no good information on its occurrence is available. "Black-headed" shrimp are not discarded by vessels whose catches are used for peeled shrimp products. This applies to the Greenland fleet and since 1976 to the Norwegian fleet and in 1977 to a part of the Faroese fleet. Discarding of commercially-undersized shrimp may vary among vessels. Greenland trawlers land their entire catches, but some, if not all, vessels producing shrimp products at sea sort the shrimp into size categories, of which the smallest size group may be discarded. Observations made by Norwegian observers on a commercial vessel indicated that the rate of discarding (mainly "undersized" shrimp) was about 8% in Div. 1B during July-August 1976, about 22% and 13% in Div. 1B and 1C respectively during June-July 1977, and about 10% in Div. 1B during July-August 1978.

Vessels fishing within the Greenland fishing zone are requested to report information on discards (TACs include discards) but only a very limited amount of data are available at present. More information is needed, including the possible survival of discarded shrimp, before a better evaluation of discarding can be made.

8. By-catch in the Shrimp Fishery (Res. Doc. 78/XI/87, 88, 94)

New information on by-catch of finfish in the shrimp fishery in Subarea 1, presented by Norway (statistics collected by observer at sea) and by Denmark (G) (statistics from logbooks), confirmed earlier observations that the major finfish by-catch consists mainly of small redfish and Greenland halibut and some other species. Statistics available for Greenland trawlers show that by-catches during the period from October 1977 to September 1978 amounted to approximately 2,600 tons of redfish and 45 tons of other finfish in catches totalling 5,500 tons of shrimp. Thus, by-catches may be roughly equal to about one-half of the shrimp catch. However, both the Greenlandic and Norwegian data indicate that by-catch ratios vary considerably by time and area, so that a longer period of observation is needed in order to fully evaluate the problem.

The Canadian surveys in Statistical Area 0 indicate that small redfish and Greenland halibut are common as by-catch but Arctic cod (*Boreogadus saida*) frequently occurs, 5 tons being taken in a 10-minute haul at one location.

9. Future Research Requirements

The Working Group noted that some of the recommendations made at the November 1977 Meeting of STACRES (*ICNAF Redbook* 1978, page 14) were followed up in 1978, including studies on vertical distribution of shrimp and expansion of the photographic surveys, the latter showing some potential to assess recruitment. Future requirements in terms of priority were reviewed, and the Working Group

recommends (8)

i) that extensive stratified surveys using "swept area" and photographic techniques be carried out, with a view to updating the estimate of the minimum trawlable biomass of shrimp in Subarea 1 beyond the 1976 reference point; and

ii) that an extensive observer program designed to closely monitor the shrimp fishery on a year-round basis be implemented, in order to provide more detailed information on catch-per-unit-effort, size composition, by-catches and discards.

The Working Group noted that the surveys recommended in (*i*) above would require a considerable amount of sea time, and that such surveys could also provide data leading to mortality estimates, recruitment estimates, and additional knowledge on vertical migration and its variability.

10. Other Matters

The Working Group was pleased to note that *Selected Papers* No. 4, containing shrimp papers presented at meetings in 1976, was now available, and expressed appreciation to the Secretariat for its efficiency in producing this publication. It was also noted that shrimp stocks in other parts of the world were being assessed and managed and that it would be valuable to follow the developments and experience in such areas, e.g. in Alaskan waters.

APPENDIX III. REPORT OF *AD HOC* WORKING GROUP ON STANDARDIZATION OF REPORTING PROCEDURES FOR SAMPLING DATA

Convener: W. G. Doubleday Rapporteur: V. M. Hodder

The *ad hoc* Working Group met at Bergen, Norway, on 13-16 November 1978 in accordance with the recommendation of STACRES at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 41) to consider the advisability of reporting individual length and age samples to the Secretariat and to develop suitable formats for reporting as required. Representatives attended from Canada, Denmark, USSR, USA, and the ICNAF Secretariat. The terms of reference for the Working Group, as specified by STACRES, were adopted as the agenda for the meeting and are indicated as headings for the following eight sections.

1. Review of the Present Situation

The Working Group was referred to the present ICNAF sampling standards as outlined in *ICNAF Sampling Yearbook* Vol. 20 for 1975. The most recent review of sampling activity in the ICNAF Area showed that sampling efficiency had improved slightly from 1975 to 1976 (Sum. Doc. 78/VI/11). However, it was noted that the number of samples was still inadequate in some cases, that sampling by sex for flatfish species was not always carried out and that the time of sampling did not always correspond with the period of major fishing activity. Furthermore, there has been no recent review to consider whether ICNAF sampling standards are complied with, and such compliance could not be inferred from the data reported to the Secretariat.

The Working Group noted that the institution of observer schemes by some coastal states had significantly improved both the distribution and the number of samples. Concern was expressed that samples from joint ventures were not appearing in data submitted to ICNAF.

The Danish representative indicated that there were at present no special international requirements for sampling data in Subarea 1 but expected the minimum ICNAF requirements to be met by those countries fishing in the area. He indicated that weekly reporting to the coastal state of catch and effort data was required in the regulated fisheries.

The Canadian representative indicated that sampling plans are requested in conjunction with the submission of fishing plans and that the number of samples taken is requested to be reported together with weekly catch and effort data to permit the monitoring of sampling performance in relation to progress toward the quotas in the Canadian zone. Sampling coordinators have been appointed to positions at St. John's and Halifax. The sampling requirements generally follow ICNAF standards with some additions, particularly the reporting of individual length and age samples from within the Canadian fishing zone.

The USA representative indicated that ICNAF sampling guidelines are generally followed but that the minimum requirement has been increased to one sample per 1,000 tons per month per 30' x 30' unit area for distant-water fleets fishing in the USA zone. This standard is presently being exceeded due to an extensive observer program. Individual length samples collected by USA observers from the distant-water fleets for 1977 and 1978 have not yet been computerized nor have the age samples been processed. Samples from USA landings for this period have been processed and are available.

The USSR representative indicated that the ICNAF guidelines given in *Sampling Yearbook* Vol. 20 have generally been followed, and that for some species (e.g. silver hake and squids) the minimum requirements have been exceeded by 4 to 5 times. It was pointed out that the Canadian deadline of 60 days for the submission of samples could not always be met due to the extended periods that the vessels are at sea, and it was proposed that the deadline of 60 days should be counted from the date of delivery of the samples on shore. It was noted that samples taken in the USA fishing zone are not reported to the ICNAF Secretariat. It was also noted that the current practice of having a uniform minimum sampling rate for all stocks was not optimal since fewer samples would be needed for short-lived species than for long-lived species.

2. Review of Coastal States' Positions Regarding Requirements for Sampling Data

a) The representative of Canada favoured the submission of data on individual samples to the ICNAF Secretariat, but takes a flexible view regarding the format of reporting.

b) The representative of Denmark raised no objection to the reporting of individual samples, while indicating that catch and effort statistics for the Greenlandic fleet of large vessels are collected by $7\frac{1}{2}$ x 15' unit areas, and may become mandatory for national vessels greater than a certain size.

c) No statement on requirements was available for France.

d) The representative of USA favoured the reporting of individual samples, but pointed out the need for linkage between sampling and corresponding catches for estimation of appropriate weighting factors and expressed concern about the possibility of misinterpretation of individual sampling data.

3. Review of Proposed NAFO Convention in Relation to Research and Statistics

The Working Group referred to Articles VI and XX of the NAFO Convention and concluded that the Scientific Council has a role in maintaining a sampling data base, that coordination of the reporting of sampling within the Convention Area would facilitate the provision of advice by the Council, and that the reporting of individual samples would facilitate any future revisions of statistical boundaries in the Convention Area.

4. Evaluation of the Need for Standardized Reporting of Individual Samples

The Working Group agreed that standardized reporting was desirable for countries whose vessels fish widely in the Convention Area, and stressed the need for coordination of sampling standards and procedures for stocks overlapping the 200-mile zone boundaries. It was also noted that the Scientific Council of NAFO would require a data base to aid in its formulation of management advice. In view of these considerations, the Working Group

recommends (1)

that individual length samples of commercial catches and the corresponding age-length keys be made available to the ICNAF (NAFO) Secretariat for final incorporation into its sampling archives.

5. Implications on the Secretariat of Reporting and Processing of Individual Samples

Adoption of the above recommendation would result in a substantial increase in the number of samples submitted to the Secretariat (from about 1,000 presently to somewhere in the range of 2,000-10,000) with a corresponding increase in the number of age-length keys. This would substantially increase the key-punching workload of the Secretariat, unless data were submitted in machine-readable form. However, the cost of maintaining the more detailed data base would not significantly increase over the present level. Countries fishing in the ICNAF (NAFO) Regulatory Area would be expected to submit their samples directly to the Secretariat, while countries fishing within the 200-mile zones might, in some instances, by bilateral agreement, arrange for sampling data to be key-punched and forwarded to the ICNAF (NAFO) Secretariat by the coastal states.

6. Implications on Member Countries

None of the country representatives present foresaw any serious problems for their own country in the reporting of individual length and age samples of commercial catches.

7. Availability of Sampling Data Through the Secretariat

The Working Group noted that the proposed sampling data base will contain considerably more detail, some of which is of a confidential nature, than at present and that STACRES might wish to limit the distribution of the data. However, the Working Group

recommends (2)

that an inventory of the sampling data be published annually, and that the data be available to members of STACRES at present and to members of the Scientific Council of NAFO in the future.

8. Design of Forms and Procedures

The Working Group discussed the contents of forms and proposed a form similar to the attached for the reporting of individual length samples. Time did not permit the development of a format for the reporting of age samples. However, the Working Group agreed on a list of contents and proposed that the Secretariat develop a draft form for the reporting of age-length keys to be circulated to members of STACRES for comment prior to discussion and possible adoption by STACRES at its Special Meeting in February 1979. The list of contents is as follows:

a) Year
b) Country
c) Vessel name
d) Vessel side number
e) National registration number
f) ICNAF gear abbreviation
g) Mesh size
h) Observer
i) Date (month/year)
j) Starting position of set (latitude, longitude)
k) Starting time of set (local time)
l) Fishing depth (m)
m) Species
n) Sex (where applicable)
o) Sampling method
p) Method of measuring length (fork, total, mantle, etc.)
q) Recorded measurement (nearest cm, to cm below)
r) Structures used in ageing
s) Weight of age sample (kg), if available
t) Were individual weights taken?
u) Age-length key
v) Mean weight-at-length, if available

The Working Group recognized that combination of ageing material from several length samples is practically necessary in some cases. However, the Working Group

recommends (5)

that data from samples taken for ageing not be combined for periods exceeding one calendar month or for areas greater than one ICNAF division (or subdivision, where applicable).

9. Acknowledgements

The Chairman thanked the participants for their contributions to the Working Group.

COMMERCIAL FISHERY LENGTH SAMPLES

Year	Country	Vessel name	Side no.
National reg. no.	Gear	Mesh size (mm)	Observer

Date (month/day)						
Start of set position Lat. / Long.						
Starting time of set (local)						
Fishing depth (m)						
SPECIES SAMPLED						
Catch or Landing						
Method of measuring						
Recorded meas.						
Length interval						

1cm	2cm	3cm	5mm	M	F	M	F	M	F	M	F	M	F	M	F
0	16-	15-													
1	18-	18-													
2	20-	21-													
3	22-	24-													
4	24-	27-													
5	26-	30-													
6	28-	33-													
7	30-	36-													
8	32-	39-													
9	34-	42-													
0	36-	45-													
1	38-	48-													
2	40-	51-													
3	42-	54-													
4	44-	57-													
5	46-	60-													
6	48-	63-													
7	50-	66-													
8	52-	69-													
9	54-	72-													
0	56-	75-													
1	58-	78-													
2	60-	81-													
3	62-	84-													
4	64-	87-													
5	66-	90-													
6	68-	93-													
7	70-	96-													
8	72-	99-													
9	74-	102-													
0	76-	105-													
1	78-	108-													
2	80-	111-													
3	82-	114-													
4	84-	117-													
5	86-	120-													
Number measured															
Sample weight (kg)															
Catch weight (kg)															
No. for ageing															

Form CFS-1 (12/78)

See overleaf for Notes

NOTES FOR COMPLETION OF FORM CFS-1

1. The form is designed to facilitate the reporting of (a) several species from the same set, or (b) the same species from several sets. In order to facilitate data-processing, it is essential that all of the information required for each sample be entered in the appropriate spaces on the form.

2. In the space "National reg. no.", record the national registration number of the fishing vessel.

3. In the space for "Gear", record the appropriate abbreviation for the gear type used based on the ICNAF Gear classification for reporting sampling data, as follows:

OTB	-	Bottom otter trawl (side and stern)
OTM	-	Midwater otter trawl (side and stern)
PTB	-	Bottom pair trawl (2 boats)
PTM	-	Midwater pair trawl (2 boats)
SN	-	Seine net (Danish and Scottish seines)
SB	-	Beach seines
PS	-	Purse seines
GN	-	Gillnets (set and drift)
LL	-	Longlines (set)
LHP	-	Handlines and pole-lines (including mechanized lines)
FPN	-	Uncovered pound nets
FWR	-	Weirs, barriers, fences, etc.
DRB	-	Boat dredges
HAR	-	Harpoons

4. In the space for "SPECIES SAMPLED", record the common English name of the species, supplemented by the ICNAF 3-digit code as given in *ICNAF Statistical Bulletin* Vol. 26.

5. In the space for "Method of measuring" length, record one of the following as appropriate: Fork, Total, Mantle, Carapace. If other methods of length measuring are used, please specify.

6. In the space for "Recorded meas.", enter one of the following as appropriate: Nearest cm, Cm below, Nearest half-cm, Half-cm below.

7. In the space for "Length interval", record the appropriate length group used, i.e. 1 cm, 2 cm, 3 cm, or 5 mm, etc. For the "1 cm" and "5 mm" intervals, please ensure that the appropriate starting length group is given in the relevant column.

8. In the columns labelled "M" and "F", enter the actual length frequencies for species required to be sampled by sex. For species not required to be sampled by sex, enter the actual length frequency in the "M" column.

9. At the bottom of the form, the "Sample weight" refers to the actual weight (kg) of the length frequency sample recorded in the column above. The "Catch weight" refers to the actual weight (kg) of the sampled species in the set, where the sample pertains to an individual haul, and in the landing, where port sampling is carried out.

10. Where samples are taken for ageing, record in the "No. for ageing" space the actual number of specimens in each sample.

PART B

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

Special Meeting on Capelin and Squid, February 1979

CONTENTS

[1] Distributed previously as *ICNAF Sum. Doc.* 79/VI/5.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Special Meeting on Capelin and Squid, February 1979.

Chairman: G. H. Winters

Rapporteur: V. M. Hodder

STACRES met at Tokyo, Japan, during 14-21 February 1979 to provide advice on the scientific basis for management in 1979 of the capelin stocks in Subareas 2 and 3 and the squid (*Illex*) stocks in Subareas 3 and 4. The agenda for the meeting is given in Part D (this volume). The assessment of the southern capelin stock in Divisions 3LNOPs and the squid stocks were deferred from the 1978 Annual Meeting (*ICNAF Redbook* 1978, pages 39 and 48). The reassessment of the northern capelin stock in Subarea 2 and Div. 3K was added to the agenda for this meeting at the request of Canada (Com. Doc. 79/III/1). Following the recent resignation of the Chairman of STACRES (Dr E. C. Lopez-Veiga), it was unanimously agreed that Dr G. H. Winters (Canada) act as Chairman for this meeting. Scientists attended from Canada, Cuba, France, German Democratic Republic, Japan, Norway, Poland and USSR, and an observer was present from USA.

Meetings of the *ad hoc* Working Group on Capelin (convened by G. H. Winters) and on Squid (convened by F. Nagasaki) were held concurrently during 15-20 February and their reports as approved by STACRES are given in Appendices I and II. Brief summaries of these reports, together with other matters considered by STACRES, are given below.

1. Assessment of Capelin Stocks (App. I)

a) Trends in catch and effort

The nominal catch of capelin in Subareas 2 and 3 declined from a peak level of 366,000 tons in 1975 to 84,000 tons in 1978. The development of the fishery during 1971-75 and the subsequent decline to 1978 followed a similar pattern in both the northern (Subarea 2 and Div. 3K) and the southern (Div. 3LNOPs) stock areas, but the decline was particularly great in Div. 3NO where the nominal catch decreased from 132,000 tons in 1975 to about 5,000 tons in 1978. Stock discrimination studies indicated that the spawning population on the Southeast Shoal (Div. 3N) is distinct from that spawning inshore in Div. 3L but they were unable to demonstrate the possible mixture of these spawning components in the offshore fishery in Div. 3L.

Analysis of catch and effort statistics indicated that the catch per hour fishing of USSR BMRT-A trawlers in Subarea 2 and Div. 3K declined from 6.5 tons in 1975 to 2.3 tons in 1978. Statistics for this vessel type were not available for Div. 3LNOPs, but the catch per day of USSR trawlers (>2000 GRT) declined from 44 tons in 1976 to 28 tons in 1978. Catch per unit effort was considered not to be a reliable index of abundance in Div. 3N, since the catchability coefficient would probably increase with declining abundance, given the distributional characteristics of capelin on the spawning grounds.

b) Subarea 2 and Division 3K

Both Canadian and USSR analytical assessments indicated that the biomass of the northern stock was high during the mid-1970's (up to 4.0 million tons) due to good recruitment of the 1969 and 1973 year-classes but has since declined due to poor recruitment of the 1974-76 year-classes. Biomass estimates for 1978, derived by various methods, ranged from 59,000 tons to 1.25 million tons. Weighting of the various estimates according to the reliability of the data yielded an average biomass estimate of 665,000 tons on 1 September 1978. This estimate was projected forward to 1980, assuming catches of 50,000 and 100,000 tons in 1979 and assuming that recruitment of the 1977 and 1978 year-classes at age 2 was equal to the geometric mean of the strength of previous year-classes. It must be emphasized that the size of the stock in 1980 will depend very greatly on the strengths of the 1976-78 year-classes. In view of the uncertainties about the size of these year-classes, STACRES advises that the TAC for Subarea 2 and Div. 3K in 1979 should be set at 75,000 tons.

c) Divisions 3LNOPs

Tagging studies by Norway in Div. 3N in 1978 indicated that the catch (about 5,000 tons) represented a high proportion of the spawning biomass in that area. An acoustic survey in May indicated a biomass of 310,000 tons in Div. 3L, and a sequential capelin abundance model indicated a biomass of approximately 200,000 tons in Div. 3LNOPs, 98% of which was estimated to be in Div. 3L. The sequential abundance model indicated that biomass levels during the early and mid-1970's were much higher than in 1978, due to recruitment of the strong 1969 and 1973 year-classes, and that the proportion of the stock in Div. 3NO was much higher in earlier years. Recent recruitment (1974-76 year-classes) has been poor. The decline in stock biomass has been much greater in Div. 3NO than in Div. 3L, and, since bottom temperatures on the spawning grounds in Div. 3N in recent years have been within the range suitable for spawning in that area, the possibility of recruitment overfishing should be taken into account.

Projections of stock size, using two different estimates of the strength of the 1976 year-class (860 and 2,134 million fish) and two levels of biomass estimated for 1978 (200,000 and 310,000 tons), indicated that the biomass in 1979 would be lower than the estimates for 1978 and that the strength of the 1976 year-class would have to be much greater than the maximum estimate used in the projections for the biomass in 1979 to exceed the levels estimated for 1978. Since a species like capelin with a short life-cycle usually exhibits large fluctuations in abundance, STACRES concluded that, during periods of poor recruitment, the exploitation rate should be low in order to protect the spawning stock biomass. Using a conservative exploitation rate of 10%, the projections indicate that the TAC for capelin in Div. 3LNO should fall in the range of 9,000-16,000 tons. On the basis of the higher estimate of capelin abundance in 1979, STACRES advises that the 1979 TAC in Div. 3LNO should be set at 16,000 tons. Furthermore, in order to protect the spawning stock in Div. 3N and during its migrations through Div. 3O, STACRES advises that there should be no commercial fishery for capelin in Div. 3NO and that the TAC apply only to Div. 3L.

d) Future research

The uncertainties which continue to exist about the population dynamics of capelin make it important, for future assessments, that all biomass estimates be accompanied by estimates of variance, that methods be investigated for improving the estimation of pre-recruit abundance, that studies on predator-prey interactions and migration patterns be continued, and that research on spawning behaviour and egg mortality in Div. 3N be initiated.

2. Assessment of Squid (*Illex illecebrosus*) Stocks in Subareas 3 and 4 (App. II)

a) Fishery trends

The nominal catch of squid in Subareas 3 and 4 increased rapidly from an annual average of 4,500 tons in 1970-74 to 99,000 tons in 1978, 54% of which were taken in Subarea 4. No estimate of the 1978 catch in Subareas 5 and 6 could be made due to incomplete statistics, but the *Illex* catch was about 25,000 tons in 1976 and 1977.

The overall distribution of *Illex* in Subareas 3 and 4 during 1978 did not change much from that of 1977. Squid appeared on the Scotian Shelf in June and the fishery lasted until November. Offshore occurrence on the Grand Bank was noted in June and the fishery there extended from July to September. In Newfoundland inshore waters, squid appeared in late May and remained available to the fishery until December.

b) Biological studies

When the fishery on the Scotian Shelf began on 15 June 1978, squid were on the average considerably smaller than at the same time in 1977 (mantle length difference of 27 mm), but growth was rapid during the summer so that by September the average size was similar to that for 1977. Studies on maturation indicated that both males and females were approaching full maturity upon their departure from the coastal and shelf areas in late November. In the laboratory, female *Illex* were observed to reach full maturity and to spawn. The eggs hatched in 6-8 days at 13°C and early larval stages were observed for the first time. Further studies on age determination by statoliths confirmed the existence of numerous zones which may represent diurnal or feeding periods. Large numbers of squid were successfully tagged in inshore Newfoundland waters late in the season, and specimens recaptured up to 29 days after tagging showed no apparent adverse effects.

c) Environmental effects

Several sources of information indicated that squid abundance has fluctuated greatly over the past several years. It was noted that prevailing environmental conditions, especially water temperature, seem to be correlated with changes in availability, with possible influence on the arrival and concentration of squid on the fishing grounds. Such conditions may have influenced not only the growth but also the availability of squid on the Scotian Shelf in the early part of the 1978 fishing season.

d) Mesh selection

Various mesh selection studies were conducted in 1977 and 1978, using codend mesh sizes ranging from 45 to 130 mm. Early in the season (June) the 90-mm mesh codend released 20-23% of the catch by weight in contrast to 13-14% for the 45- and 60-mm mesh sizes currently in general use, whereas later in the year (October-November) the 90-mm mesh released 1-2% against no escapement for the 60-mm mesh . It was noted that general use of 90-mm mesh codends would not only reduce the by-catch of small commercially-important finfish species but allow the escapement of small squid early in the season with a consequent increase in the yield per recruit. It was also

pointed out that the yield per recruit of silver hake would be greatest if the size at first capture was increased to about 26 cm which corresponds to the 50% retention length for silver hake with the 90-mm mesh. STACRES agreed that the possibility of having a uniform mesh size for the squid and silver hake fisheries should be deferred until the status of the silver hake fishery is assessed, and it accordingly

recommends (1)

that the codend mesh size for the silver hake and squid fisheries be considered by the Assessments Subcommittee at its April 1979 Meeting.

e) Biomass estimates

STACRES noted that the biomass estimates provided for 1978, based on sequential population analysis and areal expansion methods, varied greatly for both Subareas 3 and 4. After discussion, it as agreed to accept the average of the various estimates of stock size with the result that the biomass (as on 1 September 1978) was estimated to be 97,000 tons in Subarea 3 and 152,000 tons in Subarea 4. Exploitation rates in 1978 were calculated to be 0.29 and 0.18 for Subareas 3 and 4 respectively.

f) Total Allowable Catch for 1979

Due to the very short life-span of *Illex* and the large fluctuations in availability from year to year, its abundance in Subareas 3 and 4 cannot be predicted at this time. The design of an effort regulation for 1979 was not possible due to the many technical problems involved. Consequently, it was agreed that a TAC should be applied to the squid fishery in 1979, accompanied by limitation of effort based on 1978 catch rates to ensure that fishing mortality would not greatly increase in the case of reduced abundance. It was noted that, should the abundance of *Illex* in 1979 be as high or higher than in 1978, a higher exploitation rate than that in 1978 would be appropriate. STACRES therefore advises that the TAC for 1979 should be set at 120,000 tons, with 70,000 tons for Subarea 4 and 50,000 tons for Subarea 3, and that the opening date of the fishery should be 1 July 1979. Since migration patterns are variable from year to year, STACRES

recommends (2)

that the Assessments Subcommittee at its April 1979 Meeting give further consideration to the commencement date for the squid fishery in relation to availability of squid on the fishing grounds and to environmental conditions.

g) Future research

STACRES noted the need for more intensified research on the general biology and distribution of *Illex*, including the effects of environmental factors on migration and abundance, through the extension of research vessel surveys, improved tagging techniques to facilitate studies on stock discrimination and the estimate of population parameters, and continued mesh selection studies to obtain more precise information on *Illex* and by-catch species.

3. Standard Form for Reporting Age-Length Keys

STACRES noted that this item had been deferred from its Special Meeting in November 1978. In view of the absence of representation at this meeting from two of the coastal states involved in the initial design of the form, STACRES agreed that the matter be deferred for consideration at the 1979 Annual Meeting by the Statistics and Sampling Subcommittee.

4. Other Matters

STACRES was informed that the publication of *Statistical Bulletin* Vol. 27 for 1977 was unduly delayed due to the non-receipt of STATLANT 21B statistics for 1977 from three countries, namely Portugal, Spain and United Kingdom, despite several telexed reminders following the reporting deadline of 30 June 1978. The Secretariat has received no response to any of its requests for the data and, consequently, cannot indicate if or when these countries will submit their data. In fact, it was noted that two of the three countries involved did not submit a preliminary monthly statistical report during the whole of 1978. STACRES expressed great concern not only for the invonvenience to the many users of ICNAF statistics caused by the delay in publishing the Statistical Bulletin, but, more important, for the effect that incomplete statistics for 1977 and 1978 will have on the stock assessments to be carried out at the forthcoming meeting of the Assessments Subcommittee in April 1979. Noting that the Secretariat had done all in its power to solicit the appropriate statistics, STACRES

recommends (3)

that the matter of non-reporting of fisheries statistics for the ICNAF Area by certain countries be brought to the attention of the Commission at its forthcoming Special Meeting in March 1979.

5. Acknowledgements

The Chairman expressed his appreciation on behlaf of STACRES to the Japanese hosts for the excellent service and facilities provided for the meeting and for their generous hospitality, he thanked all participants including the conveners of working groups and the rapporteurs for their interest and cooperation during the meeting, and the Secretariat for their usual efficient work. STACRES expressed its gratitude to Dr G. H. Winters for agreeing to preside over this meeting at very short notice.

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

Convener: G. H. Winters

Rapporteur: J. E. Carscadden

The *ad hoc* Working Group on Capelin met during 15-19 February 1979 to review the status of the capelin resource and fishery in Subareas 2 and 3. Initially the assessment was intended to cover only the southern stock complex in Div. 3LNOPs (*ICNAF Redbook* 1978, page 39), but the agenda was subsequently amended to include a reassessment of the northern stock in Subarea 2 and Div. 3K at the request of Canada (Com. Doc. 79/III/1). Scientists attended from Canada, Cuba, German Democratic Republic, Japan, Norway, Poland and USSR. During the course of the assessments, the Working Group reviewed Res. Doc. 79/II/1, 7, 9, 10, 23, 29, 30, 31, 32, 33 and 34, and unpublished data.

1. Fishery Trends

The nominal catch of capelin in Subareas 2 and 3 increased greatly from less than 3,000 metric tons in 1971 to 366,000 tons in 1975 and declined rapidly to 84,000 tons in 1978 (Table 1). The development of the fishery during 1971-75 and the subsequent decline followed a similar pattern in both the northern (Subarea 2 + Div. 3K) and the southern (Div. 3LNOPs) stock areas, except that the peak catch occurred a year later in the northern area. From 1976 to 1978, the nominal catch declined by 75% in the northern area and by 80% in the southern area. In Div. 3LNOPs, apart from Subdiv. 3Ps where catches have generally been small, the most drastic decline occurred in Div. 3NO.

Table 1. Nominal catches (metric tons) of capelin by stock area in Subareas 2 and 3, 1971-78.

Year	2+3K	3L	3NO	3Ps	3LNOPs	SA 2+3
1971	242	870	750	999	2,619	2,861
1972	45,623	1,241	21,417	2,522	25,180	70,803
1973	136,422	3,876	126,875	1,356	132,107	268,529
1974	126,939	57,713	100,751	2,248	160,712	287,651
1975	198,501	34,097	131,783	1,583	167,463	365,964
1976	216,326	33,823	110,186	61	144,070	360,396
1977	152,409	26,802	50,092	1,016	77,910	230,319
1978[1]	55,051	23,763	5,164	8	28,935	83,986

[1] Preliminary statistics.

A review of nominal catches by stock area and country during 1971-78 (Table 2) indicates that about 92% of the total catch in the northern area was taken by USSR and that 60% and 23% of the total catch in the southern area were taken by USSR and Norway respectively.

2. Migrations and Stock Interrelationships

Capelin in Div. 3LNOPs exhibited unusual distribution patterns during the 1978 fishing season. Most of the catch was taken in Div. 3L (about 24,000 tons), with only about 5,000 tons being taken on the spawning grounds in Div. 3N. It is likely that this extremely small catch in Div. 3N represented the bulk of the spawning stock (Res. Doc. 79/II/1). Anomalous hydrographic conditions in 1978 may have influenced the distribution of capelin (Res. Doc. 79/II/31). However, bottom temperatures on the spawning grounds (Div. 3N) in recent years, including 1978, were within the range of temperatures considered sufficient for capelin spawning (Res. Doc. 79/II/9). Surface temperatures in the same area were higher in 1978 than in previous years.

A multivariate analysis of meristic characters of spawning capelin (Res. Doc. 79/II/29) suggested that there are three major stocks in the Newfoundland area: the Southeast Shoal stock, the Gulf of St. Lawrence (western Newfoundland) stock, and the insular Newfoundland stock. Although meristics were not considered to be the best characters to discriminate capelin stocks, the Working Group noted that the method offered some promise in stock differentiation and recommended the continuation of such studies in view of the scarcity of knowledge on the subject.

3. Trends in Abundance

a) Commercial catch-effort analyses

Subarea 2 and Division 3K. The catch of capelin in this area has declined greatly following the

Table 2. Nominal catches (metric tons) of capelin by stock area and country, 1971-78.

Area	Country	1971	1972	1973	1974	1975	1976	1977	1978[1]
2+3K	Bulgaria	-	-	-	-	1,394	-	2,892	-
	Canada	242	461	598	1,343	698	1,684	2,136	2,446
	Cuba	-	-	-	-	-	-	5,089	1,340
	GDR	-	11	-	-	7	-	1,014	227
	Japan	-	-	-	-	62	51	870	69
	Norway	-	-	-	16	2	-	-	-
	Poland	-	24	2,356	5,734	20,267	10,494	4,282	1,036
	Portugal	-	-	-	-	175	-	-	-
	Romania	-	-	-	-	-	-	2,610	2,530
	USSR	-	45,127	133,468	119,846	175,896	204,097	133,516	47,403
	Total	242	45,623	136,422	126,939	198,501	216,326	152,409	55,051
3LNOPs	Bulgaria	-	166	-	-	-	1,271	578	25
	Canada	1,869	3,312	5,502	13,693	3,817	7,832	9,715	6,277
	Cuba	-	-	-	-	-	-	700	82
	GDR	-	-	-	-	-	-	-	179
	Iceland	-	-	-	-	15,814	8,839	3,394	354
	Japan	-	-	-	-	2,819	5,063	3,958	789
	Norway	-	653	41,293	43,964	37,477	23,178	21,499	4,238
	Poland	-	-	744	3,742	4,608	4,627	1,018	502
	Portugal	-	-	-	3,500	399	-	-	-
	Romania	-	-	-	-	-	-	-	107
	Spain	-	-	-	4,016	4,284	-	-	-
	USSR	750	21,049	84,568	91,797	98,245	93,030	37,047	16,382
	Others	-	-	-	-	-	230	1	-
	Total	2,619	25,180	132,107	160,712	167,463	144,070	77,910	28,935

[1] Preliminary statistics

peak catch in 1976. In view of the oceanic distribution of capelin during the fishing season, the Working Group concluded that catch-per-hour trawling of the standard class USSR BMRT-A trawlers would provide a useful index of stock abundance (Res. Doc. 79/II/30). Catch-per-hour trawling was considered to be a more accurate index than catch-per-day fished, as the catch during a day can be increased or decreased by fishing for different periods of time. The catch-per-unit effort was highest in 1975 (6.47 tons per hour) and declined to a low level in 1978 (2.29 tons per hour).

Divisions 3LNOPs. Estimates of catch per unit effort of USSR trawlers (>2000 GRT) in Div. 3L indicate a gradual decline from 1975 to 1977 (46.1 to 39.9 tons per day) and an abrupt decline in 1978 (27.6 tons per day) (Res. Doc. 79/II/33). In Div. 3N, catch per unit effort declined from 50.1 to 37.9 tons per day from 1974 to 1977 with a sharp decline to 0.8 tons per day in 1978. The Working Group noted that, because the capelin occurring in Div. 3N are composed of dense spawning schools, the catchability coefficient would probably increase as the stock declined and the catch per unit effort would remain high. Under these conditions, catch per unit effort would not likely be indicative of the trend in stock abundance until the stock had declined to an extremely low level. The Working Group therefore concluded that the estimates of catch per unit effort (Res. Doc. 79/II/23, 31 and 33) were useful as an index of stock abundance in Div. 3L only.

b) Research vessel survey indices, including acoustic data

Subarea 2 and Division 3K. A USSR acoustic assessment in November 1977 provided a biomass estimate of 59,000 tons (Res. Doc. 79/II/30), but this estimate was considered to be unreliable because the distribution of capelin in 1978 made the photographic estimation of density of the schools difficult and the survey did not include areas inside Canadian territorial waters. A Canadian acoustic assessment in October 1978 provided a biomass estimate of 339,000 tons (Res. Doc. 79/II/34), which is considered to be an underestimate because the capelin were observed to be congregating at the end of the survey.

Divisions 3LNOPs. An acoustic assessment by Cuba in early July 1978 (Res. Doc. 79/II/7) indicated

a biomass of 4,500 tons of immature capelin, which could not be considered as indicative of the abundance of the mature population in 1978. A USSR acoustic survey in Div. 3L during May-June 1978 (Res. Doc. 79/II/31) yielded a biomass estimate of 310,000 tons. Because most of the capelin remained in Div. 3L in 1978, this estimate was considered to be indicative of the relative abundance in comparison with those of previous years but may be an underestimate because the entire area was not surveyed. However, no estimates of variance were provided and the Working Group could not evaluate with statistical validity any range of values around the acoustic estimate. Due to problems in locating capelin concentrations, Canadian scientists could not obtain an acoustic estimate of the capelin biomass in Div. 3N in 1978.

c) Numerical population models

Subarea 2 and Division 3K. A USSR analytical assessment using the Allen model indicated that the biomass of capelin at the end of the 1978 fishery was 598,000 tons (Res. Doc. 79/II/30), implying that the biomass was approximately 700,000 tons at the beginning of the 1978 fishery. No variance estimate was provided, but the Working Group concluded that the major source of error in this method is that the 1978 biomass estimate is dependent on the starting biomass used in earlier years. A Canadian assessment based on a sequential capelin abundance model estimated the capelin biomass at the beginning of the 1978 fishery to range from 1.12 to 1.25 million tons (Res. Doc. 79/II/32). No variance estimates were provided but the major sources of error in the model pertain to the assumptions on spawning mortality and proportions mature at age.

Both the USSR and Canadian assessments indicated that the capelin biomass was high in 1975 and 1976 and declined during 1977 and 1978, such that the 1978 biomass was between one-third and one-half of the 1975 and 1976 levels. The biomass was high in the earlier years of the fishery due to the strong 1969 and 1973 year-classes.

Divisions 3LNOPs. Canadian assessments based on sequential capelin abundance models indicate that the stock in Div. 3LNO has declined since 1972 to a low level of 200,000 tons in 1978, the decline in the Div. 3NO portion of the stock being much greater than that in Div. 3L (Res. Doc. 79/II/33). These declines are also evident from catch per unit effort indices. As a consequence of these dynamics, the Div. 3L portion of the stock has constituted the major part of the total biomass since 1975 such that it made up 98% of the stock in 1978. Although no estimates of variance were provided for these sequential population analyses, the Working Group recognized that the models are sensitive to such input variables as spawning mortality and the proportions mature at age. It was noted that the high biomass levels in the early and mid 1970's were the result of the strong 1969 and 1973 year-classes.

d) Other estimates

Subarea 2 and Division 3K. A Cuban assessment based on the areal expansion technique (Res. Doc. 79/II/10) provided a biomass estimate of 77,000 tons. This was considered to be an underestimate because it was based only on the area fished by the Cuban fleet in 1978.

Divisions 3LNOPs. A tagging experiment conducted by Norway (Res. Doc. 79/II/1) was not successful in providing an estimate of the spawning stock in Div. 3N because of the absence of capelin for tagging before the fishery began and the sudden end to fishing after only two days. Some capelin were tagged and the high number of recaptures indicated that a large proportion of the capelin in the fishing area were caught.

4. Biological Characteristics

The Working Group did not discuss the following sub-items of this agenda item due to the lack of any new information: annual variation in growth, annual variation in maturity and spawning, stock-recruitment considerations, and the importance of capelin as a major prey species in the Grand Bank area.

5. Recruitment Estimation and Prognosis for 1979

a) Subarea 2 and Division 3K

In view of the wide range of biomass estimates provided, the Working Group agreed to take a weighted average (665,000 tons) as the "best" estimate of the biomass on 1 September 1978. The weighting factors were determined after considering the reliability of the data used. The age structure of this estimate was calculated from the population structure derived from the Canadian sequential capelin abundance model. Using this age structure and assuming the size of the 1977 year-class to be the geometric mean of previous year-classes as 2-year-olds, the biomass of the stock on 1 January 1979 was estimated at 1.266 million tons (Table 3). Since this estimate was considered indicative of a low stock level for 1979, the main concern of the Working Group was directed to a reduction in fishing mortality in an attempt to stabilize the stock and perhaps

allow for some recovery. The results of the projections under assumed catches of 50,000 and 100,000 tons in 1979, which corresponds to approximately 10% of the biomass levels at the beginning of the fishing season in 1979 as predicted from the models, are given in Table 3.

Table 3. Capelin in Subarea 2 and Division 3K: projected catches in 1979 and stock sizes in 1980 under assumed catches of 50,000 and 100,000 tons in 1979.

Age	Stock size at start of 1979 (10^6)	1979 catch at 50,000 tons		Stock size at start of 1980 (10^6)	1979 catch at 100,000 tons		Stock size at start of 1980 (10^6)
		Number (10^6)	Weight (000 t)		Number (10^6)	Weight (000 t)	
2	73,000	980	15.5	73,000	1,874	32.6	73,000
3	17,705	904	23.0	53,231	1,825	46.5	52,296
4	7,014	331	9.9	8,653	601	17.9	7,780
5	1,655	50	1.7	874	91	3.0	619
Total	99,374	2,265	50.1	135,758	4,391	100.0	133,695
F multiplier			0.315			0.670	
Spawn. biomass (000 tons)	460			730			687
Total biomass (000 tons)	1,266			1,902			1,856

The Working Group points out that the size of the capelin biomass in 1980 will depend very much on the strength of the most recent year-classes, 1976 and 1977 in particular. Since the estimated size of the 1976 year-class and the assumed size of the 1977 year-class are subject to substantial errors, a catch of 100,000 tons may be too high and, alternatively, a pessimistic error may result in a low yield of 50,000 tons. Therefore, in view of the uncertainty associated with estimating the sizes of the incoming year-classes, the Working Group advises that the TAC in Subarea 2 and Div. 3K should be set at 75,000 tons for 1979.

b) Divisions 3LNOPs

Estimates of the strength of the 1976 year-class in Div. 3L were obtained from correlations of strengths of year classes in Subarea 2 + Div. 3K with the strengths of corresponding year-classes in Div. 3L. These provided two estimates of year-class strength which were used in the projections based on the Canadian sequential capelin abundance models. These projections indicated that the biomass of capelin in Div. 3L in 1979 would be lower than in 1978 (Table 4). Projections, using the same estimates of the strength of the 1976 year-class and the 1978 biomass estimate from the USSR acoustic survey, also indicated that the biomass in Div. 3L in 1979 would be lower than in 1978 (Table 5).

Table 4. Projections of numbers at age and total biomass for Div. 3L at the start of 1979, based on a biomass of 200,000 tons in 1978 (Canadian SCAM model) assuming two different levels of recruitment at age 3.

Age	Numbers at age (10^6)	
	Option 1	Option 2
3	859.7	2,134.1
4	1,380.1	1,380.1
5	587.1	587.1
6	111.3	111.3
Total number (10^6)	2,938.2	4,212.6
Total biomass (tons)	86,708	114,617

Table 5. Projections of numbers at age and total biomass for Div. 3L at the start of 1979, based on a biomass of 310,000 tons in 1978 (USSR acoustic survey) and assuming two different levels of recruitment at age 3.

Age	Numbers at age (10^6) Option 1	Option 2
3	859.7	2,134.1
4	2,273.6	2,273.6
5	960.7	960.7
6	185.0	185.0
Total number (10^6)	4,279.0	5,553.4
Total biomass (tons)	130,500	158,409

The Working Group points out that the 1976 year-class is apparently weak but that no estimates of variance associated with the recruitment of this year-class were available. However, even if the strength of this year-class was much higher than predicted, the biomass level in 1979 would probably not exceed the calculated biomass level for 1978. Since the Div. 3L portion of the stock has constituted the major part of the total stock (Div. 3LNOPs) in recent years, the biomass projections given in Tables 4 and 5 should reflect the abundance of the total capelin stock in Div. 3LNOPs in 1979. Because of the predicted low abundance of the 1976 year-class, it is expected that the 1974 and 1975 year-classes will be the major components of the population in 1979.

It is the conclusion of the Working Group that no strong year-classes have been evident in the Div. 3LNO population since that of 1973, which constituted only a small proportion of the biomass in 1978 and will virtually disappear in 1979, and that the decline in biomass in recent years has been the result of poor recruitment since 1973. The decline in recruitment in Div. 3NO has been greater than in Div. 3L, although a general trend in declining recruitment of capelin is evident for all stocks in the ICNAF area. The effects of hydrographic conditions on recruitment could not be assessed by the Working Group due to the lack of data. However, since bottom temperatures on the spawning grounds (Div. 3N) in recent years, including 1978, were within the range of temperatures considered sufficient for capelin spawning, unfavorable water temperatures are not likely to be the only cause of recruitment failure in Div. 3N. The intense commercial fishery on the spawning grounds in Div. 3N may have substantially reduced the spawning stock size in recent years, and the possibility of recruitment overfishing should be taken into account.

Because of marked fluctuations in recruitment and the short life cycle of the species, capelin populations will exhibit violent fluctuations in biomass. The Working Group therefore concludes that, during periods of poor recruitment, the exploitation rate should be low to protect the spawning stock. Using a conservative exploitation rate of 10%, the projections for 1979 (Tables 4 and 5) indicate that the TAC should fall in the range of 9,000-16,000 tons. Based on the higher estimate of capelin abundance in 1979, the Working Group advises that the 1979 TAC for capelin in Div. 3LNO be set at 16,000 tons. In order to protect the spawning stock in Div. 3N and since capelin migrating to Div. 3N usually pass through Div. 3O, the Working Group further advises that there be no commercial fishery for capelin in Div. 3N and 3O in 1979 and that the TAC apply only to Div. 3L.

6. Future Research

a) Since most of the assessments of capelin abundance presented at this meeting did not provide estimates of variance, the Working Group recommends that a concerted effort be made in future assessments to provide such estimates of variance in order to better evaluate historical and projected abundance estimates. This is particularly true for acoustic surveys where careful planning of survey tracks and replicate surveys will provide meaningful variance estimates. In addition, the intercalibration of acoustic equipment in joint surveys should be attempted. When designing acoustic surveys, consideration should be given to the issue of errors resulting from incomplete coverage of the survey area, errors from the use of incorrect target strength due to lack of knowledge of fish orientation, and errors resulting from individual fish producing echoes below the threshold level.

b) In analytical models, research should be focused on estimating values of the proportions mature at age and of the spawning mortality. Historical data on weight-at-age and length-at-age of capelin in the commercial fishery would be valuable in this regard.

c) Methods of estimating pre-recruit abundance should continue to be investigated. Surveys conducted shortly after the beginning of capelin spawning will provide estimates of the abundance of the spawning population. Later surveys will provide more accurate estimates of pre-recruit abundance but will offer less precision in estimating the spawning biomass.

d) Studies on predator-prey interactions should continue, and, in this regard, the importance of analyses of cod feeding habits both inshore and offshore to compare with historical feeding patterns of cod is emphasized. Such studies are particularly important during periods of low capelin abundance in order to assess any changes in the feeding habits and the growth of cod.

e) Studies of migration patterns and stock discrimination should be continued. The tagging of capelin in Div. 3L would provide valuable information on the relative importance of inshore and offshore spawners in the fishery of this area.

f) An intense commercial fishery on capelin spawning grounds, such as has occurred in Div. 3N, may affect spawning behaviour and the mortality of capelin eggs. In the absence of such a fishery, it is important that studies on egg mortality and spawning behaviour be initiated to provide baseline data in the event that favorable recruitment of capelin permits a fishery in Div. 3N in the future. Such surveys of egg abundance may also allow the estimation of spawning stock size.

7. Other Matters

a) The Working Group emphasized the need for coordination of acoustic surveys being planned by member countries, and accordingly

recommends (4)

that an ad hoc working group on capelin be convened during the time of the Assessments Subcommittee Meeting, 28 March-10 April 1979, at St. John's, Newfoundland, to evaluate and coordinate capelin research plans for 1979.

b) In view of the short life cycle of capelin and the difficulty of estimating the size of recruiting year-classes, the Working Group strongly

recommends (5)

that future assessments of both the northern and southern capelin stocks be carried out early in the year for which advice on management is required.

c) The Working Group wishes to remind members of STACRES that a joint USA-USSR acoustics symposium will be held at Cambridge, Massachusetts, USA, in July 1979.

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

Convener: F. Nagasaki

The *ad hoc* Working Group on Squid met during 15-20 February 1979 to assess the status of the squid (*Illex illecebrosus*) stocks in Subareas 3 and 4 in accordance with the STACRES recommendation from the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 39). Scientists attended from Canada, Cuba, France, German Democratic Republic, Japan, Poland and USSR, and an observer from USA. During the course of its discussions, the Working Group reviewed Res. Doc. 79/II/2, 3, 4, 5, 6, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 35, 36, 37 and 38, and unpublished data.

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 80,000 tons in 1977 (Table 1). Preliminary data indicate that the 1978 catch was about 99,000 tons, an increase of 24% over that of 1977.

Table 1. Nominal catches (metric tons) of short-finned squid (*Illex illecebrosus*) in Subareas 2-4 by country, 1970-78.

	1970	1971	1972	1973	1974	1975	1976	1977	1978[1]
Bulgaria	-	-	-	-	-	25	1,034	2,998	948
Canada (MQ)	6	16	8	11	65	89	943	1,275	26,960
Canada (N)	74	1,606	18	622	17	3,204	9,929	29,733	39,277
Cuba	-	-	-	-	-	-	3,248	4,685	4,056
France (M)	-	-	-	-	-	-	-	775	1,974
France (SP)	-	-	-	-	-	-	442	584	1,730
FRG	-	-	-	-	-	-	27	8,020	1,065
GDR	-	-	-	-	-	17	-	-	-
Italy	-	-	-	-	-	-	1,355	2,467	1,055
Japan	63	58	11	24	5	507	3,055	3,145	4,477
Poland	-	-	-	228	-	-	809	2,939	1,944
Portugal	-	-	-	-	-	-	264	1	580
Romania	-	-	-	-	-	-	-	1,304	980
Spain	-	-	-	-	265	268	934	3,070	4,010
USSR	1,242	7,226	1,831	8,992	85	13,634	16,900	18,953	9,534
Ireland	-	-	-	-	-	13	2,827	-	-
USA	-	-	-	-	-	-	-	4	-
Total	1,385	8,906	1,868	9,877	437	17,757	41,767	79,953	98,590

[1] Preliminary data

A review of *Illex* catches by subarea (Table 2) indicates that only small sporadic catches were taken in Subarea 2, that the yield in Subarea 3 increased greatly from an average of 500 tons during 1970-74 to 45,000 tons in 1978, and that the yield in Subarea 4 increased from an average of 4,000 tons during 1970-74 to 53,000 tons in 1978. In Subareas 5 and 6, the known catch of *Illex* increased from about 2,000 tons in 1970 to nearly 17,000 tons in 1974 and declined to 14,000 tons in 1975. However, 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 available for these years. In 1976 and 1977, the *Illex* catch in Subareas 5 and 6 (including USSR data) was about 25,000 tons, but a reliable estimate for 1978 was not available at the time of this meeting due to incomplete statistics.

In the Northwest Atlantic as a whole, the known catches of *Illex* increased from about 4,000 tons in 1970 to about 32,000 tons in 1975 (Table 2). The overall catch increased significantly to 67,000 tons in 1976 and to 105,000 tons in 1977. During the two most recent years for which statistics are available, the proportion of the total catch taken in Subareas 2 to 4 increased from 62% in 1976 to 77% in 1977.

Preliminary information on overall fishing effort (days fished) in relation to directed squid fisheries on the offshore grounds in Subareas 3 and 4 during 1978 are given in Table 3. The data indicate considerable variation in overall catch per unit effort by the various countries involved in the fisheries.

Table 2. Nominal catches (metric tons) of *Illex* by subareas, 1970-78.

Year	Subareas 2	Subareas 3	Subareas 4	Total SA 2-4	Total SA 5-6
1970	-	111	1,274	1,385	2,453[2]
1971	-	1,607	7,299	9,906	4,036[2]
1972	-	26	1,824	1,850	14,713[2]
1973	2	620	9,255	9,877	15,178[2]
1974	31	17	389	437	16,653[2]
1975	-	3,764	13,993	17,757	13,790[2]
1976	-	11,254	30,510	41,764	24,936
1977	6	32,748	47,199	79,953	24,795
1978[1]	-	45,472	53,118	98,590	...

[1] Preliminary data
[2] Excludes USSR catches which have not been reported for *Illex* and *Loligo* separately.

Table 3. Catch (metric tons) and effort data for offshore directed squid fisheries in Subareas 3 and 4 for 1978[1].

Country	Subarea 3 Days fish.	Subarea 3 *Illex* catch	Subarea 3 C/f	Subarea 4 Days fish.	Subarea 4 *Illex* catch	Subarea 4 C/f
Canada (MQ)	54	1,560	28.9	862	21,465	24.9
Cuba	79	1,298	16.4	183	2,654	14.5
France (M)	-	-	-	94	1,974	21.0
Italy	-	-	-	120	1,084	9.0
Japan	62	549	8.9	288	3,625	12.6
Poland	-	-	-	84	1,662	19.8
USSR	5	35	7.0	378	9,260	24.5
Totals	200	3,442	17.2	2,009	41,724	20.8
Total catch		45,472[2]			53,118	

[1] Source: Res. Doc. 79/6, 22, 37, and unpublished data.
[2] Newfoundland inshore fishery accounted for 39,122 tons.

2. Biological Characteristics

a) Distribution

The overall distribution of *Illex* in Subarea 4 during 1978 did not change much from that reported for 1977 (*ICNAF Redbook* 1978, page 23). The offshore distribution in 1978, based on observations from all international fisheries on the Scotian Shelf (Res. Doc. 79/II/17, 22), showed three main areas of concentration at depths ranging from 100 to 250 m: Sable Island Bank, Banquereau Bank and Emerald Bank, near the line defined for the regulation of small-meshed gear. The major concentrations occurred in the Emerald Bank area during June and July and in the Sable Island Bank area later in the season (Res. Doc. 79/II/22, 36). Although immigration to the fishing grounds occurred early in June, commercial concentrations did not occur until mid-July. These concentrations lasted until late November. Distribution by depth changed from 75-150 m in June to 150-250 m in October-November (Res. Doc. 79/II/36). A small concentration of large maturing squid was noted at 350-450 m in late October and at 450-550 m in early November. Diurnal vertical migrations were apparent throughout the fishing season.

An unusual extension of *Illex* distribution into the Gulf of St. Lawrence occurred early in October 1978 and prevailed until early November, with large numbers having been washed ashore in the Northumberland Strait area in mid-October. Inshore occurrence along the east coast of Nova Scotia extended from early June to late September.

In Subarea 3, the inshore distribution of *Illex* in 1978 did not change from that of 1977, with squid appearing in late May and remaining available to the fishery until early December. Offshore occurrence on the Grand Bank was observed early in June with the fishery extending from

July to September. In Subdiv. 3Ps the fishery extended from July to early October.

b) Life cycle

Discernible geographic and seasonal patterns in the modal sizes of *Illex*, based on a compilation of data from several published sources, were noted by STACRES at its Special Meeting on Squid in February 1978 (*ICNAF Redbook* 1978, page 23). Further data for Subareas 3 and 4 were reviewed by the Working Group at this meeting (Res. Doc. 79/II/5, 14, 27 and 35, and unpublished data). The mean mantle length of both males and females in April 1978 was 150 mm, approximately the same as in 1977. When the fishery began on 15 June 1978, the average size was 159 mm (157 mm for male and 163 mm for female) in contrast to an average size of 186 mm at the same time in 1977. The difference in size between 1977 and 1978 represents an approximate delay in growth of about five weeks in 1978. However, by mid-September the average length in 1978 was similar to that in 1977 at approximately 225 mm (220 mm for male and 230 mm for female in 1978). Apparent asymptotic growth occurred in October-November of both years at approximately 245 mm (225 mm for male and 255 mm for female). Thus, while the squid were smaller at recruitment to the fishery in 1978 than in 1977, growth during the period from mid-June to mid-September was more rapid in 1978. The length distributions in 1978 were generally unimodal, but some multimodal frequencies were noted. The possibility of *Gonatus fabricii* being misidentified as *Illex illecebrosus* was suggested as an explanation for some of the modes at small size-classes.

From a compilation of data on mean weights of *Illex* in samples collected in Subarea 4 during the 1978 season (unpublished data), the average weights in May were 72 g for males and 82 g for females and in November were 269 g for males and 317 g for females. Growth was rather slow up to the end of August after which both sexes showed rapid gains in weight. A statistical analysis of length-weight relationships in squid (Res. Doc. 79/II/4) indicated that a single equation derived from the combination of all samples irrespective of sex, area, season and year is about as precise as using separate equations for each sex, season, area and year.

Maturation indices for male and female *Illex* (Res. Doc. 78/II/5, 79/II/13) were used to trace the progression of maturation throughout the 1978 season. In Subarea 4, 50% of immature males (stage 1) had advanced to stage 2 in mid-July and to stage 3 in September, whereas 50% of the females had advanced to stage 2 in late May and to stage 3 in September. A few females were observed at stage 4 on the Scotian Shelf in late October and November, and two spent females (unconfirmed) were noted at the end of October, in depths of 350-550 m. In Subarea 3 inshore, the maturation of males advanced to stage 2 in September and rapidly to stage 3 in October, with a small percentage of stage 4 males being observed in late November. The sex ratio in Subarea 4 changed throughout the season as shown in Fig. 1, due probably to the greater selection of the larger females by the gear in July, August and September. The sudden decrease in percentage of males in the population from September to October may be due to emigration.

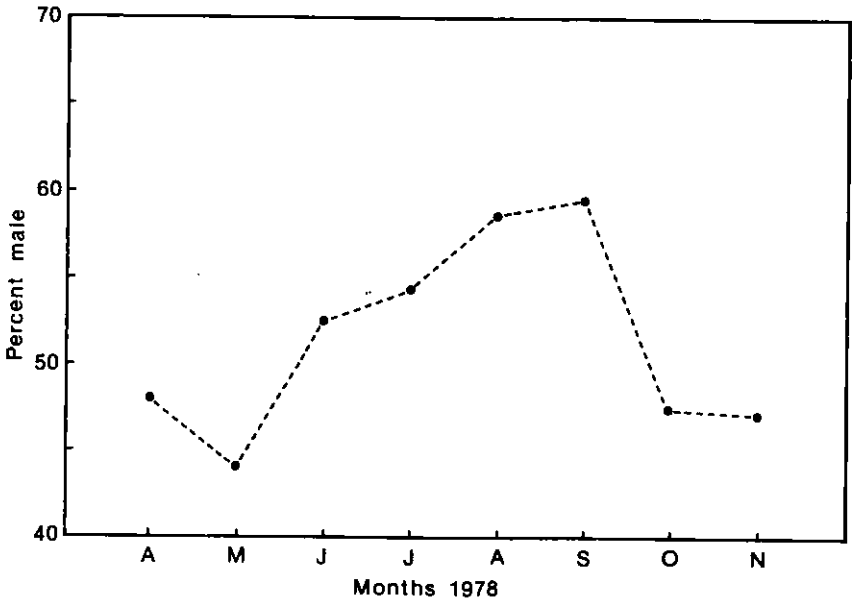

Fig. 1. Monthly percentage of males in the *Illex* stock on the Scotian Shelf during 1978.

c) Spawning (Res. Doc. 79/II/13)

Laboratory observations on stage 4 male *Illex* showed that the quantities of spermatophores produced increased as maturation progressed through this stage with time. The larger males produced more spermatophores than the smaller ones, the number produced ranging from 200 to 700. The spermatophores release sperm after contact with the nidamental gland jelly produced by the females.

Females were brought to maturity in the laboratory and successfully spawned. Egg masses consisted of large neutrally buoyant jelly masses, about 40-120 cm in diameter, containing in the order of 100,000 ova dispersed about 1 cm from each other. Each female produced one or more egg masses and died soon after spawning. The jellied egg masses break up easily, making the collection of field samples difficult. The eggs hatched in 6 to 8 days after spawning at 13°C, and the early larval stages were observed for the first time. The ellipsoid egg (1.0 × 0.8 mm) enlarged to 1.8 mm in diameter before hatching. Newly hatched larvae had a mantle length of about 1.1 mm and carried a small internal yolk sac. One larva survived for 8 days, at which time it had a mantle length of 1.25 mm with characteristic dorsal arms, developing proboscis and chromatophore patterns.

d) Age determination (Res. Doc. 79/II/26)

Age determination in *Illex* was attempted using statoliths from samples taken inshore in Subarea 3. Many difficulties were encountered in preparing the statoliths for examination. The difference in the mean numbers of discernible rings in samples taken on 9 June and 2 August (54 days) is 37, with a 95% confidence interval of 19-55. The indications are that daily rings may be discernible in more detailed studies.

e) Tagging (Res. Doc. 79/II/12, 25)

Laboratory experiments were conducted using different types of tags attached at different locations on the body. The spaghetti-type anchor tag appeared to affect the animal least especially in relation to the mortality observed in animals with skin lesions. In late October and early November 1978 tagging operations were undertaken in Conception Bay, Newfoundland. Of 3,184 squid tagged, 1,011 tags were recovered from the commercial fishery in the time lapse of 2 to 29 days within swimming distance of 10 km. Both anchor-type (32.8% return) and metal-clip (26.4% return) tags were successfully used, and the recovered squid showed no apparent adverse effects.

f) Food and feeding patterns (Res. Doc. 79/II/11, 16)

The diet of *Illex* taken offshore on the Scotian Shelf in June 1978 consisted mainly of euphausiids, whereas the major components were fish and cephalopod remains in October-November. The gut contents were often difficult to identify because squid macerate their food, but such remains as otoliths, squid beaks, vertebrae, scales, lenses, etc., aided in the identification of components. Feeding activity varied with the time of day, the peak occurring between 0000 hours and 0800 hours. The larger squid tended to feed less on crustacea and more on cephalopods (particularly *Illex*) and fish (gadoid species such as silver hake and longfin hake). The composition of food items varied from one location to another on the Scotian Shelf.

Feeding and growth studies, monitored for two months in the laboratory showed that the daily feeding rate for maintenance was about 1% of body weight. Average daily feeding rates ranged from 3.6 to 6.7% and average growth rates from 1.1 to 1.9%. Both rates increased with temperature.

3. Possible Environmental Influence on Abundance

It was indicated at the February 1978 Meeting of STACRES (*ICNAF Redbook* 1978, page 28) 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. This was demonstrated by data available from the Newfoundland inshore fishery and from Canadian surveys in Div. 4VWX. Such changes would seem to be influenced by prevailing environmental conditions, especially temperature, which may affect the arrival and concentration of squid on the fishing grounds.

In 1978, the delay in the arrival and concentration of squid on the Scotian Shelf can apparently be explained by lower bottom temperatures than those which prevailed in the two preceding years (Table 4), whereas in Newfoundland inshore waters the squid fishery occurred where the water temperature ranged from 7 to 15°C (Res. Doc. 79/II/25). Delays in offshore migration and winter spawning related to abnormally low temperatures have also been suggested, with a possible consequence of smaller squid at the beginning of the fishing season and hence smaller catches in June and July due to greater escapement from the trawls (Res. Doc. 79/II/37).

Table 4. Mean bottom temperatures in July on the Scotian Shelf relating to biomass estimates (Res. Doc. 79/II/14) and nominal catches of *Illex* in Subarea 4, 1970-78.

Year	Temp. (°C)	Biomass (000 t)	Catch (tons)
1970	5.3	1.9	1,274
1971	5.6	14.7	7,299
1972	5.6	3.2	1,824
1973	5.8	8.9	9,255
1974	5.7	9.5	389
1975	5.4	24.8	13,993
1976	6.9	262.5	30,510
1977	6.5	50.5	47,199
1978	5.9	11.5	53,118

Undoubtedly, such a migratory animal as the squid must be influenced by environmental conditions and food availability, but it is difficult, if not impossible, from the data available to clearly understand the effects of these factors on squid behavior and on fishery parameters such as availability and true abundance. Analysis of this phenomenon is largely masked by the setting of a starting time for the fishing season and by fishing strategy, with most of the vessels arriving on the grounds at the peak of the fishing season.

4. Abundance Estimates

The Working Group reviewed a number of papers which provided a variety of estimates of squid abundance in Subareas 3 and 4, based on three different methods of analysis, namely, areal expansion technique using data from commercial fishing activities, sequential abundance analysis, and research vessel random-stratified surveys.. It was noted that abundance estimates derived from the research vessel surveys underestimated considerably the actual abundance. However, the importance of these biomass estimates for Div. 4VWX (Res. Doc. 79/II/14) as indicators of year to year relative abundance was stressed. For Subarea 3, an annual predictive index of relative abundance in inshore waters later in the season is generated from the results of a research vessel survey of the Grand Bank in May-June (Res. Doc. 79/II/25).

A summary of all relevant abundance estimates considered by the Working Group is given in Table 5. In Subarea 4, there were 12 estimates derived from research and commercial fishing operations ranging from 6,580 to 434,580 tons, and one estimate based on sequential abundance analysis (212,470 tons). In Subarea 3, there were three estimates based on commercial fishing operations ranging from 29,284 to 76,200 tons, and one estimate based on sequential abundance analysis (216,530 tons).

The means of the estimates of population numbers from the research and commercial surveys and the estimates from sequential abundance analysis for Subareas 3 and 4 are given in Table 6. For the mean survey estimates, the standard deviation, the number of observations and the relative standard error are also given. For the sequential abundance analysis estimates, additional information include the standard error, the relative standard error and the regression estimate of terminal F. The estimates of the population numbers have variances of approximately 50%. However, the relative standard errors indicate that the estimates from sequential analyses have about the same variance as those derived from research and commercial surveys.

Since the sequential method yields the population numbers at the beginning of the season, these estimates are not directly comparable with the mid-season estimates from the research and commercial surveys. Therefore, the population numbers on 1 September (mid-fishing season) generated by the sequential method used in calculating the combined means of the population numbers given for both subareas. The exploitation rates for 1978 could then be derived using the formula $\mu = C/N$. Given the mean population numbers on 1 September and an estimated natural mortality value ($M = 0.06$), the population numbers at the beginning of the season were back-calculated for each subarea. The resulting exploitation rates for 1978 were 0.29 for Subarea 3 and 0.18 for Subarea 4.

5. Mesh Selectivity

The Working Group reviewed two research documents relating to mesh selection of *Illex* on the Scotian Shelf during 1977 and 1978. The results of two joint studies, one with Cuba in August 1977 and the other with USSR in October-November 1977 are summarized in Res. Doc. 79/II/3. The author rationalized that the morphology of squid make the 50% retention length too difficult to measure and

Table 5. Summary of abundance estimates for Subareas 3 and 4 in 1978, based on research documents and other information reviewed by the Working Group.

Country	ICNAF area	Documentation	Time period	Population (numbers)	Biomass (tons)	Survey area (km^2)	Comments
Canada	3	Res. Doc. 79/II/25 + Corr.	Fishing season	715×10^6 (1 Sep)	216,530	Inshore Nfld and offshore in SA 3	From sequential abundance analysis
	4VWX	Unpubl. data	Fishing season	584×10^6 (1 Sep)	212,470	Commercial fishing area	From sequential abundance analysis
	4	Res. Doc. 79/II/36	June November	85×10^6 57×10^6	6,580 16,910	3.68×10^6 4.62×10^6	Mesh selection study
Cuba	3	Res. Doc. 79/II/8	July August September	212×10^6 515×10^6 185×10^6	29,280 76,200 41,150	$0.6\text{–}1.3 \times 10^6$	0.004 (F-values) 0.004 0.009
	4	Res. Doc. 79/II/8	July August September October	901×10^6 392×10^6 254×10^6 $1{,}849 \times 10^6$	124,390 57,990 56,450 434,580	$1.7\text{–}4.0 \times 10^6$	0.003 (F-values) 0.002 0.001 0.001
Japan	4	Res. Doc. 79/II/20	July August September October	559×10^6 $1{,}627 \times 10^6$ $1{,}566 \times 10^6$ 632×10^6	80,050 276,510 347,740 153,610	23,241	Commercial fishing activity
Poland	4	Res. Doc. 79/II/37	Fishing season	$1{,}069 \times 10^6$	138,400	18,600	Commercial fishing activity
USSR	4W	Res. Doc. 79/II/28	July	$3{,}052 \times 10^6$	354,000	11,548	Commercial fishing activity[1]

[1] Based on catches during 1200-1500 hours (local time)

Table 6. Squid abundance estimates (numbers) for 1978 in Subareas 3 and 4, based on the results given in Table 5.

Method	Parameter	SA 3	SA 4	SA 3+4
Survey estimates:	Mean pop. estimate (10^6)	304	1,004	
	standard deviation (10^6)	183	886	
	number of observations	3	12	
	relative standard error	0.35	0.25	
Squential method:	population estimate (10^6)	715	584	
	standard error of F	0.022	0.016	
	$\hat{F}$	0.070	0.049	
	relative standard error	0.31	0.33	
	Mean population numbers (10^6)	510	794	1,304[1]
	Biomass on 1 September (000 tons)	97	152	249

[1] Relative standard error = 0.16

indicated that results of such studies should be analyzed with respect to the percentage retained by weight. It was indicated that, in late summer and early autumn, 25-30% of the squid entering the trawl would escape through a 90-mm codend. Such a mesh size would allow the escapement of not only small squid which would increase the yield per recruit but also various species of small commercially-important finfish. The proportion of squid released by the 90-mm mesh would decrease with time as the squid increased in size. Since the growth of squid is usually rapid from April to June with

increase in size becoming more gradual later in the year, the use of 90-mm mesh codends would allow the cropping of larger squid in the latter part of the year with no substantial reduction in yield relative to that obtained with small mesh sizes. The 50% retention lengths for the 60-, 70-, and 90-mm mesh codends were observed to be 140, 180 and 250 mm respectively.

The mesh selection studies reported in Res. Doc. 79/II/3 also contained the results for silver hake, which were taken concurrently with squid. The study indicated that the 90-mm mesh would, in the long term, give a slight increase in yield of silver hake over that for the 60-mm mesh, with a consequent increase in the average size of fish. The study further indicated that the change from using a 60-mm to a 90-mm mesh would entail an increase in effort in the order of 10-30%, whereas a change from a 90-mm to a 120-mm mesh would entail an increase in effort in the order of 30-100%. The 50% retention length for silver hake in the 90-mm mesh trawl was 260 mm, thus agreeing with earlier studies (*ICNAF Selected Papers* No. 1: 51-58) which indicated that the greatest yield-per-recruit would occur if the length at recruitment was increased to 25.5 cm and that the fishery should not start cropping silver hake until their third year (30-32 cm). The 90-mm mesh codend would therefore seem appropriate for silver hake, but the need for further investigation was noted.

The results of a joint Canada-Japan mesh selection study of squid on the Scotian Shelf in 1978 were reported in Res. Doc. 79/II/35. The experiment was conducted in two periods: (i) June, when codend mesh sizes of 45, 60 and 90 mm were used; and (ii) October-November, when codend mesh sizes of 60, 90, 100 and 130 mm were used. The 50% retention lengths obtained had the following ranges:

45 mm codend	109-148 mm
60 " "	122-134 "
90 " "	107-183 "
100 " "	190-197 "
130 " "	190-234 "

These indicate that selectivity was affected by the morphology and behaviour of squid. Therefore, the percentage released by weight rather than the 50% retention length was used to evaluate the selectivity of each net. In June, 21-23% of the squid catches were released by the 90-mm mesh codend in contrast to 13-14% by the 45- and 60-mm codends. In October-November, the 90-mm mesh codend released 1-2% of the catch, while none were released by the 60-mm mesh codend. The 130-mm codend released 19-43% of the catch depending on the time when fishing occurred.

The Working Group agreed that the possibility of having a uniform mesh size for the squid and silver hake fisheries should be deferred until the status of the silver hake fishery and stock is assessed, and it accordingly

recommends (1)

that the codend mesh size for silver hake and squid fisheries be considered by the Assessments Subcommittee at its April 1979 Meeting.

6. Total Allowable Catch for 1979

In view of the very short life-span of *Illex* and the apparently large fluctuations in abundance and availability, its abundance in Subareas 3 and 4 cannot be predicted at this time, and data from surveys in early 1979 will not be available in sufficient time for effective adjustment of the TAC for 1979. The Working Group still favors, in principle, effort regulation as a means of managing the squid fishery. However, because of the many technical difficulties involved in the design of effort regulation for 1979, the Working Group agreed that a TAC should be applied to the 1979 squid fishery. Should the abundance of *Illex* be much reduced in 1979, the fishing mortality in Subarea 3 is unlikely to increase greatly. Limitation of fishing effort in Subarea 4, by applying 1978 catch rates to the 1979 TAC would ensure that fishing mortality would not increase greatly despite reduced abundance. Data reviewed by the Working Group indicated that a higher exploitation rate than the 1978 level is appropriate should the abundance of *Illex* in 1979 be as high or higher than in 1978.

The Working Group advises that the TAC for 1979 be 120,000 tons, with 70,000 tons for Subarea 4 and 50,000 tons for Subarea 3, based on relative biomass estimates for 1978, and that the opening date of the fishery be 1 July.

Since migration patterns are variable from year to year, the Working Group

recommends (2)

that the Assessments Subcommittee at its April 1979 Meeting give further consideration to the commencement date of the squid fishing in relation to the availability of squid on the fishing grounds and to environmental conditions.

7. Future Research

a) The Working Group noted with interest the progress made in using statoliths as a possible means of ageing *Illex* and urges that such studies be continued.

b) The Working Group noted the results of laboratory and field tagging experiments undertaken in 1978 and emphasized the need for improved tagging techniques to facilitate studies on stock discrimination and the estimation of population parameters.

c) The Working Group noted the need for more extensive research vessel surveys on an annual basis to determine the distribution and abundance of *Illex*.

d) The Working Group noted that intensive mesh selection studies had been carried out in 1978 and indicated that such studies should be continued to provide more precise information on *Illex* and by-catch species.

e) The Working Group emphasized the need for continued studies on the general biology of *Illex*, such as, maturation, larval identification and distribution, and the effects of environmental factors on migration.

f) The Working Group noted some improvement in the reporting of detailed catch and effort data for squid and urged that all countries with directed squid fisheries should comply with the requirements.

PART C

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

Annual Meeting, May-June 1979

CONTENTS

[1] Proceedings No. 1 of the 1979 Annual Meeting.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Annual Meeting, May-June 1979

Chairman: R. G. Halliday Rapporteur: V. M. Hodder

Meetings of STACRES and its Subcommittees were held at Dartmouth, Nova Scotia, Canada, during 22-26 May 1979 to consider and report on matters listed in its agenda (Part D, this volume). A further session was held on 5 June to consider outstanding items deferred from the earlier sessions and to approve its report prior to its formal adoption at the Final Plenary Session of ICNAF. Following the resignation of Dr E. C. Lopez-Veiga early in 1979, Dr R. G. Halliday agreed, with the unanimous approval of all representatives present at the first session of STACRES, to act as Chairman for this Annual Meeting. Scientists attended from Bulgaria, Canada, Cuba, Denmark, France, Federal Republic of Germany, Japan, Poland, Union of Soviet Socialist Republics, and United States of America, and the Secretary of the CWP (Coordinating Working Party on Atlantic Fishery Statistics) attended on behalf of the Food and Agriculture Organization (FAO).

Since the 1978 Annual Meeting, STACRES met at Bergen, Norway, in November 1978 to review the state of the shrimp stocks in Subareas 0 and 1 and the seal stocks in Subareas 1 to 4, and to consider progress made in the development of standardized procedures for sampling data (Part A, this volume). STACRES also met at Tokyo, Japan, in February 1979 to review the state of the squid (*Illex*) stocks in Subareas 3 and 4 and the capelin stocks in Subareas 2 and 3 (Part B, this volume). Dr G. H. Winters acted as Chairman for both of these Special Meetings. The Assessments Subcommittee met at St. John's, Newfoundland, Canada, during 28 March-9 April 1979, and joint sessions of the Assessments and Biological Surveys Subcommittees were held on 5 April and 23 May, the reports of which were adopted by STACRES at its current sessions. At the request of the Commission, STACRES and STACTIC met jointly on 1 June 1979 to consider a proposal for the implementation of an international scientific observer scheme.

Since this is expected to be the last meeting of STACRES under the ICNAF regime, and in order to maintain continuity in the transition of scientific matters to NAFO (Northwest Atlantic Fisheries Organization), the various sessions of STACRES were held jointly with the Scientific Council of NAFO. 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), Appendix IV (Environmental) and Appendix V (Joint Meeting of Assessments and Biological Surveys). The report of the Joint Meeting of STACRES and STACTIC is at Apprendix VI. Brief summaries of these reports, together with other matters considered by STACRES, are given below. Part D of this volume contains the agenda for STACRES meetings, the lists of research and summary documents, and the list of participants in scientific meetings of ICNAF during 1978/79.

I. ASSESSMENTS (APP. I)

1. Fishery Trends

Details of provisional nominal catches in the Northwest Atlantic for 1978 are given in Sum. Doc. 79/VI/30, with the exclusion of data for Spain which were not available at the time of preparing this report. Consequently the nominal catches for 1978 and the percentage changes in 1978 catches relative to those for 1977, particularly with regard to Spanish directed fisheries for cod and squids in 1978, will change slightly depending on the magnitude of the Spanish catches. The total catch of all species (except seaweeds) in the Northwest Atlantic (Subareas 0 to 6) was about 2.72 million tons in 1978, a decline from 2.96 million tons in 1977. Substantial declines occurred in the catches of redfish (22%) mainly in Subarea 1, silver hake (25%) mainly in Subarea 5, mackerel (60%) in Subareas 5 and 6, and capelin (58%) in Subareas 2 and 3. Significant increases occurred in haddock (52%) and pollock (15%) both mainly in Subarea 5, roundnose grenadier (50%) in Subareas 1 to 3, and Greenland halibut (26%) mainly in Subarea 3. Among the invertebrate species, increases were noted for sea scallops (10%) and oysters (15%), while the overall squid catch probably remained at the same level as in 1977. With respect to the nominal catches of all species (except seaweeds) by subarea, decreases from 1977 to 1978 were noted for Subarea 0 (5,000 to 1,000 tons), Subarea 1 (150,000 to 129,000 tons), Subarea 2 (190,000 to 78,000 tons), Subarea 3 (630,000 to 587,000 tons) and Subarea 6 (838,000 to 722,000 tons), and increases were noted for Subarea 4 (628,000 to 691,000 tons) and Subarea 5 (516,000 to 517,000 tons).

2. Stock Assessments

The Assessments Subcommittee at its meeting in April 1979 reviewed the state of, and advised on catch levels in 1980 for, a number of stocks in Subareas 0 to 4 which lie completely or partly within the 200-mile fisheries zones of Canada and the European Economic Community (Com. Doc. 79/VI/6, 16) and the three stocks which lie outside national fisheries zones in Div. 3M. In so far as it was possible, total allowable catch (TAC) levels for 1980 were advised and these are listed in the last column of Table 1. Details of the stock assessments are given in Appendix I.

Table 1. Summary of recent catches (1974-78) and TACs (1974-79) for stocks reviewed at the April 1979 Meeting of the Assessments Subcommittee, together with advised TACs for 1980.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)						
		1974	1975	1976	1977	1978[1]	1974	1975	1976	1977	1978	1979	1980
Cod	1	48	48	33	38	37	107	60	45	31	...[2]	...[2]	( )[3]
	2GH	4	7	6	4	5	20	20	20	20	20	20	(20)
	2J+3KL	373	288	214	173	136	657	554	300	160	135	170	( )[3]
	3M	25	22	22	25	33	40	40	40	25	40	40	( )[3]
	3NO	73	44	24	18	15	101	88	43	30	15	25	( )[3]
Redfish	1	3	9	14	31	10	-	-	-	-	13	...	( )[3]
	3M	35	16	17	20	16	40	16	16	16	16	20	(20)
	3LN	22	18	21	16	12	28	20	20	16	16	18	(25)
Silver hake	4VWX	96	116	97	37	48	100	120	100	70	70	70	( )[3]
A. plaice	3M	2	2	1	1	1	2	2	2	2	4	2	(2)
	3LNO	46	43	52	44	50	60	60	47	47	47	47	(47)
Witch	2J+3KL	16	12	11	8	7	22	17	17	17	17	17	(17)
	3NO	8	6	6	6	3	10	10	10	10	10	7	(7)
Yellowtail	3LNO	24	23	8	12	15	40	35	9	12	15	18	(18)
G. halibut	0+1	14	25	16	13	12	-	-	20	20	20	25	(25)
	2+3KL	27	29	25	32	38	40	40	30	30	30	30	(35)
R. grenadier	0+1	12	5	9	3	6	-	10	14	8	8	8	(8)
	2+3	28	27	21	15	21	32	32	32	35	35	35	(30)
Argentine	4VWX	17	15	7	2	2	25	25	25	20	20	20	(20)

[1] Provisional statistics.
[2] Catches restricted to Greenlanders' fishery and to by-catch (regulated by percentage allowances).
[3] See relevant subsection of Section III in Appendix I to this report for comments and options.

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 are presented rather than a single TAC associated with a particular level of fishing mortality. This was in accordance with requests by Canada (Com. Doc. 79/VI/6) and the European Economic Community (Com. Doc. 79/VI/16). Such management options and their long-term effects are given for cod in Subarea 1 and Div. 2J+3KL and for American plaice in Div. 3LNO. In considering the degree of reliability in the data and the models used for some stocks, it was agreed not to advise a change in the TAC in cases where the catch projections for 1980 were not significantly different from the TACs previously set for 1979.

Increases in TAC for 1980, compared with 1979, were advised for redfish in Div. 3LN and Greenland halibut in Div. 2+3KL, and decreases in TAC were advised for roundnose grenadier in Subareas 2+3 and the cod stocks in Div. 3M and 3NO. Categoric advice on a specific TAC for silver hake in 1980 could not be provided, due to widely varying opinions as to the strengths of the 1978 and 1979 year-classes which will comprise a substantial proportion of the catches in 1980. STACRES therefore advises that, if more precise advice as to the level of a TAC for 1980 is required, a reassessment of the silver hake stock in Div. 4VWX should be carried out after the completion of the 1979 fishery. No TAC for 1980 was advised for shrimp in Subareas 0+1 because of the necessity of having available complete information on the commercial fishery and the results of surveys in 1979.

STACRES noted with concern the general remarks of the Assessments Subcommittee on the state of the cod stocks, particularly regarding the phenomenon of fisheries concentrating more than ever before on newly-recruited year-classes of depressed stocks, thereby not achieving the best possible yield-per-recruit and not allowing the stocks to rebuild. In this regard, it was noted that the only cod stock in which considerable rebuilding has occurred in recent years is that in Div. 2J+3KL where exploitation rates have been kept lower than F_{max}.

3. Other Matters Relevant to Assessments

a) Sampling data for Greenland halibut

STACRES noted the general lack of sampling data necessary for an analytical assessment of the Greenland halibut stock in Subareas 0+1 and, recognizing the possible relationship between this stock and that in Subareas 2+3,

recommends (1)

that scientists of the various countries whose vessels have been or are now fishing for Greenland halibut in Subareas 0 to 3 submit all available length compositions and age-length keys by sex

(data not previously submitted) to the Secretariat as soon as possible.

b) Uniform mesh size for the silver hake and squid fisheries in Subarea 4

STACRES noted that the Assessments Subcommittee had further considered the feasibility of a uniform mesh size for these fisheries in Subarea 4 but could not accurately quantify the effect of a change in mesh size from 60 to 90 mm due to insufficient data. It was agreed that the best way to acquire the necessary data would be from a large-scale experimental fishing program, and STACRES therefore

recommends (2)

that an experimental program be implemented in 1980, involving at least 15% of each of the national fleets participating in the silver hake-squid mixed fishery, with the designated vessels using trawls with 90-mm mesh codends and fishing whenever possible in proximity to the remainder of the fleet.

This experiment should extend throughout the silver hake and squid fishing seasons to the extent that this is possible.

c) Timing of future assessment meetings

STACRES recognized the difficulties experienced by the Assessments Subcommittee in providing precise management advice in April for stocks for which information is very inadequate or even lacking prior to the meeting. In view of the recent extension of coastal state jurisdiction over fisheries to 200 miles, the reduction in the number of stocks for which management advice is requested, and the need for more detailed and complete data on which to base the advice, STACRES therefore

recommends (3)

that future stock assessments be carried out in May immediately preceding the Annual Meeting to allow more time for the compilation of complete statistical data, the pre-meeting distribution of relevant documentation, and the possible availability of some data for the early months of the current year.

STACRES noted, however, that in the case of such short-lived species as shrimp, capelin and squid, and other stocks on which fishing is occurring mostly on recruiting year-classes, a meeting near the end of the year or early in the subsequent year would be necessary in order to provide the best possible advice for management.

II. BIOLOGICAL SURVEYS (APP. II)

1. Review of Survey Activities

STACRES noted that the Biological Surveys Subcommittee had reviewed research vessel survey activities in the Northwest Atlantic for 1978 and survey plans for 1979. A significant increase in survey activity was noted in 1978 and a further increase was indicated for 1979.

2. Manual on Groundfish Surveys

Progress toward the implementation of relevant recommendations from the 1978 Annual Meeting pertinent to the development of a groundfish survey manual was reviewed. STACRES noted that, although most of the recommendations had been acted upon, the recording and exchange of information on untrawlable unit areas required further action, and therefore

recommends (4)

that records of untrawlable units, indicating whether determined by acoustic observation or gear damage, specifying the gear, be sent to fisheries research institutes maintaining master stratification charts for distribution on request.

STACRES requested the editor of the manual to circulate a revised draft prior to the 1980 Annual Meeting of the Scientific Council of NAFO.

3. Stratification Schemes and Numbering Systems for Groundfish Surveys

STACRES noted that Danish scientists had developed a survey stratification scheme for Subarea 1 (Res. Doc. 79/VI/82), and accordingly

recommends (5)

that the stratification scheme for Subarea 1 be incorporated in the draft groundfish survey manual and be used for groundfish surveys in the area.

STACRES recognized the advantages that would accrue from having a common numbering system for stratification schemes adopted for the Northwest Atlantic, particularly with regard to exchange of survey data, and therefore

recommends (6)

i) that a five digit stratum numbering scheme for groundfish surveys in the Northwest Atlantic be adopted for the exchange of biological survey data, the first digit indicating the subarea, the second digit indicating the (sub)division, and the remaining three digits indicating the stratum number as in existing numbering systems; and

ii) that strata overlapping (sub)division boundaries be divided.

4. Species Codes for International Exchange of Survey Data

It was noted that not all countries are presently using species codes for processing biological survey data while others were planning changes in their existing codes. STACRES considered that this was an opportune time to study standardization of species codes to facilitate the exchange of survey data, and accordingly

recommends (7)

that the Assistant Executive Secretary obtain from research institutes copies of relevant species codes and, by correspondence, undertake a feasibility study of introducing a common coding system for consideration at the 1980 Annual Meeting.

5. Pilot Study on Processing Survey Data

STACRES noted that the circumstances which led to the initiation of a pilot study on the processing of groundfish survey data by the Secretariat had been superseded and, due to the uncertainty about the needs of the NAFO Scientific Council for a biological survey data base, agreed that no further action be taken on the pilot project at this time.

6. Progress in Improving Survey Methods

STACRES noted a method for estimating trawl door spread from wing spread, a method of reducing biases in line transect surveys, and the examination of robust estimators of stratum means for groundfish surveys. Recognizing the benefits of such advances to fisheries research in general and to abundance estimation in particular, STACRES stresses the value of these contributions and encourages further research on these topics.

III. STATISTICS AND SAMPLING (APP. III)

1. Review of CWP Activities Relevant to ICNAF

The CWP Secretary, Mr L. P. D. Gertenbach, indicated that a standard list of 3-alpha species identifiers for the world as a whole had been established and incorporated into the FAO data base. These identifiers now appear in the ICNAF List of Species for the Northwest Atlantic. It was agreed that these 3-alpha identifiers would serve adequately the publication needs of national and inter-governmental agencies but that adoption for use in logbook records and other similar data collection functions should await practical testing.

STACRES noted that the 10th Session of the CWP will be held in Madrid, Spain, during 26 August-4 September 1980, with ICSEAF and ICCAT as the host organizations, and that the attention of the Scientific Council of NAFO should be drawn to the CWP practice of including three representatives from each participating agency.

STACRES was informed that FAO, in collaboration with other agencies, had made considerable progress in updating the lists of national weight conversion factors, previously published in *FAO Fish Bull.* No. 25 (1971), and expected to be able to provide computer printouts by the end of 1979. STACRES, noting the urgency of having available the updated lists,

recommends (8)

that the CWP Secretary provide the ICNAF/NAFO Secretariat with the manuscript covering the conversion

factors applicable to species caught in the Northwest Atlantic by the various countries, preferably by the end of 1979 or early in 1980 well in advance of the next Annual Meeting.

2. Review of ICNAF Statistical Activities

STACRES was informed that the publication of *ICNAF Statistical Bulletin* Vol. 27 for 1977, was significantly delayed due to the incomplete acquisition of catch and effort statistics from one country and that the provisional catch statistics for 1978 were similarly incomplete. STACRES indicated its concern for the apparent deterioration in statistical reporting and again reiterates the urgent need for all countries to recognize their national obligations to maintain adequate statistical systems which can expeditiously provide the data required by ICNAF and its successor organization. In this regard, STACRES also noted that the advance statistics required for the April 1979 Meeting of the Assessment Subcommittee were very incomplete.

Concerning the recommendation that member countries submit to the Secretariat detailed descriptions of national systems of collecting and processing fisheries statistics (*ICNAF Redbook* 1978, page 87), it was noted that only Norway had responded to the request. It was pointed out that ICES had already accumulated similar reports from its member states, and STACRES accordingly

recommends (9)

that the Secretariat obtain from ICES a set of reports on national statistical systems (provided by some countries) and use these in urging member countries to supply similar reports relevant to their fishing activities in the Northwest Atlantic.

STACRES was informed that catches of blue whiting (*Micromesistius poutassou*) and alfonsinos (*Beryx* spp.) were reported for the Northwest Atlantic in 1978, and agreed that these be added to the "List of Species".

3. Review of STATLANT Forms

With regard to the STATLANT 21A and 21B forms used by member countries to report fishery statistics for the Northwest Atlantic, STACRES was informed that no changes were required at this time but that "NAFO" would be substituted for "ICNAF" when the forms and instructions are reprinted for distribution to national statistical offices early in 1980 to acquire fishery statistics for 1979.

4. Review of ICNAF Sampling Program

STACRES noted that the list of sampling data for 1977 (Sum. Doc. 79/VI/12) will soon be published in *ICNAF Sampling Yearbook* Vol. 22, and urged scientists to submit any outstanding data to the Secretariat as soon as possible. It was also noted that all available sampling data for 1972-77 have been computerized and were available upon request in the form of computer printout or magnetic tape to scientists and institutes involved in the Commission's work, and that progress was being made in preparing pre-1972 data for automatic processing.

STACRES was pleased to note that the Working Group on Standardization of Reporting Procedures for Sampling Data had completed its work and that the proposed forms for use in reporting length and age sampling had also been reviewed by the Assessments Subcommittee. STACRES accordingly

recommends (10)

that forms CFS-1 and CFS-2, as amended and presented in Annex 1 of Appendix III, be adopted for use in the reporting of commercial length frequencies (CFS-1) and age-length keys (CFS-2).

STACRES requested the Secretariat to make the necessary revisions in the outline of the sampling program (Sum. Doc. 79/VI/22) in the light of the new requirements for the reporting of more detailed sampling data.

5. List of Fishing Vessels

STACRES noted that the 1977 *List of Vessels*, which was scheduled for printing in the autumn of 1978, had not yet been published because data were still lacking for Spain and Romania. However, Romanian data have recently been received, and all available data are given in Sum. Doc. 79/VI/13 + Addendum.

6. Scientific Observer Program

STACRES noted that the Statistics and Sampling Subcommittee had considered it premature to establish standards for the collection, reporting and processing of data required under the Scientific Observer Program until the views of the Scientific Council of NAFO are clarified. However, in order to expedite consideration of this program later during this Annual Meeting or afterwards, should the need arise, STACRES

recommends (11)

that the ad hoc Working Group on the Scientific Observer Program, consisting of representatives from each of Canada, Cuba, Spain, USSR, USA, and any other interested countries, with Mr J. S. Beckett (Canada) as convener, meet as soon as possible after a decision has been taken in order to formulate its terms of reference and report to the Scientific Council of NAFO if required.

7. Length Measurement Standard for Roundnose Grenadier

After revieweing the need for a different method of measuring roundnose grenadier from that used at present (total length), STACRES

recommends (12)

that studies be undertaken as soon as possible to determine the most suitable partial length measurement for grenadiers and be documented for consideration at the 1980 Annual Meeting.

IV. ENVIRONMENTAL STUDIES (APP. IV)

1. Flemish Cap Project

STACRES noted that extensive oceanological and biological observations were made on or near the Flemish Cap by Canada and USSR in the latter part of 1978 and early 1979. In addition, the regular oceanographic surveys by the US Coast Guard were carried out and were supplemented by the deployment of satellite-tracked drogued buoys. STACRES reaffirmed its support for this most valuable project, and

recommends (13)

that the Convener of the ad hoc Working Group on the Flemish Cap Project convene a meeting of a small group of scientists working on the project to undertake an in-depth examination of the data obtained in 1978 and 1979, and, using these results and following the general strategies developed at the meeting in Murmansk (ICNAF Redbook 1977, pages 83-86) and the plans considered at the meeting of the Working Group in Bonn (Res. Doc. 78/VI/80), to assemble a detailed plan for a well-coordinated sampling scheme for 1980.

2. Gulf of Maine-Georges Bank Project

STACRES noted that the larval herring surveys, which have been carried out on an international cooperative basis since 1971 by research vessels of Federal Republic of Germany, Poland, USSR and USA, were continued. Collections of larval herring and associated oceanographic measurements were made on the standard Georges Bank-Gulf of Maine station grid. A major multi-disciplinary, multi-ship larval herring patch experiment was conducted from mid-October to early November 1978 in the Georges Bank-Nantucket Shoals area, with the principal objective of identifying and mapping the distribution of an isolated patch of herring larvae to obtain information on larval growth, mortality, and dispersion, in relation to changes in the biological and hydrographic conditions.

STACRES noted that an extremely valuable time series (10 years) of biological and oceanographic data exists, most of which is now in machine-processable form, and that the time was not opportune for a concentrated, cooperative, international effort toward analyzing this valuable data base. Consequently, STACRES strongly

recommends (14)

a) that the Task Force on the Larval Herring Program be reconstituted to undertake the analysis of the extensive data assembled from the Gulf of Maine-Georges Bank area, with the following terms of reference:

   i) the Task Force will determine the most appropriate and desirable methods of study and carry out such studies through the year with the goal of presenting the results to the Scientific Council of NAFO at its 1980 Annual Meeting;

   ii) the Task Force will analyze the data collected over the 10 years of the surveys and the data collected during the patch study in 1978, incorporating in the study such additional environmental data that are available;

   iii) the Task Force should also consider the matter of continuing field work and make recommendations to the Scientific Council of NAFO; and

b) that a USA scientists from the Northeast Fisheries Center, Woods Hole, will be the convener of the Task Force.

It is anticipated that at least three meetings of the Task Force will be required to carry out the work. The first meeting should be convened at the Narragansett Laboratory as soon as possible to organize the study and begin analysis of the data.

3. Environmental Conditions in 1978

STACRES noted the review of environmental conditions in 1978, as presented in Appendix IV, and was pleased to know that the task was aided considerably by the summary produced by MEDS from data contributed by various countries. STACRES reaffirmed its endorsement of this approach but indicated the need for prompt submission of data if the report is to achieve its full value.

4. Marine Environmental Data Service (MEDS)

STACRES noted with satisfaction that considerable progress had been made during 1978 in achieving the input of current oceanographic data to the MEDS data base, and that many data products and information summaries are now being produced. These products have proved to be of great value to the Flemish Cap Project, in that data summaries resulting from the use of the IGOSS system for the transmission of data by radio have aided in the planning of subsequent cruises. STACRES reiterated its concern that there are still some large gaps in the historical data bank of oceanographic information and requested MEDS to continue its efforts to acquire these data. In particular, STACRES

recommends (15)

that MEDS liaise directly with the USSR representative (Dr V. Ponomorenko) in an effort to acquire the missing USSR data for 1975 and report on progress at the 1980 Annual Meeting.

5. Plankton and Ecosystem Studies

STACRES was pleased to note that, in addition to the work being carried out under the Flemish Cap and the Gulf of Maine-Georges Bank projects, considerable national activity was occurring. In particular, it was noted that results were beginning to appear from the extensive MARMAP (Marine Resources Monitoring, Assessment and Prediction) program of the USA. The desirability of managing fisheries on a multi-species or ecosystem basis has been long recognized, and STACRES was encouraged to see that the data bases derived from these ecosystem studies have now evolved to the stage where multi-species models may be developed which might have immediate relevance to fisheries management. STACRES welcomed these valuable contributions and encourages participating countries to continue to submit reports on these very relevant topics.

V. REPORT OF JOINT SESSION OF ASSESSMENTS AND BIOLOGICAL SURVEYS SUBCOMMITTEES (APP. V)

1. Evaluation of Commercial Abundance Indices

STACRES noted that the Assessments and Biological Surveys Subcommittees met jointly on 5 April 1979 and again on 23 May 1979 to evaluate commercial fishery based indices of abundance, in accordance with its recommendation at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 39). The sparseness of documentation available (4 papers) was attributed to the short interval between the receipt of 1978 fishery statistics and the beginning of the 1979 Meeting of the Assessments Subcommittee, thus preventing most scientists from carrying out the requested analyses.

The analyses presented on catch and effort data from Newfoundland vessels for yellowtail flounder and American plaice in Div. 3LNO showed that the usual estimates of catch per unit effort were biased toward under-estimation, particularly at low levels of effort. It was found that a jack-knife statistic effectively reduced this bias and also tended to reduce the variance of the estimates. STACRES also noted the great difficulties associated with the definition of fishing effort in mixed fisheries and the potential biases introduced by changes in vessel efficiency due to changes in mean tonnage and horsepower. Commercial catch per unit effort is usually considered to be more reliable than research vessel indices for fully-recruited age-groups but less reliable for estimating recruitment. The correspondence between research and commercial indices was considered to be better at high levels of stock abundance than at low levels due to increasing catchability in commercial fisheries at declining stock sizes.

STACRES recognized the value of evaluating commercial fishery abundance indices but noted that much background work must be completed by individual scientists before general conclusions can be drawn. Consequently, STACRES

recommends (16)

that experts be encouraged to critically evaluate commercial fishery abundance indices used in their assessments, and that general discussion on the problems be delayed until progress is seen in a variety of cases.

VI. CONSIDERATION OF CANADIAN PROPOSAL FOR CHANGING THE MESH REGULATION FOR REDFISH IN DIVISION 3M

1. Introduction

STACRES noted that the proposal to change the mesh regulation for redifsh in Div. 3M (Com. Doc. 78/VI/12) was based on reports of Canadian fishermen that the current minimum mesh size of 130 mm results in significant quantities of redfish floating out through the meshes at the surface and being lost during the process of taking the catch on board. STACRES, at its June 1978 Annual Meeting, specified the research required to fully evaluate the implications of a reduction in the minimum mesh size for redfish on the short-term and long-term yields of both redfish and cod in the Flemish Cap area (*ICNAF Redbook* 1978, page 45). Relevant documentation reviewed at the present meeting include Res. Doc. 79/VI/43, 51, 53, 63, 113, 121 and 122, and the results are summarized below.

2. Relative Distribution of Cod and Redfish

Smaller redfish tend to be found on the northern part of Flemish Cap in depths less than 550 m. Large *mentella* redfish are found in significant numbers in depths to 550 m and catch rates are high for these large fish in depths greater than 550 m. *Marinus* redfish are found in depths less than 275 m. Nominal catch statistics for redfish do not distinguish between the *mentella* and the *marinus* types. Both types occur on Flemish Cap in concentrations of commercial size, and, although there is no indication of the proportions of these species in the commercial catches, research surveys indicate that the stock of *mentella* redfish is larger than the stock of *marinus* redfish.

Cod have been taken in commercial quantities during research vessel surveys as deep as 550 m, and thus are available over the entire depth distribution of *marinus* redfish and overlap that of *mentella* redfish. From the limited data available, it appears that changes in the seasonal distribution of redfish are not particularly large. No information was available on the seasonal distribution of cod.

3. By-catches in the Directed Redfish and Cod Fisheries

Information from the Canadian directed redfish fishery on Flemish Cap indicated relatively little by-catch of other species, but the Canadian redfish catch forms only a small part of the total redfish catch in the area. However, since the depths fished by the Canadian fleet were not included in the analysis, the significance of the low by-catches could not be fully evaluated. In the directed redfish fishery at depths less than 550 m, there is a distinct potential for significant by-catch of cod. Likewise, in the same depths, a potential exists for by-catch of redfish in the directed cod fishery.

4. Redfish Selection in Trawls

Selection factors reported in the literature for the North Atlantic show considerable variation, but the average value is about 2.8. Data used in the current analysis are consistent with the historical information on selectivity.

5. Effects on Redfish Stock of Decreasing the Minimum Mesh Size for Redfish

Several papers on the effects on redfish of decreasing the mesh size were reviewed. In one analysis, a decrease from the current minimum mesh size of 130 mm to 114 mm would result in a substantial immediate gain in yield but a relatively insignificant gain in yield in the long term. However, the calculated length frequency for the 114-mm mesh was not intermediate between the observed length frequencies of commercial samples from catches taken with 130-mm mesh codends and length frequencies obtained from USSR and Canadian research vessel catches in 1978 or with the results of a study using small-meshed codends in August 1978, as would be expected. The calculated frequency for the 114-mm mesh contains a higher proportion of fish in the 28-35 cm and 20-25 cm size ranges than would be expected, which casts some doubt on the relevance of the calculated frequency. A second analysis used a redfish growth curve for the East Greenland area and was, therefore, to some extent, biased. In addition, the natural mortality coefficient which was applied (0.25) is outside the range of natural mortality considered appropriate for redfish. A third analysis, although based on growth data for Flemish Cap redfish, utilized ageing data from scale readings, but the observed discrepancies between ages of redfish determined by scales and otoliths have not yet been resolved.

The status of the redfish stock on Flemish Cap has been assessed in recent years on the basis of general production model analyses, as the limited amount of catch-at-age data available at present is inadequate for an analytical assessment. Consequently, concern was expressed that the effects on the stock of a change in mesh size would be difficult to quantify in the short term. It would, therefore, be difficult to adjust TACs to allow the (unspecified) benefits to accrue to the fishery, even in the short term.

6. Effects on Cod Stock of Decreasing the Minimum Mesh Size for Redfish

A decrease in the mesh size implies an immediate gain in the cod catch, but, since there would be an

increase in the number of small cod taken, there would probably be an increase in discards. In the long term, a loss in yield-per-recruit would result, but it is not now possible to quantify the extent of this long-term loss and the effect on the cod stock as a whole, since data on the actual by-catch of cod in the directed redfish fishery are not available.

7. Observations on Escapement of Redfish at the Surface

The limited data from the experiment in 1978 indicate that the escapement of redfish through the meshes of 130-mm mesh codends is not large enough to warrant concern. Anecdotal information from a few Canadian fishermen indicates that, when taking on board large catches of redfish, rips in the net caused by excessive strain may result in considerable escapement and that this factor is more significant than escapement through the codend meshes. However, it was considered that the data available at present are insufficient to evaluate the significance of escapement of redfish through the meshes at the surface.

8. Conclusion

In view of the present uncertainties about the effects of decreased mesh sizes on the redfish and cod resources, STACRES advises that there should be no change in the minimum mesh size for redfish on Flemish Cap.

VII. GEAR AND SELECTIVITY STUDIES

1. Silver Hake and Squid Selection Studies

The results of selection studies (Res. Doc. 79/II/3, 35) were reviewed in detail by STACRES at its Special Meeting in February 1979 (Part B, this volume) and by the Assessments Subcommittee (Appendix I). A specific recommendation for further work is given in Section I(3) of this report.

2. Greenland Halibut Selection Studies

STACRES was informed that the selection experiments recommended at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 45) are planned to be carried out during 1979.

3. Other Selectivity Studies

STACRES noted with interest the results of selection studies on the Scotian Shelf for a variety of species and a literature review of previous studies on these species (Res. Doc. 79/II/2). The results of studies on redfish selection (Res. Doc. 79/VI/43, 51, 53 and 113) were considered in discussions on the proposal to decrease the minimum mesh size for redfish on the Flemish Cap (see preceding Section VI).

4. Gear Studies

Research on the estimation of trawl door spread from wing spread (Res. Doc. 79/VI/77) was discussed by the Biological Surveys Subcommittee (Appendix II, Section 8). STACRES noted this contribution with interest and urged that scientists be encouraged to increase research activities on gear behaviour, as this could substantially improve the precision of estimating abundance indices from trawl surveys. It was noted that the Fish Reaction Working Group of the Fishing Technology Committee of ICES will discuss the herding effect of warps and selectivity in the forward parts of trawls at its next meeting.

VIII. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Silver Hake

STACRES noted that the guidelines for the ageing of silver hake have been completed (Res. Doc. 79/VI/42) and reviewed by individual scientists and the Assessments Subcommittee. This paper is currently being revised for publication, as recommended by STACRES at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 44). It was noted that other recommendations on silver hake ageing studies are being acted on, including an otolith exchange program, and that reports can be anticipated for future meetings. Although good agreement on ageing of silver hake was achieved at ageing workshops, there was still serious disagreement in the estimation by the national laboratories concerned of the age composition of removals by the fishery. Canadian and USSR scientists agreed to discuss this problem on a bilateral basis.

2. Atlantic Cod

STACRES was informed that the guidelines for cod otolith interpretation, as recommended at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 44), had not been prepared in the form of a research paper, because it was considered more appropriate to have the guidelines based largely on numerous annotated photographs without elaborate text. STACRES accordingly agreed that guidelines based largely on photographic examples of otolith interpretation should be prepared by Mr R. Wells and submitted to the Sec-

retariat for publication in one of the ICNAF publication series. The results of further cod otolith exchanges (Res. Doc. 79/VI/68, 81), indicating good agreement among the age readers involved, were noted and considered most encouraging.

3. Atlantic Redfish

STACRES noted that no significant progress had been made in initiating a redfish scale and otolith exchange program, which was recommended at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 44), as the objective to be achieved from such a program had not been clearly defined. It was agreed that such an exchange program would not resolve the primary question of which ageing method was more valid. Noting that priority should be given to validation studies, STACRES

recommends (17)

that redfish age validation studies be conducted based on both scale and otolith ageing techniques, and that the results of the studies, together with reviews of earlier relevant studies, be presented at the 1980 Annual Meeting.

4. Short-finned Squid (*Illex*)

STACRES noted that studies conducted (Res. Doc. 79/II/26) and presently in progress on the ageing of squid from statoliths are producing encouraging results, and urged that this line of research be actively pursued.

5. Other Research

STACRES agreed that further workshops and exchange programs concerned with ageing are of lesser importance at this time than are ageing validation studies, and therefore

recommends (18)

that studies on validation of ageing techniques be given higher priority in research programs than is presently the case.

IX. REVIEW OF TAGGING ACTIVITIES

1. Tagging Activities in 1978

Tagging activities in 1978 were reviewed (Sum. Doc. 79/VI/21), and STACRES was pleased to note that experiments were being conducted on a variety of species. However, it was noted that not all countries are following the agreed procedure of reporting tagging activities to the Secretariat for information and distribution to other member countries. The importance of this matter was stressed and all countries are urged to inform the Secretariat as soon as possible after tagging experiments are initiated.

X. COLLABORATION WITH OTHER ORGANIZATIONS

1. West Greenland Salmon Tagging Experiment

STACRES was pleased to learn that the report of the Joint ICES/ICNAF Salmon Tagging Experiment had been forwarded to the printer but that proofs have not yet been checked. The report will be published in Vol. 176 of the *Rapports et Procès-Verbaux* series late in 1979.

2. Symposium on Biological Basis for Pelagic Fish Stock Management

This Joint ICES/ICNAF Symposium was held at Aberdeen, Scotland, during 3-7 July 1978, with the Assistant Executive Secretary attending on behalf of ICNAF. Information from ICES indicates that the complete manuscript was received in April 1979 and that technical editing is now in progress. The papers will be published in Vol. 177 of the *Rapports et Procès-Verbaux* series. It was pointed out that ICNAF will contribute $5,000 toward publication costs as recommended by STACRES at the 1977 Annual Meeting.

3. Symposium on Early Life History Stages of Fish

STACRES noted that the Second International Symposium on this subject was held at Woods Hole, USA, during 3-6 April 1979. In connection with ICNAF's offer to print the proceedings of this symposium (*ICNAF Redbook* 1978, page 47), the Executive Secretary and the Administrative Assistant attended the meeting and held discussions with the editors regarding publication arrangements.

4. CWP Activities Relevant to ICNAF

STACRES noted that CWP matters had been discussed by the Statistics and Sampling Subcommittee (Appendix III), 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.

XI. OTHER RESEARCH MATTERS

1. International Observer Program for the Convention Area Outside Coastal State Jurisdiction (APP. VI)

At the Commission's request from its Special Meeting in March 1979 (Sum. Doc. 79/VI/8, page 14), STACRES reviewed the June 1975 Resolution of the Commission relating to the adoption of a scientific observer program (*ICNAF Meet. Proc.* 1975, No. 4, App. VI). STACRES continues to hold the view that implementation of a scientific observer program would significantly improve scientific knowledge on the effects of fishing on the resources. The primary data to be collected by scientific observers should be concerned with the biological characteristics of catches and discards, the species composition of catches and discards, and such ancilliary data (e.g. fishing gear characteristics) which are necessary for accurate quantitative estimation of (i) the biological characteristics (i.e. length and age compositions) of removals from the stocks, and (ii) by-catches and discards. Although it is recognized that the data collected will be utilized to formulate new or revised management measures, and indeed it is the primary objective of the program to improve the management of the resource, the scientific observer program cannot be used as the basis for enforcement actions, in the view of STACRES, without prejudicing its effectiveness. This view is consistent with that expressed to the Commission at the June 1975 Annual Meeting. STACRES is prepared to discuss the development of an international observer program at a joint meeting with STACTIC as required by the Commission. In fact, at the request of STACRES, the Statistics and Sampling Subcommittee has already set up an *ad hoc* working group to consider the most appropriate standardized methods of data collection, processing and reporting (see Section III(6)). It was recognized that more time would be needed to deal with this matter than is available at this Annual Meeting.

Subsequent to the discussions outlined in the preceding paragraph, a joint meeting of STACRES and STACTIC was held on 1 June 1979 when both the legal and practical aspects of implementing a multilateral scientific observer scheme were discussed (Appendix VI). It was agreed that the legal aspects of implementing the scheme should be considered by the General Council of NAFO and that the practical aspects relating to standards of data collection be considered by the Scientific Council of NAFO.

2. Consideration of Commencement Date for the Squid Fishery in Future Years

This matter was deferred from the Assessments Subcommittee Meeting in April 1979 due to incomplete documentation of available data (see Appendix I). No new data were available at the present meeting and the matter was again deferred to the next scientific meeting at which conservation measures for squid are scheduled to be discussed.

3. Review of Research Papers in STACRES

Research documents not reviewed by STACRES or its Subcommittees (Res. Doc. 79/VI/40, 41, 50, 55, 66, 84, 85, 86, 87, 88, 89, 90, 92, 98, 99, 101, 102, and 103) were noted with interest. STACRES regretted that time did not permit the thorough review of these papers and hoped that the Scientific Council of NAFO will provide the forum for consideration of such papers in the future. It is important to the scientific community that it be fully informed on scientific matters throughout the Northwest Atlantic if it is to provide management advice as required, particularly as ecosystem considerations are likely to play an increasingly important role in providing such advice.

XII. 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. Although scientific advice on the conservation of certain stocks in 1980 was deferred to a meeting late in 1979 or early in 1980, it was anticipated that such a mid-term meeting, and all subsequent scientific meetings in 1980, will be held under the Scientific Council of NAFO. It was therefore agreed that the election of officers at this Annual Meeting be limited to the election of a Chairman, who will maintain liaison with the Chairman of the Scientific Council of NAFO, if required, during the remainder of this transitional year.

2. Collaboration with Scientific Council of NAFO

STACRES noted that the Scientific Council of NAFO, at its Inaugural Meeting in March 1979, unanimously

agreed to consider the Report of the Assessments Subcommittee of ICNAF as the basis for advice expected of the Council at its June 1979 Meeting. It was also noted that the Scientific Council in joint sessions with STACRES, 22-26 May 1979, adopted the provisional report of STACRES (including the Report of the Assessments Subcommittee) as the basis for its report at this First Annual Meeting of NAFO.

3. Review of ICNAF Publications

STACRES noted that, since the 1978 Annual Meeting, the following publications have been issued or are in preparation:

a) *Redbook* 1978, containing the reports of STACRES meetings in November 1977, February 1978 and May-June 1978, was distributed in August 1978.

b) *Statistical Bulletin* Vol. 27 for 1977, scheduled for printing in December 1978 but delayed due to incomplete data for one country, to be issued in 2-3 months as soon as the recently-received data have been processed.

c) *Sampling Yearbook* Vol. 19 for 1974 (revised) was distributed in August 1978.

d) *Sampling Yearbook* Vol. 21 for 1976 was distributed in December 1978.

e) *Research Bulletin* No. 13, containing seven scientific papers, was distributed in July 1978.

f) *Research Bulletin* No. 14 is expected to be distributed in August-September 1979.

g) *Selected Papers* No. 4, containing 11 scientific papers on shrimp, was distributed in August 1978.

h) *Selected Papers* No. 5, containing 9 scientific papers, was distributed in April 1979.

i) *Index and List of Titles of Meeting Documents* No. 2, covering the years 1965-74, was distributed in November 1978. No. 1 covering the years 1950-64 is expected to be distributed in August-September 1979.

j) *List of Fishing Vessels* for 1977, scheduled for printing in the autumn of 1978 but delayed due to incomplete data, will be printed later in 1979 as soon as the missing data are received.

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

STACRES agreed that, since future policy on scientific publications would be determined by the Scientific Council of NAFO, the current editorial policy be maintained for pending issues of the Research Bulletin and Selected Papers, based on contributions in hand and those selected from the ICNAF Research Document series (to Res. Doc. 79/VI/122). It was agreed that consideration for publication of any subsequent documents in the 1979 Research Document series should be referred to the Scientific Council of NAFO.

5. Review of 1979 Documents for Publication

a) Research documents presented to the 1979 Meeting of STACRES were reviewed by the Steering and Publications Subcommittee, and the following were selected for possible publication in *ICNAF Selected Papers* No. 6, subject to the author's approval and revision where appropriate: Res. Doc. 79/II/11, 13, 16 and 29; 79/VI/49, 52, 56, 58, 66, 74, 77, 91, 92, 98, 101, 104, 109, 112 and 117. STACRES also noted that Res. Doc. 79/II/32 and 33 contained an interesting approach to the analysis of stocks, such as capelin, and agreed that a contribution based on the methodology used in these documents, without specific recommendations for management, would be welcomed for publication.

b) STACRES noted that Res. Doc. 79/II/3 and 79/VI/42 have been refereed and accepted for publication in *ICNAF Research Bulletin* No. 15 to be issued later in 1979.

c) STACRES noted that *ICNAF Redbook* 1979, to be issued in August 1979, will contain (i) the Report of the Special STACRES Meeting on Seals and Shrimp held in November 1978, (ii) the Report of the Special STACRES Meeting on Capelin and Squid held in February 1979, and (iii) the Report of the 1979 Annual Meeting, including the reports of subcommittees as appendices.

6. Annual Indexing of ICNAF Publications and Meeting Documents

STACRES noted that the Assistant Executive Secretary had prepared provisional indexes and lists of titles for ICNAF publications and meeting documents in 1977 and 1978 (Sum. Doc. 78/VI/3 and 78/VI/10). It was noted that work was already in progress on the updating to 1979 of *ICNAF Special Publication* No. 11, expected to be issued in 1980.

7. Future Publications Relating to Research and Statistics

The participants in meetings of STACRES indicated the desirability of maintaining continuity in the numbering and general format of publications relating to research and statistics in the Northwest Atlantic and hopes that the Scientific Council of NAFO will give consideration to this matter.

XIII. FUTURE SCIENTIFIC MEETINGS

1. STACRES noted that the Assessments Subcommittee had not found it possible to advise on conservation measures in 1980 for the shrimp stocks in Statistical Area 0 and Subarea 1, the capelin stocks in Subareas 2 and 3, 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 1979 fisheries be available. It was also noted that precise advice for 1980 could not be given for the silver hake stock in Div. 4VWX. Since the status of these stocks is unlikely to be reviewed again before early 1980, and since 1979 data will not be available until January 1980, the most appropriate time for consideration of these stocks would be at a meeting in early February 1980, in conjunction with the reconsideration of advice for 1980 management of cod in Div. 3M and 3NO as required by the Commission.

XIV. OFFICERS FOR 1979/80

1. Noting that the functions of STACRES and its Subcommittees would be assumed by the Scientific Council of NAFO in 1980 but that there may be a need for liaison with the Chairman of the Scientific Council during the remainder of 1979, STACRES unanimously re-elected Dr R. G. Halliday (Canada) as its Chairman for the remainder of the transitional period.

XV. ACKNOWLEDGEMENTS

1. STACRES expressed its thanks to Dr G. H. Winters who, in addition to his duties as Chairman of the Assessments Subcommittee, assumed the Chairmanship of Special Meetings of STACRES in November 1978 and February 1979. STACRES was also very grateful to Dr R. G. Halliday for agreeing to preside over this Annual Meeting upon very short notice and to continue as Chairman of STACRES for the remainder of the period of transition from ICNAF to NAFO.

2. Various participants reminisced about their past involvement with STACRES and the scientific achievements of ICNAF, particularly during the past two decades, and expressed the hope that scientific cooperation would continue under the new regime.

3. 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.

APPENDIX I. REPORT OF ASSESSMENTS SUBCOMMITTEE

Chairman: G. H. Winters

The Subcommittee met at St. John's, Newfoundland, Canada, during 28 March-9 April 1979 to review the state of and advise on catch levels in 1980 for certain stocks in Statistical Area 0 and Subareas 1 to 4 (Com. Doc. 79/VI/6, 16), to consider proposals for changing the mesh regulation for redfish in Div. 3M (Com. Doc. 78/VI/12) and the implementation of a uniform mesh size for the silver hake and squid fisheries in Subarea 4 (see Part B, this volume), and to evaluate, in collaboration with the Biological Surveys Subcommittee, the accuracy of commercial fishery indices of abundance (see Part C, Appendix V, this volume). The relevant section of the STACRES agenda is given in Part D (this volume). Scientists attended from Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Japan, Norway, Poland, USSR and USA.

Since the 1978 catch statistics available to the Subcommittee at this April 1979 Meeting were confined to species and stocks under catch quota regulation, the Chairman, in collaboration with the ICNAF Secretariat was requested to prepare the usual summary of fishery trends from more complete statistics that would be available at the 1979 Annual Meeting. Section I, therefore, contains a summary of provisional nominal catches in 1978 compared to those in 1977, based on the STATLANT 21A reports of all countries except Spain, whose 1978 statistics were not available at the time of preparing this report for publication. The results of the stock assessments are given in sections II and III, and other matters considered by the Subcommittee are given in section IV.

I. FISHERY TRENDS

1. General Trends in the ICNAF Area

Provisional nominal catches in the Northwest Atlantic for 1978, as compiled from the STATLANT 21A returns of 18 countries (Bulgaria, Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Iceland, Ireland, Italy, Japan, Norway, Poland, Portugal, Romania, UK, USA and USSR) are summarized in Table 1, together with the most up-to-date information available for 1977. Spanish catches, although included in the figures for 1977, are not yet available for 1978. It is important to note that the catch figures for 1978 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 1979 Meeting of the Subcommittee.

The total nominal catch of all finfish and invertebrates declined from 2.96 million tons in 1977 to about 2.72 million tons in 1978 (8%), after having declined from 3.4 million tons in 1976. The total groundfish catch declined from 1.17 million tons in 1977 to 1.11 million tons in 1978 (5%); within this category, significant declines occurred in redfish (22%) and silver hake (25%) while increases were noted for haddock (52%), pollock (15%), flounders (5%) and roundnose grenadier (50%). The total pelagic fish catch declined from 658,000 tons in 1977 to 605,000 tons in 1978 (8%), mainly due to the large decline in mackerel (60%). Catches in the "other fish" category declined from 311,000 tons in 1977 to 178,000 tons in 1978 (57%), mainly due to a substantial decline in capelin (58%). The total catch of invertebrates increased slightly from 825,000 tons in 1977 to 831,000 tons in 1978 (1%), with increases in sea scallops (10%) and oysters (15%) being largely offset by a decline in the overall catch of various species of clams.

2. Statistical Area 0

The total nominal catch of all species declined from 5,000 tons in 1977 to about 1,000 tons in 1978. As in 1977, the 1978 catch consisted mostly of Greenland halibut.

3. Subarea 1

The total nominal catch of all species decreased from 150,000 tons in 1977 to 129,000 tons in 1978 (14%). Significant declines were noted for redfish (74%) and shrimp (19%) while increases occurred for flounders (31%) and roundnose grenadier (200%). The cod catch in 1978 was at approximately the same level as in 1977.

4. Subarea 2

The total nominal catch of all species decreased sharply from 190,000 tons in 1977 to 78,000 tons in 1978 (59%), due mainly to a major decline in capelin (90%) but also to declines in cod (30%) and flounders (18%). Increases were noted for redfish (71%), roundnose grenadier (67%) and shrimp (150%).

5. Subarea 3

The total nominal catch of all species decreased from 630,000 tons in 1977 to 587,000 tons in 1978

Table 1. Nominal catches (000 tons) for 1977 and 1978[1]. (The symbol + indicates less than 500 tons.)

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978
Cod	-	-	38	39	47	33	212	187	129	152	40	48	+	+	467	459
Haddock	-	-	+	+	-	-	1	1	25	33	14	28	+	-	40	61
Redfish	+	+	31	8	7	12	75	67	34	24	13	14	-	-	160	125
Silver hake	-	-	-	-	-	-	+	+	37	48	63	26	14	11	114	86
Red hake	-	-	-	-	-	-	-	+	+	1	7	3	2	1	9	5
Pollock	-	-	+	-	-	-	1	1	22	23	16	22	+	+	40	46
Flounders	4	1	13	17	14	8	109	130	38	35	40	39	11	11	228	240
Roundnose grenadier	1	-	2	6	3	5	12	15	-	+	-	-	-	-	18	27
Other groundfish	-	-	22	13	5	1	15	8	20	19	18	15	8	8	89	62
Herring	-	-	+	+	+	+	30	30	199	212	52	51	1	+	282	294
Mackerel	-	-	-	-	-	-	8	17	13	11	5	1	50	1	75	30
Other pelagics	-	-	-	-	+	-	+	+	1	4	20	50	280	227	301	281
Argentine	-	-	-	+	-	-	-	-	2	2	-	-	-	-	2	2
Capelin	-	-	+	+	109	11	122	75	2	10	-	-	-	-	233	96
Other fish	-	-	2	12	2	2	7	5	15	15	11	10	38	36	76	80
Squids	-	-	-	-	+	-	33	42	47	50	8	3	35	8	123	103
Shrimp	+	+	42	34	2	5	-	+	5	6	+	+	1	+	51	46
Other invertebrates	-	-	-	-	-	-	5	10	39	47	208	206	398	419	651	682
All species [2]	5	1	150	129	190	78	630	587	628	691	516	517	838	722	2958	2724

[1] Nominal catches for 1978 are based on STATLANT 21A reports (all countries except Spain) compiled for the 1979 Annual Meeting.

[2] Except seaweeds.

(7%), but this decrease may be partly offset by the Spanish catch for 1978 when it becomes available. The groundfish catch declined from 425,000 to 409,000 tons (4%), due mostly to decreases in the catch of cod (12%) and redfish (11%) but partly offset by an increase in the catch of flounders (19%). The pelagic fish catch increased from 38,000 to 47,000 tons (24%), due entirely to a significant increase in the catch of mackerel (113%). Catches in the "other fish" category declined from 129,000 to 80,000 tons (42%), due entirely to a major decline in the catch of capelin (39%). The squid catch increased from 33,000 to 42,000 tons.

6. Subarea 4

The total nominal catch of all species increased from 628,000 tons in 1977 to 691,000 tons in 1978 (10%). The total groundfish catch increased from 305,000 to 335,000 tons (10%), due mostly to increases in cod (18%), haddock (32%) and silver hake (37%) but being partly offset by decreases for redfish (29%) and flounders (8%). The total catch of pelagic fish increased slightly from 213,000 to 227,000 tons (7%), due almost entirely to an increase in the herring catch (7%). The total catch of species in the "other fish" category increased from 17,000 to 27,000 tons (59%), due mostly to an increase in the capelin catch from 2,000 to 10,000 tons. The total catch of invertebrates increases from 91,000 to 103,000 tons, due mainly to increases in catches of squid (6%), lobster (31%) and crabs (32%).

7. Subarea 5

The total nominal catch of all species (except seaweeds) remained at about the same level in 1978 as in 1977 (517,000 tons). The total groundfish catch decreased slightly from 211,000 to 195,000 tons (8%), due mostly to a decrease in the catch of silver hake (59%) but being partly offset by increases in the catch of cod (20%), haddock (100%) and pollock (37%). The total catch of pelagic species increased from 77,000 to 102,000 tons (32%), due mostly to an increase in the menhaden catch (175%). The total catch of other finfish and invertebrates decreased slightly from 227,000 to 219,000 tons (4%), with increases in the catch of some species being offset by decreases for others.

8. Statistical Area 6

The total catch of all species decreased from 838,000 tons in 1977 to 722,000 tons in 1978 (14%). This decline was due largely to decreases in the catches of pelagic species, especially mackerel and menhaden (36%), and squids (73%). The total catch of invertebrates (except squids) changed only slightly (+5%).

II. SUMMARY OF RECENT CATCHES AND TACs

The Subcommittee used as the basis for discussion the Canadian request for advice on 12 stocks which lie completely or partly within its 200-mile fisheries zone in Subareas 2 to 4, and 2 stocks which overlap the Canadian and Danish fisheries zone in Statistical Area 0 and Subarea 1 (Com. Doc. 79/VI/6). The Subcommittee also reviewed the cod and redfish stocks in Subarea 1 at the request of the European Economic Community (EEC) (Com. Doc. 79/VI/16), and the three stocks which lie completely outside of the national fisheries zones in Div. 3M.

In reviewing the state of the various stocks, the Subcommittee took account of the Canadian and EEC views on options to be considered in providing advice on the scientific basis for management in 1980 (Com. Doc. 79/VI/6, 16). 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 1980, where specific advice could be given. Details of the stock reviews are given in Section III below.

Table 2. Summary of recent catches (1974-78) and TACs (1974-79) for stocks reviewed at the April 1979 Meeting of the Assessments Subcommittee, together with advised TACs for 1980.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)						
		1974	1975	1976	1977	1978[1]	1974	1975	1976	1977	1978	1979	1980
Cod	1	48	48	33	38	37	107	60	45	31	...[2]	...[2]	( )[3]
	2GH	4	7	6	4	5	20	20	20	20	20	20	(20)
	2J+3KL	373	288	214	173	136	657	554	300	160	135	170	( )[3]
	3M	25	22	22	25	33	40	40	40	25	40	40	( )[3]
	3NO	73	44	24	18	15	101	88	43	30	15	25	( )[3]
Redfish	1	3	9	14	31	10	-	-	-	-	13	...	( )[3]
	3M	35	16	17	20	16	40	16	16	16	16	20	(20)
	3LN	22	18	21	16	12	28	20	20	16	16	18	(25)
Silver hake	4VWX	96	116	97	37	48	100	120	100	70	70	70	( )[3]
A. plaice	3M	2	2	1	1	1	2	2	2	2	4	2	(2)
	3LNO	46	43	52	44	50	60	60	47	47	47	47	(47)
Witch	2J+3KL	16	12	11	8	7	22	17	17	17	17	17	(17)
	3NO	8	6	6	6	3	10	10	10	10	10	7	(7)
Yellowtail	3LNO	24	23	8	12	15	40	35	9	12	15	18	(18)
G. halibut	0+1	14	25	16	13	12	-	-	20	20	20	25	(25)
	2+3KL	27	29	25	32	38	40	40	30	30	30	30	(35)
R. grenadier	0+1	12	5	9	3	6	-	10	14	8	8	8	(8)
	2+3	28	27	21	15	21	32	32	32	35	35	35	(30)
Argentine	4VWX	17	15	7	2	2	25	25	25	20	20	20	(20)

[1] Provisional statistics.
[2] Catches restricted to Greenlanders' fishery and to by-catch (regulated by percentage allowances).
[3] See relevant subsection of Section III for comments and options.

III. STOCK ASSESSMENTS

1. Cod in Subarea 1 (Res. Doc. 79/VI/59)

a) Fishery trends

The total nominal catch of cod in 1977 was about 38,000 tons, exceeding the TAC for that year by about 23%, although fishing by trawlers was stopped in the first half of the year. The local inshore catches, which were as low as 5,200 tons in 1976, increased to about 14,000 tons in 1977 with a further increase to about 18,000 tons in 1978. Recent catches and TACs are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	107	60	45	31	...[1]	...[1]
Catch (000 tons)	63	48	48	33	38	38	

[1] Catches limited to Greenlanders' fishery and to by-catch.

Only Greenland vessels were allowed a directed cod fishery in 1978. Although fishing by trawlers was stopped by May, the total nominal catch, including the above-mentioned 18,000 tons in the inshore fishery, is provisionally reported to be about 37,000 tons. This figure includes about 1,000 tons reported as by-catch by non-Greenlandic vessels fishing for species other than cod. Taking into account the stringent regulations for by-catch of cod (10% in fisheries for redfish, 3% in fisheries for Greenland halibut and roundnose grenadier) and the fact that as much as 10,000 tons of the total catch of finfish in the area in 1978 are reported as "unspecified", it cannot be precluded that the actual removal of cod (including possible discards) was higher than 37,000 tons in 1978.

The proportion of the total catch of cod by trawlers in Subarea 1 increased from about 37% in 1977 to about 52% in 1978. Fishing by Greenland trawlers in the first quarter of 1979 was at least as good as in 1978. Although some of them have already been stopped (converted to shrimp fishing), it seems likely that the total catch by Greenland vessels in 1979 will be about the same as that in 1978 (i.e. 35,000 tons).

b) Trends in distribution, abundance, and stock composition

For the offshore trawl fishery (Greenland trawlers), there was a further significant increase in overall catch rate by about 160% from 1977 to 1978. However, since about 80% (by numbers) of the catch in 1977, as well as in 1978, consisted of the 1973 year-class, part of the increase in catch rate (by weight) could be explained by the growth, but the major factor may have been a considerable increase in availability (catchability) in the first part of the year when trawlers found dense shoals. These shoals were, however, found in a rather limited area. In the first months of 1979, when the catch rate was at least as good as in 1978, acoustic surveys and the location of the fishery have confirmed that the shoals are found in a very limited area. Thus, although the catch rate is very good, it is not possible to use it for direct estimation of overall stock abundance. The offshore fishing in 1978 took place in the southern part of Div. 1C and southwards, with hardly any offshore fishing for cod in Div. 1A and 1B.

As mentioned above, the 1973 year-class made up by far the major part (80% by numbers) of the catches in 1977 and 1978. It was expected that the same year-class would have been the major contributor to the offshore trawl fishery in the first quarter of 1979. However, in the main fishing area (southern part of Div. 1C), the major part of the catches in the first quarter of 1979 seems to consist of rather small cod of the 1974 and 1975 year-class, whereas the 1973 year-class seems to be decreasing in relative importance quicker than expected. In Div. 1D, the 1973 year-class still seems to be the most important one at the beginning of 1979, but fishing here has been much less intensive than in the southern part of Div. 1C. Since the inshore fishing by pound net is expected to be based mainly on the 1974 and 1975 year-classes, it seems likely that the relative importance of the 1973 year-class will decrease substantially in 1979 compared with 1977 and 1978.

c) Assessment parameters

Mortality rates. On the basis of trends in fishing effort and catches, the Subcommittee at its April 1977 Meeting concluded that fishing effort had decreased by about 25% from 1975 to 1976, and at its April 1978 Meeting that effort decreased further from 1976 to 1977, so that the range of fishing mortality (F) in 1977 was between 0.16 and 0.20 for fully-recruited age-groups. Although the number of hours trawled in the directed cod fishery has decreased further (by about 38%) from 1977 to 1978, the analyses do not indicate a further decrease in fishing mortality. Rather, it appears that fishing effort has concentrated on the dense, easily available shoals, and the analyses in fact point to the likelihood of an increase in F for the age-groups forming these shoals in 1978, primarily age-groups 4-6.

The trend in exploitation seems to be that, when a new, relatively strong year-class recruits to the fishery after a period of very low stock size, the fishery concentrates on this year-class, and older age-groups, if they tend to be separated from the younger fish, may be less heavily fished. This may have been particularly so in 1978, as gillnets and longlines which exploited the older fish have virtually vanished from the offshore fishery.

Analyses were, as formerly, carried out with a constant F for fully-recruited age-groups (age 6+), but the results seemed so unrealistic that the hypothesis of a constant F had to be rejected. Analyses were then made under the assumption of F varying with age in 1979. Furthermore, the analyses were carried out for a likely range of catch composition in 1979, as evidenced by catches and sampling in the first quarter of 1979. The catch compositions and F-values used in the analyses are given in Table 3, the total numbers in the catch corresponding to an expected catch of about 37,000 tons in 1979 (Res. Doc. 79/VI/59). In order to take into account possible discarding of commercially-undersized fish of the youngest age-group, the natural mortality (M) was set at 0.3 for age 3. As in previous analyses, M was set at 0.20 for ages 4 to 6 and at 0.25 for older ages (to include emigration rate).

Table 3. Catch composition and fishing mortality by age-group used in the analyses of the Subarea 1 cod stock under two assumptions of recruitment of the 1973 year-class in 1979.

Assumptions		Catch (000 fish) and F by age-group									
		3	4	5	6	7	8	9	10	11	12+
A. Lower estimate of recruitment of the 1973 year-class	Catch	200	9000	6000	4000	200	20	20	10	5	1
	F	0.05	0.30	0.30	0.30	0.15	0.10	0.05	0.03	0.02	0.01
B. Upper estimate of recruitment of the 1973 year-class	Catch	200	5000	3000	9000	200	20	20	10	5	1
	F	0.05	0.20	0.30	0.30	0.15	0.10	0.05	0.03	0.02	0.01

Year-class estimates. Due to uncertainty as to the absolute size of the important 1973 year-class, the Subcommittee at its April 1978 Meeting had to assume a rather wide range of values for this year-class (120-200 million fish at age 3). The present analyses indicate that the size of this year-class at age 3 was in the range of 100-145 million fish. The year-class was fished rather heavily during 1976-78, with removals (excluding discards) estimated to have been at least 45 million fish. Therefore, the contribution of the 1973 year-class to the fishery in 1980 and following years is expected to be low relative to that of younger age-groups. The residual numbers of the 1973 year-class at the beginning of 1979 are 17 and 38 million fish respectively for assumptions A and B of Table 3, residual numbers of the 1974 year-class by 1979 are 25 and 13 million fish respectively. These figures were used in the forecasts.

The analyses do not yet allow for firm conclusions about the absolute strengths of year-classes younger than that of 1974. The size of the 1975 year-class at age 3 has tentatively been estimated at 75 million fish, and the strengths of the 1976 and 1977 year-classes at age 3 were set at 20 and 50 million fish respectively. While the strengths of the 1978 and 1979 year-classes were set at 20 and 40 million fish respectively for use in the projections, they have no influence on the projections of spawning stock size up to 1983.

d) Results of assessment

Projections of catch for 1980-82 and of resultant spawning biomass were carried out for the two sets of assumptions on the 1979 stock status given above and for various fishing strategies (Table 4). While the absolute values, especially for spawning biomass, depend upon the assumptions made, they do, however, demonstrate the relative changes between the various fishing strategies. In the last line of Table 4, the spawning stock at the beginning of 1983 is compared with the 1971 level.

Variation in spawning biomass (age-groups 6 and older) during 1972-79 relative to that in 1971 is indicated as follows:

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979
Index	100	71	39	44	29	15	10	8	25(A) 47(B)

Recruitment of the relatively good 1968 year-class helped to maintain the spawning stock in 1974, but the stock decreased rapidly thereafter with poor year-classes maturing. The recruitment of the 1973 year-class to the spawning stock in 1979 will mean some increase in spawning biomass, and so will probably the recruitment of the 1975 year-class by 1981. It must be emphasized that the spawning stock is presently at a very low level, and that the 1971 stock size, to which comparison is made in the foregoing tables, was only about one-quarter to one-third as large as the stock sizes of the 1950's and 1960's.

The projections for all strategies in Table 4 are based on the assumption that a catch of 36,000-39,000 tons will be taken in 1979. Strategy 1 illustrates the resultant spawning stocks in 1981 to 1983 by maintaining a catch of 35,000 tons. Strategy 2 indicates the catches and spawning biomasses if the exploitation rate closely corresponds to fishing at $F_{0.1}$ during 1980-82. Strategy 3 shows the effect of nearly closing the fishery in 1980 and thereafter fishing at a level corresponding to that assumed for 1979. Strategy 4 shows the effects on spawning stock size by maintaining a catch of 15,000 tons during 1980-82.

Table 4. 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 start of the year. The lower and upper values of the ranges given relate to the lower and upper estimates of recruitment of the 1973 year-class in 1979 (assumptions A and B in Table 3). Fishing mortality (F) relates to fully-recruited age-groups.

Fishing strategy No.		1	2	3	4
1979	Spawning biomass	66-127	66-127	66-127	66-127
	Fishing mortality (F)	0.30	0.30	0.30	0.30
	Projected catch	36-39	36-39	36-39	36-39
1980	Spawning biomass	96-121	96-121	96-121	96-121
	Fishing mortality (F)	0.27-0.25	0.40	0.05	0.11-0.10
	Projected catch	35	49-53	7-8	15
1981	Spawning biomass	145-176	131-158	174-205	167-198
	Fishing mortality (F)	0.28-0.26	0.40	0.30	0.10
	Projected catch	35	43-46	43-46	15
1982	Spawning biomass	133-159	110-130	158-181	175-201
	Fishing mortality (F)	0.36-0.34	0.40	0.30	0.11
	Projected catch	35	34-35	33-34	15
1983	Spawning biomass	144-169	126-136	169-190	214-237
	As % of spawning biomass in 1971	54-63	47-51	63-70	80-88

The recent trend in exploitation indicates that the possibilities for increasing the stock size, created by the recruitment of the 1973 year-class, have not been used to the extent that was advised. The further potential for rebuilding the spawning stock by the relatively good 1975 year-class is also not likely to result in an increase in stock size, since it appears that exploitation of this year-class has already started. Rebuilding of the stock to the state where the spawning stock approaches the 1971 level and comprises more than just one good year-class still requires a low level of fishing. Of the strategies listed in Table 4, only Strategy 4 leads to a spawning stock by 1983 which approaches that of 1971.

The Subcommittee points out that the recent fishing pattern implies a lower yield-per-recruit than would result by allowing more individuals of newly-recruited year-classes to reach maturity. In view of the present low stock size and the recent fishing pattern, the Subcommittee still advises that rebuilding and maintenance of the spawning stock to a level considerably above the present level should be the main concern for management.

2. Cod in Divisions 2G and 2H (Res. Doc. 79/VI/47)

a) Fishery trends

Nominal catches in the 1970's have been much lower than catches in the 1960's. The highest catch recorded was in 1966 when 94,000 tons were caught. Since the establishment of a TAC of 20,000 tons in 1974, reported catches have been substantially below this level, due, at least in part, to ice conditions in recent years.

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	20	20	20	20	20	20
Catch (000 tons)	+	4	7	6	4	5*	

* Provisional

b) Assessment

Concern was expressed about the use of commercial catch rates in assessing the status of this stock due to variability in catch rates caused by ice conditions. However, it was noted that the coefficient of variation of catch rates is comparable to that for other cod stocks. A general production model analysis indicated that the stock has been relatively stable in recent years. Calculation of the relative strength of the 1967-73 year-classes at age 5, assuming that F was 0.13 over the past few years, indicates that the 1973 year-class is substantially stronger than previous ones.

Catch curve analysis for age-groups 7-12 in 1978 indicates an average F of 0.13 for the 1970's when catches averaged about 8,000 tons. Fishing at $F_{0.1}$ during that period would imply a catch of 13,000 tons. Since this stock is probably related to that in Div. 2J+3KL, for which an increase in biomass of about 50% from 1978 to 1980 is projected, fishing at $F_{0.1}$ in 1980 implies a catch of 20,000 tons. The Subcommittee therefore advises that the TAC of 20,000 tons be maintained for 1980.

3. Cod in Divisions 2J, 3K and 3L

a) Fishery trends

Nominal catches of cod declined from an average of about 640,000 tons in 1966-70 to about 380,000 tons in 1971-75 and less than 200,000 tons in 1977 and 1978. Trends in recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	666	657	554	300	160	135	170
Catch (000 tons)	355	373	288	214	173	136*	

* Provisional

b) Assessment parameters

Sampling reported by Canada, Federal Republic of Germany, German Democratic Republic, Poland and USSR was used to derive the age composition of catches in 1978.

Reports on catch and effort by USSR and Spain to the Canadian FLASH system indicated that the standardized effort values adjusted to catches by all countries were 6,650 and 29,350 days respectively. The regressions of fishing mortality on fishing effort, taken from Res. Doc. 78/VI/66, led to estimates of F in 1978 of 0.27 and 0.29 respectively. The estimate of 29,350 days fished for the Spanish standardized effort was adjusted to 293,500 hours on the basis of the ratio of about 10 fishing hours per fishing day (from Table 6 of *ICNAF Stat. Bull.* Vol. 26). A terminal F of 0.27 was used for 1978. The results of cohort analyses indicated that fishing mortality calculated for 1977 at the April 1978 Meeting of the Subcommittee was slightly lower than that derived at this meeting.

Regressions of the geometric mean abundance of ages 1, 2 and 3 of each year-class from USSR young fish surveys against the numbers of age 4 cod from the virtual population analysis (VPA) were not significant. A similar regression using estimates of ages 2 and 3 cod from Federal Republic of Germany surveys was also not significant. The regression of the abundance of age 3 cod in USSR surveys and the abundance of corresponding year-classes from the latest VPA for the 1959-1972 year-classes was used to estimate recruitment. The abundances of the 1973, 1974 and 1975 year-classes at age 4 were thus estimated at 580, 510 and 400 million fish respectively. The estimate of the abundance of the 1973 year-class at age 4 from the cohort analysis was 400 million, and an average value of 500 million was selected for this year-class. The 1976 year-class is apparently weak and was assigned an arbitrary value of 200 million fish at age 4. A nominal value of 500 million was assigned to all subsequent year-classes.

For the stock size and catch projections, the partial recruitment pattern (same as used in the previous assessment except new values for ages 4 and 5 to reconcile stock sizes in 1978 with observed catches of ages 4 and 5 cod in 1978) and the mean weights-at-age (from Canadian sampling in 1978) are as follows:

Age	4	5	6	7	8	9	10	11	12	13	14
% recruited	14	47	76	87	93	97	100	100	100	100	100
Weight (kg)	0.70	0.99	1.59	2.53	3.40	4.26	4.75	5.51	7.32	8.25	8.43

c) Catch projections

Catch and spawning biomass projections (age 7 and older) are given in Table 5 for the years 1980-82, assuming that a TAC of 170,000 tons will be taken in 1979, for three different levels of fishing mortality.

Table 5. Cod in Div. 2J+3KL: projections of catch and spawning biomass (000 tons) in 1980-82 for three levels of fishing mortality.

	F = 0.10		F = 0.16		$F_{0.1}$ = 0.20	
Year	Catch	Spawning biomass	Catch	Spawning biomass	Catch	Spawning biomass
1979	170	409	170	409	170	409
1980	110	802	172	802	212	802
1981	145	1,341	217	1,275	259	1,232
1982	176	1,739	254	1,579	296	1,480

The Subcommittee notes that under all three options of F in 1980 the spawning stock biomass is projected to reach by 1981 the lower range of the target spawning stock biomass (1.2-1.8 million tons) advised at the April 1977 Meeting of the Subcommittee.

4. Cod in Division 3M (Res. Doc. 79/VI/46, 63, 70, 74, 79)

a) Fishery trends

Catches have varied considerably since 1960, probably in response to wide fluctuations in recruitment. In the periods 1960-64, 1965-69 and 1970-74, the average catches were 26,000, 43,000 and 33,000 tons respectively. Recent catches and TACs are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	40	40	40	25	40	40
Catch (000 tons)	23	25	22	22	25	33*	

* Provisional

Data concerning tagging of cod in 1964, vertebral averages, and growth rates were considered as confirming the discreteness of the Flemish Cap cod stock.

b) Biological studies

A feeding study of cod in Div. 3M during January-February of 1978 and 1979 (Res. Doc. 79/VI/70) showed that the major prey of cod greater than 60 cm was redfish, and that the major prey of cod less than 60 cm changed from hyperiid amphipods in 1978 to small redfish in 1979 in response to the appearance of a successful redfish year-class. In both years benthic invertebrates were unimportant as food, and cannibalism was not extensive.

Studies of the growth rate of cod and the size ranges of redfish available (Res. Doc. 79/VI/74) indicate that, in the absence from the Flemish Cap of large resident populations of capelin and launce, the growth rate of cod may depend largely on the size spectrum of redfish available.

In view of the paucity of published information on trophic dynamics of the Flemish Cap and the indication that such information may considerably aid management, the Subcommittee urges that unpublished data relevant to food and feeding in general, and to the Flemish Cap in particular, be made available, and that greater emphasis be placed on studies of trophic dynamics.

c) Assessment parameters

Examination of the age compositions of cod, both from the commercial fishery in 1976-78 and research vessel surveys in 1977-78, confirmed that the stock in these years consisted largely of age 5 and younger fish with the 1973 year-class strongly predominating. Research vessel surveys in 1979 indicated that fish of the 1973 year-class were mainly mature. Length compositions of cod in 1975 from the commercial fishery, particularly in the later part of the year, indicated that the 1973 year-class as 2-year-olds in 1975 may have been taken in considerable numbers, with possible discarding by some vessels.

A general production model analysis showed that the standardized catch rate in 1978 from limited effort data (Canadian vessels and reports on fishing activity of other vessels) was 0.54 tons per hour compared with 0.70 tons per hour in 1977. The estimate of equilibrium yield at 2/3 F_{MSY} is about 10,000 tons for 1980. This compares with estimates in the range of 10,000-22,000

tons for 1979 derived at the April 1978 Meeting of the Subcommittee based on a variety of effort standard for 1977. The Subcommittee notes, however, that general production models assume an equilibrium condition in the stock and do not take into account recruitment fluctuations.

Estimates of fishing mortality in 1978 were derived from a number of sources. A comparison of catch-at-age per unit effort in 1977 and 1978 resulted in an estimate of F = 1.08. An estimate of F = 1.72 was derived from research vessel abundance indices for 1978-79. The commercial catch-at-age data were adjusted to take into account year-class strength as shown in the USSR young fish surveys and led to an estimate from the 1978 catch curve of F = 1.14, reflecting the average fishing mortality during the 1970's. On the basis of the standardized effort estimated for 1978 and the catchability coefficient from the general production model, an estimate of F = 1.12 was indicated for 1978. The Subcommittee agreed to use 1.3 (the average of the above-mentioned estimates) as the value of terminal F in 1978.

The size of the 1973 year-class at age 3 was calculated by cohort analysis to have been about 93 million fish. Using the abundance estimates from USSR research vessel surveys, estimates of the sizes of the 1974-77 year-classes at age 3 were calculated on the basis of the geometric means of the numbers of 1-, 2- and 3-year-old cod caught per hour as compared with the estimate of 93 million fish for the 1973 year-class. The sizes of the 1974 to 1977 year-classes at age 3 were thus estimated to be 17.2, 2.7, 0.1 and 4.3 million fish respectively.

The partial recruitment values for ages 3 and 4 were adjusted to reconcile the numbers caught and the calculated stock sizes of these two year-classes in 1978, and those for age 5 and older were derived from selection ogives and average length-at-age data. The resultant F-values used for 1978 are 0.057 for age 3, 0.225 for age 4, 1.17 for age 5 and 1.3 for age 6 and older.

d) Catch and biomass projections

Projections of catch and stock biomass (tons) in 1980 and 1981 at F_{max} = 0.27 were made for three levels of catch in 1978 ranging from 10,000 to 25,000 tons (Table 6).

Table 6. Cod in Div. 3M: projections of catch and stock biomass (000 tons) in 1980-81 for three different levels of catch in 1979.

		1979 catch = 10000			1979 catch = 20000			1979 catch = 25000		
	1978	1979	1980	1981	1979	1980	1981	1979	1980	1981
Stock biomass (age 4+)	57.0	32.0	34.0	33.0	32.0	17.0	18.0	32.0	9.5	10.0
Projected catch	35.0	10.0	7.0	-	20.0	3.5	-	25.0	1.7	-
Spawning biomass	13.0	22.0	31.0	30.0	22.0	14.0	15.0	22.0	7.0	7.5

The Subcommittee noted that these estimates are quite sensitive to the various input values used, but that the projections clearly show increasingly reduced stock biomass and spawning stock size by 1981 with increasing catches in 1979.

In its advice to the Commission in 1978 (*Redbook* 1978, page 58), the Subcommittee pointed out the conflicting evidence available from research vessel surveys and from general production models, which led to estimates of yield in 1979 ranging from 16,000 to 40,000 tons, and advised that the TAC for 1979 should not exceed 40,000 tons. Furthermore, it was noted that the adoption of a TAC of 40,000 tons for 1979 might make it necessary to reduce the yield in 1980, since the absolute abundance of the strong 1973 year-class in the catches was expected to decline after 1980, especially if the size of this year-class has been over-estimated.

From new evidence examined at this meeting of the Subcommittee, it appears that the size of the 1973 year-class was over-estimated, and, depending on the actual size of the catch in 1979, the projected yields at F_{max} (0.27) in 1980 will be small, less than 7,000 tons in any case. It was pointed out that the projected reduction in spawning stock in 1980 is a matter of concern.

e) Opinion of USSR scientists on the assessment

According to the opinion of the USSR scientists, the value of F derived from commercial catch data for 1977 and 1978 and on Canadian trawl survey results for 1978 and 1979 is seriously over-estimated. Combined age compositions for two years could not be a reliable basis for estimation of F in 1978, and trawl survey data create doubt due to the lower number of sets per square mile in the 1979 survey.

Use of geometric mean [(ℓn(age 1) + ℓn(age 2) + ℓn(age 3))/3] for interpretation of USSR young cod survey data has no biological basis, because it is not possible to compare average number per hour trawling of ages 1, 2 and 3 due to differences in vertical distribution. The strength of the 1973 year-class was therefore under-estimated.

The calculations shown below do not indicate a serious decline in biomass of cod and the subsequent projected catches for 1980. The size of the 1973 year-class at age 3 in 1976 is estimated at 162 million fish as follows:

Year-class	Abundance at age 3 from USSR surveys		Stock size at age 3 (10^6)
	No.	ℓn(No.)	
1962	29	3.37	92 (from VPA)
1973	392	5.97	162 (estimated)

Using this estimate for 1976, the size of the 1973 year-class in 1978 and the relevant F-level are estimated as follows:

Year	1973 year-class (10^3)		$\frac{F}{Z}(1-e^{-Z})$	F
	Catch	Stock		
1976	28,370	162,000	0.175	0.215
1977	15,509	118,600	0.131	0.156
1978	17,749	81,040	0.219	0.278

From these estimates, fishing mortality of the 1973 year-class in 1978 was at the level of 0.3. Assuming that fishing mortality for age 5+ was 0.9, the stock biomass in 1978 would be 127,000 tons. The average F for all age-groups would in this case be 0.35.

It should be noted that an over-estimated F of 1.3 indicates a total stock biomass in 1978 of 57,000 tons, which is one-half of that estimated with F = 0.28. As the observed difference in the estimates of F cannot be resolved and the resulting TAC levels for 1980 range from 7,000 to about 40,000 tons, as well as taking into account an evident decline in stock biomass (but not to the extent indicated by the over-estimated F-level) and the STACRES advice of last year (*Redbook* 1978, page 58) on the reduction of the TAC for 1980, it is the opinion of USSR scientists that a TAC level for 1980 of 25,000-30,000 tons is not considered to be too high.

5. Cod in Divisions 3N and 3O (Res. Doc. 79/VI/45, 67)

a) Fishery trends

Catches have declined from a high of 227,000 tons in 1967 to 15,000 tons in 1978. During 1973-77, the catches were substantially less than the corresponding TACs. The catch rates of Spanish pair trawlers have declined from 1.7 tons per hour in 1967 to approximately 0.2 tons per hour in 1978. The calculated MSY for this stock is approximately 100,000 tons. Trends in recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	103	101	88	43	30	15	25
Catch (000 tons)	80	73	44	24	18	15*	

* Provisional

b) Assessment parameters

Catch-at-age data for 1973-78 were used in a cohort analysis to determine fishing mortalities and stock sizes. The calculation of input parameters in 1978 was subject to some uncertainty, mainly with regard to the value of terminal F. Four values of F were considered: 0.20 and 0.35 were obtained from regressions of weighted F's (ages 4+) against Canada-N otter trawl fishing effort and 0.41 and 0.51 from regressions of weighted F's (ages 4+) against Spanish pair trawl

effort (tonnage class 4, unadjusted and standardized). A value of 0.35 was selected as terminal F in 1978 by weighting the four estimates of F in proportion to the significance of the regressions. Estimates of recruitment at age 3 in 1977, 1978 and 1979 were determined from a regression of abundance at age 3 from the cohort analysis with terminal F = 0.35 against the abundance of age 2 cod from USSR young fish surveys. These recruitment values at age 3 were estimated to be 40.0, 40.8 and 18.9 million fish in 1977, 1978 and 1979 respectively. These values are on the average about one-fifth of those for the 1965-69 period. Recruitment of age 3 cod in 1980 was taken to be 27 million, the average of the 1970-73 estimates of recruitment at age 3 from cohort analysis (F_T = 0.35 in 1978).

c) Results of assessment

The stock size in 1978 was calculated by cohort analysis, and a catch projection was made for 1980 with F = 0.19 (approximately F_{max}) and assuming that the 1979 TAC of 25,000 tons will be taken (Table 7).

Table 7. Cod in Div. 3NO: projection of catch in 1980 at F_{max}.

Year	Recruitment at age 3 (millions)	Terminal F	Catch (tons)
1978	40.8	0.355	15,700
1979	18.9	0.377	25,000
1980	27.0	0.190	16,500

The Subcommittee also reviewed a general production model analysis which utilized catch and effort data for all of the major fleets fishing in the area up to 1977 with an estimate for 1978. The results indicated a general decline in catch-per-unit effort and that fishing at 2/3 F_{MSY} in 1980 would probably produce a catch of about 15,000 tons.

The Subcommittee concluded that the stock is in a very depressed condition. This is evident when it is considered that fishing at F_{max} in 1980 would produce a catch of 16,500 tons from a stock with the MSY level calculated at about 100,000 tons. If the TAC of 25,000 tons is taken in 1979, the fishing mortality generated (0.38) will be twice the F_{max} level (0.19).

The basis for the recommended TAC of 25,000 tons in 1979 (*Redbook* 1978, page 59) was mainly a general production model analysis. It appears now that this was an optimistic outlook and might demonstrate the inappropriateness of general production model analyses when a stock is not in equilibrium. It was emphasized that, when a stock reaches such a low level of abundance, its size becomes very difficult to estimate, and that concern for the stock is more important than the actual catch level to be obtained at a given value of F.

The Subcommittee, noting the very depressed state of this stock and the advantages to be obtained not only in terms of increases in yield-per-recruit but also the protection of the spawning stock, and noting the apparent rebuilding of the cod stock in Div. 2J+3KL as a result of reduced fishing mortality, advises that the catch for 1980 should be held at the lowest possible level in order to implement the rebuilding of the stock.

6. General Remarks on the State of Cod Stocks in the Convention Area and Their Management

The Subcommittee noted that there is a general pattern in most of the cod stocks of the Convention Area. This refers not only to the common phenomenon that some of the good year-classes are the same for many stocks but specifically to the state of the stocks in relation to the fisheries and to former stock levels. For a stock like the one in Subarea 1, environmental conditions play a major role, but, under any given environmental conditions, the stocks should still be managed in a way to ensure the best possible long-term yields.

For a number of stocks which are in a depressed state, it is evident that fishing concentrates more than ever before on newly-recruited year-class, thereby not achieving the best possible yield per recruit and not allowing the stock, especially the spawning stock, to rebuild. Although small spawning stocks may occasionally produce relatively good year-classes, the chances of obtaining more and better year-classes seem better ensured by maintaining a larger spawning stock than that at present found in these depressed stocks. The Subcommittee considers it worthwhile noting that the only cod stock in which considerable rebuilding has occurred in recent years is that in Div. 2J+3KL, where the exploitation rate has been kept lower than F_{max} in the most recent years.

In general, the Subcommittee considers that the tendency toward pulse-fishing of newly-recruited, single year-classes should be a matter of concern in the management of the cod stocks.

7. Redfish in Subarea 1 (Res. Doc. 79/VI/54, 69)

a) Fishery trends

Nominal catches have fluctuated widely over the period for which statistics have been reported to ICNAF, increasing from 150 tons in 1951 to a maximum of 61,000 tons in 1962 but decreasing generally thereafter to a low level of about 3,000 tons in 1971-74. Catches increased again in 1975-76 and very sharply in 1977 to 31,000 tons. A precautionary TAC of 13,000 tons was set for 1978 and provisional statistics indicate a total catch of about 10,000 tons.

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	-	-	-	-	13	...
Catch (000 tons)	3	3	9	14	31	10*	

* Provisional

Up to 1976, the fishery was to a great extent a mixed fishery (cod and redfish). Besides the reported nominal catch, it is highly likely that much discarding of redfish has taken place in the cod fisheries. The shrimp fishery is known to take substantial by-catches of small redfish which in nearly all cases are discarded. Although further data are necessary to fully evaluate the problem, the information reported to the November 1978 Meeting of STACRES (Sum. Doc. 79/VI/1) indicates that the total by-catch could be about 10,000 tons, corresponding to approximately 200 million fish.

Up to 1967, the fishery was distributed over Div. 1C to 1F with a minor proportion taken in Div. 1B. Fishing took place mainly in Div. 1E and 1F during 1970-74 but changed back in 1975 to a distribution pattern similar to that in the previous period. Although the fishery has to a great extent been a mixed fishery, the somewhat different depth distribution of cod and redfish indicates that it is to some extent possible to fish directly for either of the two species.

The ICNAF statistics as reported do not separate the fishing effort in the mixed fishery by species. However, examination of the data for Federal Republic of Germany otter trawlers of tonnage classes 5 and 6, when 50% or more of the total catch consisted of redfish, indicates that catch per unit effort has generally decreased since 1962 but with large year-to-year fluctuations.

b) Biological information

Information on the biology of redfish in Greenland waters (Res. Doc. 79/VI/54, 69) indicates that two species occur (*Sebastes marinus* and *S. mentella*), but they are not, and cannot likely be, separated in the fisheries statistics. The areal distribution of the two species in Subarea 1 is almost identical, but distribution according to depth is distinct. *S. marinus*, on which the commercial fishery is based, occurs generally within the depth range of 150-300 m, whereas *S. mentella* normally is found at greater depths.

Plankton surveys show that spawning takes place in the Irminger Sea and to some extent also south of Greenland to approximately 50°N latitude. From the spawning (breeding) areas the larvae drift to West Greenland waters, where major nursery areas occur in Div. 1A and 1B. Generally, the mean size of redfish increases from north to south, which indicates a migration reverse to the larvae drift. Tagging experiments in the Godthåb Fiord (Div. 1D) have demonstrated a migration of adult fish from West to East Greenland waters. Since extremely few spawning redfish have been observed at West Greenland, the migration to East Greenland seems to be a spawning migration.

c) Assessments

The first attempts to assess the yield of redfish by various levels of fishing are presented in Res. Doc. 79/VI/54 and 79/VI/69, using a general production model and an analytical model respectively. Standardized effort was taken as the number of days fished by Federal Republic of Germany trawlers of tonnage class 5 and 6 where 60 and 50% (in the two papers, respectively) of the catch were made up of redfish. Since the monthly effort data reported in the ICNAF Statistical Bulletins represent in many instances the combined fishing effort for both redfish and cod, and since the proportions of these species in the catches have varied greatly as the stocks have fluctuated over the years, use of a criterion such as indicated above to estimate fishing effort aimed at redfish add a certain degree of uncertainty to the analyses. Furthermore, in general production models, it is assumed that the stock is in an equilibrium state, but this is

unlikely to have been the case over the years for which the analyses were carried out.

In the analytical assessment, trends in recruited biomass, in the age structure of the catch, and in recruitment to the fishery seemed to be not sufficiently reflected since a standard age-length key had to be used due to lack of age determination. Consequently, another generalized production model (Schaefer model modified by Gulland) was calculated (Res. Doc. 79/VI/69) based on the two sets of standardized effort data available from the research documents. The calculations are based on an 11-year running average for a period in which the exploitation of a previously unfished stock was changing to a more normal situation. Only for an 11-year running average was the slope of the regression of CPUE on effort negative. All other periods showed a positive slope or an extremely low correlation coefficient. The results from both series of data indicate a MSY level of about 10,000 tons and an equilibrium catch at 2/3 F_{MSY} of about 9,000 tons. These figures are similar to that from the initial analytical assessment for the maintenance of the present level of exploitation. In the light of these results it should be pointed out that the previous advice that fishing should not be allowed to expand beyond the 1977 catch level (*Redbook* 1978, page 60) was meant only to prevent an uncontrolled continuation of the expansion of the fishery as observed in most recent years and was not connected with any scientific analysis.

The results of the present analysis indicate that the catch in 1977 was far beyond the MSY level and it should be lowered to that level until more detailed analysis can be provided. It was further pointed out that discarding of small redfish in the shrimp fishery would not have affected the present fishery for commercial-sized redfish, but since this might lead to reduced recruitment to the exploitable stock in the near future, a reduction in the TAC may be required in future years.

The Subcommittee also points out that, since the spawning areas of the stock are not inside the Convention Area but at East Greenland and in the Irminger Sea (ICES Subarea XIV), studies of the stock and fisheries in this area should be considered in cooperation with ICES.

8. Redfish in Division 3M (Res. Doc. 79/VI/62, 73)

a) Fishery trends

Catches of redfish were generally low during the 1960's and increased to a high of 42,000 tons in 1972. Trends in TACs and catches since 1973 are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	40	16	16	16	16	20
Catch (000 tons)	22	35	16	17	20	16*	

* Provisional

b) Abundance indices

Length frequencies from Canadian commercial sampling in 1978 indicated that redfish ranging in size from 27 to 42 cm made up the bulk of the catches. The length frequencies also showed that a relatively good year-class was being recruited to the fishery. This was substantiated by the Canadian research survey in 1978 (Res. Doc. 79/VI/62). The USSR and Canadian research surveys showed an abundance of pre-recruit redfish. However, the USSR survey showed a general increase in abundance of redfish from 1978 to 1979 while the Canadian survey showed a decrease. This was partly explained by an unusually large catch in one stratum in the 1978 Canadian survey.

c) Assessment

Two assessments of this redfish stock, using the general production model, were considered (Res. Doc. 79/VI/62, 73). The equilibrium yield at 2/3 F_{MSY} from the two models ranged from 15,000 to 17,000 tons. Both indicated that the catch rates of recent years have increased, including 1977 with an associated catch of 20,000 tons. Since the stock appears to be in relatively good condition considering both research survey data and commercial catch rates, the Subcommittee advises that the TAC for 1980 should remain at 20,000 tons.

9. Redfish in Divisions 3L and 3N (Res. Doc. 79/VI/61, 72)

a) Fishery trends

Nominal catches of redfish declined from a high of 45,000 tons in 1959 to 14,000 tons in 1970, and fluctuated between 16,000 and 34,000 tons during 1971-77. TACs and catches since 1973 are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	28	20	20	16	16	18
Catch (000 tons)	33	22	18	21	16	12*	

* Provisional

b) Abundance Indices

Length frequencies from Canadian commercial sampling in 1978 indicated that redfish ranging in size from 29 to 41 cm made up the bulk of the catches. Abundance indices from the USSR research surveys have shown an increase in catch rate over the last three years. Moreover, Canadian research length frequencies indicate a relatively high proportion of 10-16 cm redfish in the shallower water in Div. 3L.

c) Assessment

Three separate assessments, using different effort standards in the general production model were reviewed by the Subcommittee. In general, the catch per unit effort appears to be continuing to increase and this correlates well with the USSR survey results, indicating that this stock is in relatively good condition. Two of the effort standards used were not lagged which would result in an over-estimate of the MSY. The lagged effort data were standardized on tonnage class without consideration for differing catch rates which occurred between midwater and bottom trawls in the last five years. Equilibrium yields at 2/3 F_{MSY} from the three assessments were 24,000, 27,000 and 32,000 tons respectively. Noting the variation in yield resulting from the different effort standards but keeping in mind the evidence of increasing abundance from survey data, the Subcommittee advises that the TAC be increased from 18,000 tons in 1979 to 25,000 tons in 1980.

10. Silver Hake in Divisions 4V, 4W and 4X (Res. Doc. 79/VI/42, 48, 49, 75)

a) Fishery trends

The fishery on this stock began in 1958, and from 1962 to 1975 USSR vessels took approximately 98% of the catches. Catch limitations were imposed on the fishery in 1974 and area and gear restrictions have been in effect since 1977. The provisional catch in 1978 was 48,000 tons, 91% of which was taken by USSR. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	100	120	100	70	70	70
Catch (000 tons)	299	96	116	97	37	48*	

* Provisional

The 1977 and 1978 TACs were not reached, due possibly to such factors as by-catch limitations, area and gear restrictions, low recruitment to the hake fishery, the large biomass of squid and the mixed nature of the hake-squid fishery in the last two years, and different hydrographic conditions.

b) Biological studies

Age and growth of silver hake have been studied in several ageing workshops, and a summary (as recommended by STACRES) has been prepared (Res. Doc. 79/VI/42) for use by scientists in ageing silver hake to help standardize techniques. Minor revisions were suggested to update this paper. Future otolith exchanges were recommended to maintain consistency in ageing.

A study on the feeding of silver hake was made from data collected on a series of cruises during 1976-78 (Res. Doc. 79/VI/49). It was noted that small silver hake feed heavily on small crustaceans, mainly euphausiids and mysids, whereas larger hake feed mainly on smaller fish, including other hake and squid. It was shown that silver hake have a variety of prey types and appear to be opportunistic in feeding patterns.

c) Abundance estimates

The Subcommittee examined three sets of abundance indices for the period 1972-78, namely, catch in numbers per 30-min haul from USSR autumn surveys in Emerald Basin, population numbers for

age-groups 2 and older from the USSR assessment, and population numbers for age-groups 1 and older from the Canadian assessment, as listed in the following table:

Source	1972	1973	1974	1975	1976	1977	1978
USSR surveys (no./30-min)	963	875	1,342	2,629	1,508	-	1,232
USSR assessment (10^6)	5,445	4,180	2,131	1,792	1,667	1,142	3,249
Canadian assessment (10^6)	5,505	4,458	3,168	3,247	2,782	1,775	1,686

It was noted that the survey abundance indices are not consistent with the population estimates of either the USSR or the Canadian stock assessments.

d) Assessment parameters

Catch composition. Canadian estimates of catch compostiion by age for 1970-77 (Res. Doc. 79/VI/48) were reworked by using new age-length keys based on the ageing criteria agreed to in 1978 (Sum. Doc. 78/VI/10). The age composition of the catch in 1978 was determined by applying to the length frequencies an age-length key derived from samples collected through the International Observer Program and aged according to the above-noted criteria. In the light of continued differences in USSR and Canadian catch-at-age data, the Subcommittee agreed to use the Canadian catch-at-age table as the basis for this assessment.

Natural mortality. Since no new estimates of natural mortality were available, it was agreed to use M = 0.4 in order to be consistent with 1977 and 1978 assessments on which previous management advice was based.

Weight-at-age. Average weight-at-age data, used for the 1979 assessment and also to determine the yield-per-recruit estimate of $F_{0.1} = 0.558$, are as follows:

Age (years)	1	2	3	4	5	6+
Mean weight (g)	43	100	168	218	340	560

Partial recruitment. Starting F-values for ages 2 to 5 were regressed against fishing effort and adjusted to give the best fit, using the historical partial recruitment values (1970-76) as a guide. A change in partial recruitment was noted for 1977 and 1978, due probably to a change in recruitment or the area and gear restrictions introduced in 1977. Consequently, the partial recruitment values used for 1978 were altered slightly from the historical pattern. However, the historical pattern (1970-76) was used for the catch projections.

Age (years)	1	2	3	4	5	6+
Partial recruitment (1970-76)	0.16	1.00	0.81	0.72	0.70	0.58
Partial recruitment (1978)	0.11	1.00	0.88	0.80	0.77	0.67

Recruitment values of the 1976 and 1977 year-classes from the virtual population analysis were used for the catch projections.

e) Catch projections

Recruitment is the most important factor in the catch projections, and, for this reason, three recruitment options were considered. For the first option, recruitment was assumed to be equal to the geometric mean of historical values at age 1 (approximately 1,000 million fish). This projection indicates a catch in 1979 of 60,000 tons (less than the TAC of 70,000) if fishing occurs at $F_{0.1}$ and a catch of 55,000 tons at $F_{0.1}$ in 1980. The projection is extremely dependent on recruitment, 64% of the 1980 catch being dependent on the assumption about the strength of the 1978 and 1979 year-classes (1,000 million fish). For the second option, if the size of the 1978 and 1979 year-classes is assumed to be 1,900 million fish at age 1 (as indicated by possible correlation between silver hake recruitment and squid biomass), the 1980 catch at $F_{0.1}$ would be 80,000 tons. On the other hand, if these year-classes consist of 750 million fish at age 1 (the average recruitment of the 1975-77 year-classes at age 1 from cohort analysis), the 1980 catch at $F_{0.1}$ would be 40,000 tons. Given the uncertainties concerning the recruitment of incoming year-classes in 1980, the Subcommittee advises a TAC for 1980 within the range of 55,000-80,000 tons. However, if more precise advice as to the level of the 1980 TAC is required,

a reassessment of this stock after the completion of the 1979 fishery is advised.

11. American Plaice in Division 3M

This stock has been regulated since 1974 with catches approximately in the range of 1,000-2,000 tons during 1973-77. The 1978 provisional catch was about 1,300 tons. Catches from this stock are entirely by-catches in the cod and redfish fisheries. The TAC was increased from 2,000 to 4,000 tons for 1978, on the basis of improved reasearch vessel abundance indices, but was reduced to 2,000 tons for 1979. Research vessel data for 1978 indicated a decline in abundance but, because of the by-catch nature of this fishery, the Subcommittee advises that the TAC should remain at 2,000 tons for 1980.

12. American Plaice in Divisions 3L, 3N and 3O (Res. Doc. 79/VI/108)

a) Fishery trends

The highest recorded catch from this stock was 94,000 tons in 1967. Since then, catches were lower and the average catch in the past six years was approximately 48,000 tons. TACs and catches since 1973 are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	60	60	60	47	47	47	47
Catch (000 tons)	53	46	43	52	44	50*	

* Provisional

b) Abundance

Average number per set from Canadian research vessel surveys in 1978 increased slightly over 1977 values, although the average weight per set declined marginally. Catch per hour by Canadian otter trawlers increased by about 10% in 1978.

c) Assessment parameters

Length and age composition and mean weight-at-age data were derived from Canadian commercial sampling of catches from the three ICNAF divisions in most months of 1978. Quarterly age-length keys and monthly catch data were used to estimate the numbers caught by age-group.

The fishing mortality in 1978, used to initiate the cohort analysis, was derived from the regression of F-values for fully-recruited age-groups on fishing effort for 1964-76, producing values of 0.56 and 0.50 for males and females respectively.

d) Assessment results

Stock size and catch projections for 1979-86 were carried out using recruitment values (91 million males and 215 million females) derived from cohort analysis and fishing mortalities equivalent to $F_{0.1}$ (0.45 for males and 0.40 for females). The evidence available both from the cohort analysis of commercial data and from research surveys indicates an increase in the size of recent recruiting year-classes. Trends in past and projected stock sizes and catches are indicated in Table 8.

Table 8. American plaice in Div. 3LNO: trends in past and projected stock sizes and catches, 1964-1986.

	1964	1967	1971	1973	1978	1980	1983	1986
Spawning population (10^6)	391	371	248	259	447	431	456	457
Spawning biomass (000 tons)	296	286	214	186	292	320	352	348
Catch (000 tons)	38.4	94.4	67.9	52.8	48.0	46.5	57.7	58.0

On the basis of the information available, the Subcommittee advises a TAC of 47,000 tons for 1980. It is noted that, if the favourable indications of recruitment do, in fact, materialize, future increases in yield will be expected to accrue from this stock.

13. Witch Flounder in Divisions 2J, 3K and 3L (Res. Doc. 79/VI/39, 44, 64)

a) Fishery trends

Nominal catches increased from 4,400 tons in 1961 to 24,000 tons in 1973 and have declined steadily to 6,500 tons in 1978. The TAC for 1975 was reduced from 22,000 tons to 17,000 tons on the basis of an analytical assessment of the stock with fishing mortality at the $F_{0.1}$ level. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	22	17	17	17	17	17
Catch (000 tons)	24	16	12	11	8	7*	

* Provisional

b) Stock boundaries

Information based on similarities in length distribution and sexual maturity (Res. Doc. 79/VI/39) indicates that witch flounder in Div. 2J+3KL and Div. 3NO probably comprise a single stock. However, because of the natural barrier of cold water over the shallow areas of the Grand Bank, there is probably little or no mixing of these components, at least the adults (Res. Doc. 79/VI/44), as limited tagging results showed very little migration from the tagging locations. The Subcommittee was informed that more detailed investigations were in progress concerning stock discrimination of this species, and consequently agreed that consideration of stock boundaries be deferred until the results of the studies are made available.

c) Assessment

The results of research vessel surveys by Canada in Div. 3L since 1971 and by Federal Republic of Germany in Div. 3K since 1972 show that the average catch in numbers per haul has shown little fluctuation over the period, indicating a stable state in this stock. Age composition data from the commercial fishery showed considerable numbers of fish up to age 20 for males and age 25 for females, indicating a low level of exploitation. This was also brought out in the concave appearance of the catch curves. Although average Z-values appeared to be high, the Subcommittee considered that this may be due to higher natural mortality of the older age-groups. With all evidence indicating no over-exploitation of this stock, the Subcommittee advises that the TAC of 17,000 tons should remain in effect for 1980.

14. Witch Flounder in Divisions 3N and 3O (Res. Doc. 79/VI/65)

a) Fishery trends

Nominal catches increased from 4,700 tons in 1969 to 15,000 tons in 1971 and subsequently declined to about 6,000 tons during 1975-77. The provisional catch of 2,800 tons in 1978 is the lowest reported in 12 years. Recent catches and TACs are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	10	10	10	10	10	7
Catch (000 tons)	7	8	6	6	6	3*	

* Provisional

b) General production model analysis

The Subcommittee reviewed a general production model analysis presented in Res. Doc. 79/VI/65. The fishing effort used to generate the model was from Canadian stern trawlers in a directed witch flounder fishery. Although the fishing effort has declined steadily over the past five years, the catch per unit effort has not shown much change. While management of this stock at 2/3 F_{MSY} implies a catch of 6,000-7,000 tons at the equilibrium level, the catch at 2/3 F_{MSY} in 1980 is more likely to be about 3,000-4,000 tons, based on the trend in catch per unit effort in recent years.

c) Cohort analysis

Canadian commercial sampling data for 1974-78 were used in the analysis. Since the fishery has been conducted primarily by Canada and USSR, it was agreed that the Canadian data would ade-

quately reflect the total fishery. The terminal F-values used to initiate the calculations were derived from estimates of total mortality (Z), based on catch-at-age per unit effort from Canadian stern trawlers in 1977 and 1978 (F = 0.66 for males and 0.36 for females). Partial recruitment was derived from a matrix of catch-at-age (numbers) and F-values, averaged over the 1974-77 period. These values were plotted and partial recruitment curves fitted to the points. The values used in the analysis were taken directly from the curves. Because of anomalous catch-at-age data for 1978, only the 1974-77 data were used in the cohort analysis, and stock sizes were projected to 1979 from 1977 using the 1978 catch.

With estimated recruitment of 5.3 million males and 5.7 million females at age 8 and assuming a catch of 7,000 tons in 1979, the catch projected for 1980 is approximately 7,000 tons if fishing is conducted at the $F_{0.1}$ levels (0.43 for males and 0.33 for females). Therefore, the Subcommittee advises that the TAC should remain at 7,000 tons for 1980.

15. Yellowtail Flounder in Divisions 3L, 3N and 3O (Res. Doc. 79/VI/128)

a) Fishery trends

Nominal catches increased from 3,100 tons in 1965 to 26,400 tons in 1970 and to 39,300 tons in 1972. The stock has been subjected to TAC regulation since 1973. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	50	40	35	9	12	15	18
Catch (000 tons)	33	24	23	8	12	15*	

* Provisional

b) Abundance indices

Catch and effort data from Canada (Newfoundland) commercial otter trawlers indicate a gradual increase in the catch per hour since 1976, which is now approximately equivalent to the 1974 level. Research vessel survey data, however, indicate a decline in average number and weight per set from 1977 to 1978, but this may, in part at least, be attributed to the intensity of the survey coverage conducted in 1978.

c) Assessment parameters

Length and age composition and mean weight-at-age data were derived from Canadian commercial sampling of catches from the three divisions in most months of 1978. Quarterly age-length keys and monthly catch data were used to estimate the numbers caught at age from the monthly length frequencies.

Fishing mortality for the fully-recruited age-groups in 1978, used to initiate the cohort analysis, was derived from the regression of weighted F-values of fully-recruited age-groups on the directed commercial effort for 1969-76, resulting in F = 0.53.

Recruitment at age 4 (110 million fish) used for the yield projections was the average of values for 1976-77 from the cohort analysis.

d) Assessment results

It was noted that the fishing mortality generated to take the catch of 16,000 tons in 1978 was 0.53, somewhat higher than $F_{0.1}$ (0.40), and it appears that a similar value would be required to take the 1979 TAC of 18,000 tons. The value used for recruitment at age 4 in 1978 has a major effect on the catch projection for 1980, since these fish at age 6 in 1980 will probably account for at least 20% of the total catch.

While the recovery of the stock from the low levels encountered in 1974-76 appears to be encouraging, it also appears that recovery will be gradual. The Subcommittee advises that the TAC for 1980 be set at 18,000 tons, the projected value of the yield at $F_{0.1}$ with assumed recruitment at the average value for 1976-77.

16. Greenland Halibut in Statistical Area 0 and Subarea 1 (Res. Doc. 79/VI/60)

a) Fishery trends

The nominal catch increased from less than 5,000 tons prior to 1972 to 14,000 tons in that year.

The catch declined to 10,000 tons in 1973 and then peaked at 25,000 tons in 1975. Recent trends in catch and TAC are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	-	-	20	20	20	25
Catch (000 tons)	10	14	25	16	13	12*	

* Provisional

Lacking adequate data to properly assess this stock, a precautionary TAC of 20,000 tons was introduced in 1976 and retained for 1977. It was subsequently increased to 25,000 tons for 1978, based on new information presented by the USSR in 1977.

b) Assessment

A virtual population analysis, presented to the April 1978 Meeting of the Subcommittee (Res. Doc. 78/VI/53), indicated that the yield from this stock could be as high as 35,000 tons, but this assessment did not include 1977 data. While the Subcommittee welcomed this new assessment, the uncertainty about the state of the stock was enough to advise a continuation of the precautionary TAC of 25,000 tons for 1979.

Although no assessment was presented at the present meeting, some data presented by Canada indicated that recruitment prospects were promising. It was difficult, however, to determine the contribution that these recruiting year-classes would make to the commercial fishery, with no information on recruitment levels in previous years. Consequently, the Subcommittee advises that the TAC for 1980 remain at the precautionary level of 25,000 tons.

c) Future research requirements

The Subcommittee noted the general lack of sampling data available for proper evaluation of this stock. It was noted that Res. Doc. 78/VI/53 contained, in graphical form, USSR length and age composition data by sex for the years 1969-76. The Subcommittee considered that these data would be a valuable addition to the ICNAF data base and, therefore,

recommends (1)

that scientists from the various countries whose vessels have been or are now fishing for Greenland halibut in Subarea 1 and Statistical Area 0 submit all available length compositions and age-length keys by sex (data not previously submitted) to the ICNAF Secretariat as soon as possible.

In view of the possible stock relations between Greenland halibut in Statistical Area 0 and Subarea 1 and in Subareas 2 and 3, the Subcommittee agreed that similar data for Greenland halibut in Subareas 2 and 3 (if not previously submitted) should also be reported to the ICNAF Secretariat for incorporation into its sampling data base.

17. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (Res. Doc. 79/VI/71, 103)

a) Fishery trends

Nominal catches ranged from 25,000 to 30,000 tons annually during 1971-76 and increased to about 38,000 tons in 1978, more than 60% of which was taken in the Canadian inshore gillnet fishery. A TAC of 40,000 tons was introduced in 1974 and subsequently reduced to 30,000 tons for 1976 based on an analytical assessment. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	40	40	30	30	30	30
Catch (000 tons)	29	27	29	25	32	38*	

* Provisional

b) Assessment

Biological studies have shown that this fishery is composed mainly of the smaller immature fish which inhabit the Continental Shelf, while the larger mature fish are found on the deep slopes

where most are inaccessible to the commercial fishery. The lucrative fishery of 1978 was largely based on strong 1970-73 year-classes (Res. Doc. 77/VI/11), and research vessel surveys during 1978 have shown that these strong year-classes are now followed by what appears to be a strong 1974 year-class which should enter the fishery in 1980. Biomass estimates of Greenland halibut indicated high levels of abundance in Div. 2J and 3K during November-December 1978, and the Subcommittee agreed that, despite the sensitivity of the catchability coefficient used in the estimates and the difficulties encountered in obtaining an accurate value of catchability, These estimates of biomass were comparable to those derived by analytical assessment.

The fishing mortality during 1977-78 appeared to be very close to the $F_{0.1}$ level, based on survival of fully-recruited age-groups in the commercial fishery from 1977 to 1978, with the average catch during this period being 35,000 tons. Considering this and the evidence of good year-classes entering the fishery, the Subcommittee advises that the TAC for 1980 be increased to 35,000 tons.

c) Research requirements

The Subcommittee noted that intensive research activity on the problem of stock discrimination was begun during 1978, using a variety of methods such as tagging, biochemical analysis, meristic and morphometric analysis and parasitogical studies. The Subcommitte agreed that these studies should be continued in order to elucidate stock relationship in Statistical Area 0 and Subareas 1 to 3. Noting the importance of making a proper analytical assessment of this stock, the Subcommittee

recommends (1)

that all available data on Greenland halibut be compiled as soon as possible during the year in order to provide better advice on the management of this stock when it is assessed early in 1980.

18. Roundnose Grenadier in Statistical Area 0 and Subarea 1 (Res. Doc. 79/VI/57)

a) Fishery trends

Nominal catches fluctuated in the range of 3,000-12,000 tons during 1971-78. A TAC of 10,000 tons was introduced in 1975, increased to 14,000 tons for 1976 and subsequently reduced to 8,000 tons based on an assessment at the April 1976 Meeting of the Subcommittee. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	-	10	14	8	8	8
Catch (000 tons)	5	12	5	9	3	6*	

* Provisional

b) Assessment

The Subcommittee reviewed an updated general production model assessment for the period 1968-77 (Res. Doc. 79/VI/57). This model indicated an MSY of 8,000 tons with a catch of 6,700 tons at 2/3 F_{MSY}. These values agreed favourably with those estimated in the analytical assessment presented in 1978 (Res. Doc. 78/VI/45). Because the dynamics of this stock are at present uncertain, the Subcommittee advises that the TAC for 1980 remain unchanged at 8,000 tons.

19. Roundnose Grenadier in Subareas 2 and 3 (Res. Doc. 79/VI/57)

a) Fishery trends

Nominal catches, after peaking at 75,000 tons in 1971, fluctuated in the range of 15,000-28,000 tons during 1972-78. A TAC of 32,000 tons was introduced in 1974 and increased to 35,000 tons for 1977, based on an assessment at the April 1976 Meeting of the Subcommittee. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	32	32	32	35	35	35
Catch (000 tons)	18	28	27	21	15	21*	

* Provisional

b) Assessment

The Subcommittee reviewed an updated general production model assessment for the 1967-77 period (Res. Doc. 79/VI/57), which indicated an MSY of 31,000 tons and a catch of 27,500 tons at 2/3 F_{MSY}. A review of Res. Doc. 78/VI/54, assuming M = 0.15, indicated a sustainable yield of 30,000 tons at $F_{0.1}$. In view of the general declining trend in catch-per-unit-effort data for recent years, the Subcommittee advises that the TAC be set at 30,000 tons for 1980.

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

a) Fishery trends

Following a peak catch of 17,000 tons in 1974, the nominal catch of argentine declined to about 2,000 tons in 1977 and 1978, substantially below the TAC of 20,000 tons. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	-	25	25	25	20	20	20
Catch (000 tons)	1	17	15	7	2	2*	

* Provisional

b) Assessment

The only new analysis presented to the Subcommittee indicated that catch rates of Japanese trawlers were very similar in 1977 and 1978. It is noted that there appears to be little mixing between adjacent stock components, that the primary concentrations fished historically lie in the general area of disputed jurisdiction between the USA and Canada, and that this area has not been accessible for fishing by third parties since 1977. The 20,000 tons calculated to be the long-term sustainable yield refers to the entire stock in Div. 4VWX and, if this level of catch is taken from stock components on the eastern and central Scotian Shelf only, substantial over-exploitation of these components will likely occur. However, catches in 1977 (2,500 tons) and 1978 (1,900 tons) have been low and Japanese catch-per-unit-effort data indicate that stock abundance did not decline over these years. Insufficient data have been made available to conduct an analysis of the current status of this stock, and the Subcommittee can only reiterate its previous advice that the estimated MSY level of catch is 20,000 tons in Div. 4VWX.

21. Shrimp in Statistical Area 0 and Subarea 1

Data related to the fishery for shrimp and research data for 1978 were presented and discussed at the Special Meeting of STACRES at Bergen, Norway, in November 1978, and advice on management in 1979 was given (Part A, this volume).

The Subcommittee acknowledges the request by Canada and the EEC for advice on management in 1980 at the same time as most of the other stocks in the Convention Area are assessed. It is, however, noted that, although some progress has been made in observing pre-recruit shrimp, such data are not yet sufficiently evaluated to allow the Subcommittee to take them into account in the assessments. It is, therefore, still more appropriate to assess the stock of shrimp and advise on conservation measures for 1980 at a meeting near the end of 1979 when data for that year become available. The Subcommittee also noted that the laboratories involved in research on shrimp would have practical difficulties in working up shrimp data at the same time as data for other stocks and, for this reason, a meeting later in the year to assess shrimp would be more appropriate.

IV. OTHER MATTERS

1. Consideration of Proposal for Changing the Mesh Regulation for Redfish in Div. 3M (Com. Doc. 78/VI/12; *Redbook* 1978, page 45)

The Subcommittee was informed that documentation for this item was incomplete and agreed that consideration be deferred to the 1979 Annual Meeting of STACRES.

2. Consideration of Uniform Mesh Size for the Silver Hake and Squid Fisheries in Subarea 4 (Res. Doc. 79/II/3, 35; Part B, this volume)

Considering the parameters investigated for squid and silver hake (Res. Doc. 79/II/3, 35), the Subcommittee noted that a change from 60- to 90-mm mesh size in the codends would likely result in no long-term loss in yield for either squid or silver hake, very little short-term loss for silver hake, and

no short-term loss for squid. While possible increases in yield per recruit could not be precisely quantified for either species, an increase in mesh size from 60 to 90 mm would result in a reduction in fishing mortality on immature silver hake (age 1) and may result in an increase in the fishing effort associated with the $F_{0.1}$ level. Recognizing that the data are insufficient to accurately quantify the effect of such a change in mesh size, the Subcommittee agreed that the best way to acquire the necessary data would be from a large-scale experimental fishing program and recommended that such a program be implemented. It was indicated that this program should include at least 15% of each of the national fleets of vessels involved in the silver hake-squid fishery in 1980, with designated vessels using trawls with 90-mm mesh codends and fishing, whenever possible, in proximity to the remainder of the fleet.

3. Consideration of Commencement Date for the Squid Fishery in Future Years

The Subcommittee, noting that documentation for this item was incomplete, agreed that consideration be deferred to the 1979 Annual Meeting of STACRES.

4. Review of Proposed Sampling Forms

In the report of the *ad hoc* Working Group on Standardization of Reporting Procedures for Sampling Data (Part A, this volume), it was noted that, while a form (CFS-1) for reporting length samples had been approved, time did not permit the development of a form for the reporting of age samples. However, a list of contents was proposed and the Secretariat was requested to design a draft form based on the list. The draft form (CFS-2) was circulated for comment in December 1978.

The Subcommittee considered it opportune to review the draft form for age samples. Minor modifications and amendments were approved and the Secretariat was requested to prepare a revised version for review by the Subcommittee on Statistics and Sampling at the 1979 Annual Meeting.

5. Timing of Future Assessment Meetings

The Subcommittee discussed the implications of attempting to provide precise management advice in April for stocks for which information is very inadequate or even lacking prior to the meeting. Before 1975, the Subcommittee met in May during the period scheduled for the Annual Meeting. Starting in 1975, at the request of commissioners who wished to have the management advice in advance of the Annual Meeting and at the request of scientists who considered that the allotted time was inadequate to review the many stocks under regulation at that time, STACRES agreed that stock assessments be carried out well in advance of the Annual Meeting. Thus, the Assessments Subcommittee has met regularly in early April since 1975. In an effort to avoid overlap with meetings of ICES Working Groups, ICES has regularly been informed of the scheduled dates of the ICNAF Assessments Subcommittee Meeting well in advance of the ICES Annual Meeting in the autumn, but this has not avoided an overlap of the Assessments Subcommittee Meeting and meetings of ICES Working Groups. A greater degree of liaison between the scientific bodies of ICES and ICNAF is essential.

In view of the recent extension of coastal state jurisdiction over fisheries, the reduction in the number of stocks for which management advice is requested, and the need for more detailed and complete data on which to base the assessments, the Subcommittee

recommends (3)

that future stock assessments be carried out in May immediately preceding the Annual Meeting, to allow for the compilation of more complete statistical data, the pre-meeting distribution of relevant documentation, and the possible reporting of some data for the early months of the current year.

The Subcommittee noted, however, that, in the case of such short-lived species as shrimp, capelin and squid, and other stocks on which fishing is occurring mostly on recruiting year-classes, a meeting near the end of the year or early in the following year would be necessary, in order to obtain the most up-to-date information on the fishery and to provide the best possible advice for management.

V. ACKNOWLEDGEMENTS

The Chairman expressed his appreciation to the participants for their cooperation during the course of the meeting and to the Secretariat for their usual efficient work. On behalf of the participants, Mr Horsted thanked the Chairman for his guidance at this and other STACRES meetings since November 1978, and requested that he convey to the Director and Staff of the Newfoundland Environment Center the gratitude of STACRES for the hospitality and facilities provided.

APPENDIX II. REPORT OF BIOLOGICAL SURVEYS SUBCOMMITTEE

Chairman: W. G. Doubleday

Rapporteur: T. K. Pitt

The Subcommittee met at Dartmouth, Nova Scotia, Canada, during 22-23 May 1979 to consider and report on matters referred to it by STACRES (see Part D, this volume, for Agenda). Scientists attended from Bulgaria, Canada, Denmark, France, Federal Republic of Germany, Japan, Poland, USSR and USA. The following documents were considered: Res. Doc. 78/XI/87, 88, 89; 79/II/5, 7, 14, 30, 31, 34; 79/VI/77, 82, 83, 91, 109, 110, 111; Sum. Doc. 79/VI/18, 22, 24. Some of these documents had previously been considered by STACRES, and, therefore, only those aspects relevant to the Biological Surveys Subcommittee were discussed.

1. Review of Survey Activity in 1978

The Subcommittee noted that the surveys listed in Table 1 were carried out in the ICNAF Area during 1978. Several country representatives pointed out the highlights of their survey activities during the year. Denmark carried out a survey for sandeels in Subarea 1 from late May to mid-September. Canada (N) carried out groundfish biomass surveys in Div. 2G, 2H and 3K, a squid survey on the Grand Bank, shrimp surveys in Subareas 0, 1 and 2, and several cruises in connection with the Flemish Cap Project. USSR scientists reported on two surveys designed to produce information on capelin recruitment. USA scientists reported on new gear developments in quahog and surf clam surveys and on expansion of inshore surveys by State laboratories.

2. Review of Survey Activity Planned for 1979

Surveys carried out to date and planned for the remainder of the year are listed in Table 2. It was noted that France planned a tuna survey in Div. 3N and 3O, and USSR highlighted surveys for squid in Subareas 3 and 4, silver hake in Subarea 4, and contributions to the Flemish Cap Project. Federal Republic of Germany reported that a groundfish survey in Subarea 1 had been carried out early in 1979.

3. Progress on Groundfish Surveys Manual

The Subcommittee reviewed the progress that had been made in response to its 1978 recommendations related to the development of the groundfish surveys manual. It was noted that the Secretariat had collated all available stratification schemes from Div. 2J southward to Subarea 6, and that Denmark had prepared a new scheme for Subarea 1. In discussing the importance of recording untrawlable units, it was pointed out that a distinction should be made between those units found to be untrawlable by acoustic inspection and those where severe gear damage had been encountered. However, it was indicated that, while records of units where gear damage occurred were maintained by all countries conducting surveys, units rejected upon acoustic observation were not usually recorded. Also, it was noted that such records of untrawlable units have not been exchanged between interested parties. Recognizing the need for discretion in interpreting reports of untrawlable bottom due to navigational difficulties and gear effects, the Subcommittee emphasized the practical value of such information, and therefore

recommends (4)

that records of untrawlable units, indicating how they were determined, should be sent to the laboratories maintaining master stratification charts for distribution on request.

The Subcommittee noted the sampling standards and length conventions described in Sum. Doc. 79/VI/22, as requested at the 1978 Annual Meeting, but was informed that the coding scheme for species names to facilitate the exchange of survey data had not yet been prepared, nor was a revised draft of the manual available for discussion. The editor (Dr W. G. Doubleday) was requested to circulate a revised draft of the manual prior to the 1980 Annual Meeting of the NAFO Scientific Council.

4. Common Numbering System for Stratification Schemes (Sum. Doc. 79/VI/24)

The Assistant Executive Secretary presented an analysis of numbering systems for stratification schemes in Div. 2J and southward. It was noted that strata sometimes overlap division boundaries. The Subcommittee noted the advantages of identifying the division in which a stratum lies, particularly in regard to the estimation of abundance indices by division for stock assessments, and therefore

recommends (6)

that a five digit stratum numbering system be adopted for the exchange of biological survey data, the first digit indicating the subarea, the second digit indicating the division or subdivision, and the remaining three digits corresponding to those used in existing schemes.

This recommendation implies that strata overlapping division boundaries will be split, each part being assigned a different stratum number, as is the case now for the existing schemes in Subareas 2 and 3 and a part of Subarea 4.

Table 1. Inventory of biological surveys conducted in the ICNAF Area during 1978.

Sub-area	Div.	Country	Months	Sets
Random-stratified groundfish surveys				
0	B	GDR	9-10	...[1]
1	B	DEN(G)	7-8	15
2	GH	CAN(N)	9	123
	GHJ	GDR	9-10	164[1]
	J	CAN(N)	2-3	80
		"	7-8	63
		"	11	57
		FRG	11	23
3	K	CAN(N)	2-3	51
		"	7-8	92
		"	11	76
		GDR	9-10	...[1]
	LNO	CAN(N)	4-5	142
		"	5	100
		"	5-6	88
		"	7-8	52
	M	CAN(N)	1-2	137
		"	4-5	54
		"	11	34
		POL	4	5
	Pn	CAN(N)	1	13
		"	10	2
		CAN(Q)	5	...[2]
		"	6	...[3]
	Ps	CAN(N)	2	45
		"	4	62
		"	9-10	34
		FRA	3	68
		"	10	73
4	RS	CAN(N)	1	103
		"	10	92
		CAN(Q)	5	63[2]
		"	6	32[3]
	T	CAN(M)	9	63
		CAN(N)	1	6
		"	10	7
	VWX	CAN(M)	7	148
		"	7	91
		"	11	85
	X	FRG	10	...[4]
		USA	3-5	...[5]
		"	9-11	...[6]
5	YZ	FRG	10	86[4]
		USA	1	10
		"	3-5	231[5]
		"	7-8	60
		"	9-11	443[6]
	Z	POL	3	35[7]
		"	9-10	10[8]
6	-	POL	3	...[7]
		"	9-10	...[8]

Sub-area	Div.	Country	Months	Type of survey	No. of sets
Other surveys					
0	B	DEN(G)	9	Shrimp (comm. vessel)	6
1	A	DEN(G)	10-11	Shrimp	13
	B	DEN(G)	6-9	Sandeel	8
		"	7	Plankton	5
		"	9	Shrimp (comm. vessel)	27
		"	12	Shrimp (photo)	12
	C	DEN(G)	3-4,9	Shrimp	5
		"	4	Groundfish	1
		"	6-9	Sandeel	28
		"	7	Shrimp (photo)	3
		"	7	Plankton	7
	D	DEN(G)	1-4	Capelin (pelagic)	10
		"	1-4,7-10	Shrimp	13
		"	1-4,7-10	Plankton	21
		"	4	Groundfish	7
		"	5-9	Sandeel	67
	E	DEN(G)	1,4,10	Shrimp	9
		"	5	Sandeel	1
	C-F	FRG	12	Groundfish	32
2	GHJ	USSR	9-12	G. halibut, capelin assess.	?
	J	FRA	1-2	Cod (trawling and XBT)	13
		GDR	2-3	Cod, G. halibut	?
		USSR	9-10	Ichthyopl., capelin larvae	?
3	K	FRA	1-2	Cod (trawling and XBT)	14
		USSR	9-10	Ichthyopl., capelin larvae	?
	L	FRA	2	Cod (trawling and XBT)	12
	M	POL	4	Plankton	56
	KLNO	USSR	4-8	Groundfish (trawl)	?
		"	5-7	Ichthyoplankton	?
		"	9-12	G. halibut, capelin assess.	?
	LNO	USSR	5-6	Acoustic survey (capelin)	?
	MNO	FRA	9-10	Tuna (trolling, surf. temp.)	20
	Pn	FRA	2	Cod (trawling and XBT)	5
4	R	FRA	1	Cod (trawling and XBT)	18
	T	CAN(M)	5,10	Larval herring	157
		"	6-7	Mackerel eggs	237
		"	7	Mackerel	25
		"	9	Scallops	?
		CAN(Q)	6-7	Larval pelagics	60
		"	7-8	" "	57
		"	9	" "	22
		"	10	" "	17
		"	11	" "	14
	VW	CAN(M)	9	Shrimp	39
		"	9-10	Silver hake	46
	VWX	CAN(M)	5-6,8-9	Ichthyoplankton	313
		USSR	8-9	"	148
		"	10	Juvenile silver hake	100
	W	USSR	11	Groundfish	20
	WX	CAN(M)	3-4	"	48[9]
	X	CAN(M)	1,8	Juvenile herring	123
		"	4,10	Larval herring	230
		"	7,8	Lobster larvae	425[10]
		FRG	12	Hydroacoustics	-

NOTE: The footnoted numbers indicate situations where the number of sets given overlapped subareas; the number of sets is entered in one subarea and the symbol "..." followed by the corresponding footnoted digit indicates the other subarea to which the overall number of sets also applies.

Table 1. (continued)

Sub-area	Div.	Country	Months	Sets
Coordinated herring surveys				
4-5	XYZ	CAN(M)	10-11	440L
		FRG	2-3	120J
		"	10	135L
		"	10	28J
		USA	1-2,4	729L

NOTE: It is possible that some of the surveys reported under "Other Surveys" were associated with the larval and juvenile herring surveys program but were not labelled as such in the reports received. The letters "J" and "L" refer to "juveniles" and "larvae" respectively.

Sub-area	Div.	Country	Months	Type of survey	No. of sets
Other surveys (continued)					
5	Y	FRG	12	Hydroacoustics	-
		USA	4	Ichthyoplankton	47
		"	4	Primary productivity	47
	YZ	CAN(M)	10-11	Pelagics and groundfish	78
	Z	CAN(M)	3-4	Groundfish	...[9]
		"	6-7	Scallops	?
		"	7-8	Lobster larvae	...[10]
		POL	9-10	Apex predator studies	30[11]
		USA	2	Fish feeding habits	21
		"	3	Larval patch herring study	747
		"	4	Ichthyoplankton	83
		"	4	Primary productivity	115
		USSR	6-8	Ichthyoplankton	300
		"	9	Groundfish	100
		"	10	Ichthyoplankton	100
6	A	USA	1	Ocean pulse benthic grabs	48
		"	2	Ocean quahog, surf clam	14
		"	4	Primary productivity	64
		"	5	Ichthyoplankton	100
	B	USA	5	Primary productivity	77
		"	5	Ichthyoplankton	87
	C	USA	5	Primary productivity	21
		"	5	Ichthyoplankton	27
	(NK)	POL	9-10	Apex predator studies	...[11]
		"	11	Swordfish sonic tagging	-

Table 2. Biological surveys planned for the ICNAF Area in 1979 and the early part of 1980.

Country	Type of Survey	Area	Dates	Year
Canada (N)	Groundfish	2GH	Aug 1-21	1979
	"	2J,3K	Sep 28-Oct 20	
	"	2J,3K	Nov 14-Dec 4	
	"	3L	May 16-Jun 5	
	" (comp. fishing)	3L	May 16-Jun 4	
	" (deep water)	3LNO	Aug 23-Sep 10	
	"	3N	Apr 17-May 9	
	"	3NO	Sep 27-Oct 11	
	"	3Ps	Feb 28-Mar 21	
	"	*3Ps	Sep 28-Oct 12	
	"	3Pn+4RS	Sep 4-21	
	Multispecies	3M	Apr 18-May 14	
	Herring	*3KL	Aug 22-Sep 6	
	"	3Ps	Jun 6-29	
	"	*3Ps	Nov 13-26	
	"	*3Ps	Dec 3-19	
	Herring and Capelin	3L	Oct 29-Nov 30	
	" " "	3Ps	Sep 17-Oct 12	
	Capelin	2J,3K	Oct 22-Nov 12	
	"	3L	Sep 28-Oct 15	
	"	3N	Jun 6-Jul 2	
	"	*3Ps	May 18-Jun 1	
	Capelin and Scallops	*3L	Jun 6-19	
	" " "	*3L	Oct 19-25	
	" " "	*3L	Dec 10-15	
Canada (N)	Salmon	2	Jul 27-Aug 17	
	"	3LP	Apr 30-May 22	
	"	*3P	May 14-Jun 1	

Table 2. (Continued)

Country	Type of Survey	Area	Dates	Year
Canada (N)	Shrimp and Salmon	0+1	Aug 10-Sep 26	
	Shrimp	2	Jul 12-Aug 8	
	"	2	Nov 8-Dec 1	
	"	4RS	May 23-Jun 13	
	Crabs	*3L	Apr 9-May 9	
	"	*3L	Jun 20-Jul4	
	"	*3L	Jul 26-Jul 30	
	Crabs and Scallops	*3L	Sep 11-15	
	Squid and Shellfish	*3L	Jul 9-23	
	" " "	*3Ps	Sep 13-25	
	Squid	3NPs	Jun 15-Jul 10	
	"	3Ps	Nov 20-Dec 11	
	Ichthyoplankton	3LN	Jul 4-10	
	Ichthyoplankton and Salmon	3NO	Jun 11-26	
	Groundfish	3M	Jan 24-Feb 13	1980
	"	3Ps	Feb 28-Mar 21	
	Herring	*3LPs	Jan 7-28	
	"	*3Ps	Feb 4-29	
	Capelin	*3L	Mar 3-21	
	"	3Ps	Feb 29-Mar 12	
	Shrimp	*4RST	Feb 29-Mar 17	
* Inshore surveys				
Canada (Q)	Groundfish	4RS	May	1979
	"	4RS	Jun	
	Crabs	4T	Sep 27-Oct 7	
	Larval pelagics	4T	Mar 15-30	
	"	4T	May 8-11	
	"	4T	Jun 4-7	
	"	4T	Jul 3-6	
	"	4T	Aug 6-9	
	"	4T	Sep 3-6	
	"		Oct 2-5	
Canada (M)	Groundfish	4T	Sep 3-Oct 5	1979
	"	4VWX	Mar 5-29	
	"	4VWX	Jul 3-29	
	"	4VWX	Oct 17-Nov 11	
	"	4WX	Apr 10-18	
	"	4WX,5Z	Mar 21-31	
	Herring (juvenile)	4X	Feb 3-11	
	" (larvae)	4X	Mar 18-Apr 6	
	" (larvae and juveniles)	4X	Jul 24-Aug 31	
	" (larvae and juveniles)	4X	Oct 31-Nov 10	
	Mackerel eggs	4T	Jun 12-Jul 7	
	Squid	4VWX	Jan 15-26	
	"	4VWX	Jun 5-Jul 15	
	"	4VWX	Aug 1-19	
	"	4VWX	Oct 15-Nov 14	
	Scallops	4T	Jul-Sep	
	"	4X	Jun 18-22	
	"	4X	Oct 10-15	
	"	5Z	May 20-Jun 4	
	Crabs	4X	Feb 12-Mar 13	
	"	4X	May 7-17	
	Shrimp	4WX	Jul 9-20	
	Ichthyoplankton	4VWX	Jan 29-Mar 2	
	"	4VWX	Apr 1-28	
	"	4VWX	May 14-Jun 3	
	"	4VWX	Sep 25-Oct 13	
	"	4VWX	Nov 15-Dec 8	

Table 2. (Continued)

Country	Type of Survey	Area	Dates	Year
Canada (M)	Groundfish	4WX	Jan 15-26	1980
	"	4WX	Mar 2-29	
	Herring (larvae)	4X	Mar 4-22	
	Ichthyoplankton	4VWX	Feb 5-29	
Denmark (G)	Groundfish and Shrimp	1C	Jan-Mar,May	1979
		1D	Aug,Oct-Dec	
	" " "	1E	Jan-Mar,Jun-Aug	
	Cod (acoustic)	1CD	Jan-Feb,May-Jun	
	" "	1E	Jun	
	Capelin (pelagic trawl)	1D	Jan-Mar	
	Shrimp (trawl)	1A	Jul-Aug,Oct	
	" "	1B	Jul-Aug, Oct-Dec	
	" (photo)	1AB	Jul-Aug	
	" (commercial, 24 hour studies on diurnal variation by size and sex)	1B	2-3 days monthly	
	Plankton	1BC	Jul	
		1D	Jan-Mar,Jun-Jul	
Fed. Rep. Germany	Groundfish	1C-F	Apr-May	1979
	"	1C-F	Oct-Nov	
	"	2J	Nov-Dec	
	Bottom trawl (random stratified)	4X,5+6	Sep-Oct	
	Herring (juvenile)	4X,5+6	Feb-Mar	
	" (larvae)	4X,5+6	Oct-Nov	
	Ichthyoplankton	4+5+6	Nov-Dec	
France	Cod survey	2J,3KLM	Jan 11-Feb 28	1979
		3P,4R		
	Groundfish survey	3Ps	Mar 3-20	
	" "	3Ps	Oct 8-27	
	Tuna (line fishing)	3MNO	Jul 27-Aug 13	
	Shrimp	0+1	Sep 6-Oct 27	
	Scallops	3Ps	Nov 1-15	
German Dem. Rep.	Groundfish (random stratified)	0,2,3	Oct-Dec	1979
	Groundfish (cod)	2J,3K	Feb-Mar	
	Juvenile herring and plankton	4,5+6	Apr-May	
Poland	Ichthyoplankton survey	5Z	Sep-Oct	1979
	Apex predator studies	5Z	Oct-Nov	
USSR	Groundfish (migration studies and stock assessment)	2J,3K-0	Apr-Aug	1979
	Groundfish (abundance) and Ichthyoplankton	2J,3K-0	Sep-Dec	
	Groundfish	4VWX	Nov	
	"	5Z	Oct	
	Silver hake (trawl)	4VWX	Oct	
	" " (")	5Z	Sep	
	Atlantic saury	4VWX,5Z	Nov-Dec	
	Capelin (assessment)	3K-0	Apr-Jun	
	" (pre-recruits)	2J,3K-0	Aug-Sep	
	Squid (trawl survey)	4VWX	May	
	Ichthyoplankton	2J,3K-0	Mar-Jul,Sep-Nov	
	"	4VWX	Mar-Apr,Aug-Sep	
	"	5Z	Jun-Sep,Nov	
	Plankton	5Z	Jun-Sep,Nov	
USA	Groundfish (bottom trawl)	4X	Mar 26-Apr 26	1979
	" (" ")	5YZ	Mar 26-Apr 26	
	" (" ")	5YZ	Jul 30-Aug 24	

Table 2. (Continued)

Country	Type of Survey	Area	Dates	Year
USA	Groundfish (bottom trawl)	5YZ,6A	Sep 12-Nov 20	
	" (" ")	6ABC	Mar 21-Apr 27	
	" (" ")	6ABC	Aug 13-24	
	Pelagics (midwater trawl)	5Z	Aug 28-Sep 7	
	Shellfish (assessment)	5Z,6ABC	Jan 3-Feb 2	
	Scallop	6ABC	May15-Jun 1	
	Larval fish	5YZ	Feb 14-24	
	MARMAP I (ichthyoplankton, productivity, hydrography)	4X,5YZ,6	Feb 23-Mar 17	
	" "	4X,5YZ 6	Oct 1-27	
	" "	4X,5YZ,6	Nov 13-Dec 14	
	" "	5YZ,6	May 3-29	
	" "	5YZ,6	Jun 11-Jul 14	
	MARMAP I - MOCNESS (ichthyoplankton, zooplankton)	5YZ	Feb 26-Mar 11	
	MOCNESS (zooplankton, ichthyoplankton)	5YZ	Oct 30-Nov 10	
	Primary productivity	5YZ	Mar 13-22	
	Gear mensuration	5Z	Jul 9-20	
	Clam gear testing	5Z,6A	Jul 23-Aug 3	
	Buoy set and recovery	5Z	May 22-26	
	" " " "	5Z	Jun 5-9	
	" " " "	5Z	Sep 4-9	
	" " " "	5Z	Dec 17-21	

5. Review of New Stratification Schemes

The Subcommittee reviewed a very detailed stratification scheme prepared by Danish scientists for Subarea 1 (Res. Doc. 79/VI/82). This scheme permits the flexible building of strata for surveys aimed at single species and will also be used to record commercial fishery data. The Subcommittee noted that the wide range in the areas of the stratum building blocks could inhibit the achievement of uniform sampling rates, but that this may be unavoidable due to the steep slopes in this subarea. It was noted that "block number" referred to in the Subarea 1 scheme corresponds to stratum number for use in the standard numbering system. The Subcommittee

recommends (5)

that the proposed stratification scheme for Subarea 1, as described in Res. Doc. 79/VI/82, be adopted for inclusion in the groundfish surveys manual.

Canadian scientists reported that a line survey in Div. 2G and 2H in 1978 confirmed earlier reports of the unreliability of bathymetric charts covering these divisions, and that more information is needed before a stratification scheme can be confidently recommended for these divisions and for Subarea 0.

6. Species Code for International Exchange of Survey Data

The Subcommittee was informed that not all countries are presently using a species coding system for survey data and that some of the countries with species coding systems presently in use are not particularly satisfied with them. Noting that this might be an opportune time to develop a common coding system to facilitate the international exchange of survey data, the Subcommittee

recommends (7)

that the Assistant Executive Secretary contact the various laboratories to obtain the species codes presently used and, by correspondence, study the feasibility of producing a species coding system acceptable to all countries engaged in research vessel surveys in the Northwest Atlantic.

The Subcommittee noted that collaboration with ICES might be appropriate at a later date.

7. Processing of Survey Data

The Subcommittee noted that little progress had been made on the pilot project, which involved the processing at the Secretariat of survey data from two Federal Republic of Germany research vessel cruises

in Div. 2J and 3K. For various reasons, not all of the survey data were submitted to the Secretariat and no processing of the data by the Secretariat was carried out. However, the available data were forwarded to the St. John's laboratory where it has been processed and is now in machine-readable form. Additionally, the Federal Republic of Germany research institute now has the capability of processing survey data automatically. It is not known if the Scientific Council of NAFO intends to establish a centralized data base for survey data, and the Subcommittee therefore agreed that no further action be taken on the pilot project at this time.

8. Progress in Improving Survey Methods

A method of estimating trawl door spread from wing spread was presented (Res. Doc. 79/VI/77). Theoretical estimates calculated from a more complex model based on several parameters were closely approximated and predictions by the simplified method were close to experimental observations. The Subcommittee noted that coefficients of variation in door spread of up to 15% were observed in controlled experiments and anticipated greater variations in trawl performance in routine abundance surveys. Measurement of variations in trawl performance and corresponding refinement of survey analysis could lead to gains in precision in abundance estimates comparable to substantial increases in the number of sets. The Subcommittee considers that routine measurement of wing spread and headrope height is technically feasible and welcomes the analysis presented as a significant first step to reducing the effects of uneven trawl performance.

Robust estimators of stratum mean catches using α-trimmed and α-winsorized means were examined for silver hake catches on Georges Bank (Res. Doc. 79/VI/91). Trimmed estimates had lower variance than arithmetic means. The Subcommittee noted that, due to the asymmetry of catch distributions, the estimators presented were biased and that the method of choosing α tended to overestimate gains in precision. If the proportion of stock biomass found in dense aggregations is substantial, year to year variation in this proportion could mask changes in abundance when methods of analysis discounting large catches are used. This also applies to the use of transformed data. The Subcommittee noted that gains in stability of estimates must be balanced against the introduction of possible biases and recognized the value of the contribution in drawing attention to the scope for new analytical methods. Further research into the application of robust estimators for asymmetrical distributions is needed.

An analysis of a line transect photo survey for crabs was presented (Res. Doc. 79/VI/109). Means of adjusting observations for distance from the camera and camera axis were developed. Predicted frequencies compared well with observations at three stations. The Subcommittee advises scientists planning photographic transect surveys to consider means such as those presented to adjust for the biases inherent in such data.

9. Review of Relevant Research Documents

The Subcommittee reviewed research documents concerned with shrimp surveys (Res. Doc. 78/VI/87, 88 and 89) and noted that the photographic data agreed quite well with the trawl survey information. Estimates of capelin abundance from research vessel acoustic surveys (Res. Doc. 79/II/7, 30, 31 and 34) gave highly variable results. Two sources of this variation were the timing of cruises and the area coverage. There was evidence from groundfish abundance surveys in Subarea 4 of correlation between squid abundance and water temperature (Res. Doc. 79/II/14). It was noted that abundance estimates of squid from a groundfish survey in Subdiv. 3Ps (Res. Doc. 79/II/5) were not very reliable, but that such surveys were useful in obtaining biological information.

10. Acknowledgement

The Chairman expressed his thanks to representatives and observers who had contributed to the work of the Subcommittee from 1977 to 1979. The members of the Subcommittee expressed their appreciation to the Chairman for his guidance during the past three years.

APPENDIX III. REPORT OF STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: J. Messtorff

Rapporteur: L. P. D. Gertenbach

The Subcommittee met at Dartmouth, Nova Scotia, Canada, on 25 May 1979 to consider and report on matters referred to it by STACRES (see Part D, this volume, for Agenda). Scientists attended from Bulgaria, Canada, Cuba, Denmark, Federal Republic of Germany, France, Japan, Poland, USSR and USA. FAO was represented by the Secretary of the CWP, who agreed to be Rapporteur.

The Chairman, in opening the meeting, noted that this would probably be the last meeting of the Subcommittee, and that, although it will be dealing with matters referred by STACRES, the results of the discussions will be of direct concern to the Scientific Council of NAFO. The following documents were reviewed: Com. Doc. 79/III/4, 79/VI/11; Res. Doc. 76/VI/93, 79/VI/119; Sum. Doc. 79/VI/1, 8, 12, 13, 14, 18, 22, 23, 29 and 30.

1. Review of CWP Activities Relevant to ICNAF Statistical Matters

Noting that the Report of the 9th Session of the CWP, held at ICNAF Headquarters, Dartmouth, Canada, during 17-25 August 1977, had been presented at the 1978 Annual Meeting, the CWP Secretary referred briefly to current developments in the inter-agency STATLANT program. He indicated that a standard list of 3-alpha identifiers for the world as a whole had been established and incorporated in the FAO data base for the world list of species items, and noted that the ICNAF List of Species Items (Sum. Doc. 79/VI/18) included the 3-alpha identifiers for the Northwest Atlantic. It was pointed out that there could be some difficulties in using 3-alpha identifiers as a substitute for numerical codes. The Subcommittee agreed that the 3-alpha identifiers would serve adequately the publication needs of both national and inter-governmental agencies, particularly where space limitation in tables necessitates the use of abbreviated species identifiers, and would as an international standard facilitate inter-publication references and comparisons. It was thought that the extension of these 3-alpha identifiers to logbooks and logsheets, as originally envisaged by the CWP at its 9th Session, might be useful but only after experience with their use had been gained.

The CWP Secretary explained the reasons for postponing the 10th Session of the CWP from August 1979 to 26 August-4 September 1980. That session is scheduled to be held in Madrid, Spain, with ICSEAF and ICCAT as the host organizations. The Subcommittee, noting that the agenda for CWP meetings was, in general, circulated for comment only to the representatives of inter-governmental agencies involved with the CWP, requested that the agenda for the 10th Session, if available to the Secretariat early enough, be circulated to member countries for comment well in advance of the 1980 Annual Meeting. The Subcommittee agreed that the attention of the Scientific Council of NAFO should be drawn to the CWP practice of including in the representation of each participating agency the following: a) a participant from the Secretariat responsible for statistical programs and activities; b) the Chairman of the appropriate committee concerned with statistical matters; and c) a participant from a member country (presently Canada) for the Northwest Atlantic.

The CWP Secretary indicated that FAO, in collaboration with other inter-governmental agencies, had made considerable progress in collecting and compiling detailed data on the nationally-used weight conversion factors by species and by type of processing and handling, and that it was the intention to update these factors every three years. The Subcommittee was informed that the data were being computerized and that printouts would be available by the end of 1979. The Subcommittee noted with satisfaction that steps are being taken to obtain the most up-to-date factors available, and, recognizing that national offices are urgently awaiting the publication of these data,

recommends (8)

that the CWP Secretary provide the ICNAF/NAFO Secretariat with the manuscript covering the conversion factors applicable to species caught in the Northwest Atlantic by the various countries, preferably by the end of 1979 or early in 1980 well in advance of the 1980 Annual Meeting.

The Subcommittee agreed that the Secretariat should distribute the information for the Northwest Atlantic species to enable national offices to review and comment on the factors used by the various countries.

2. Review of ICNAF Statistical Activities

The Assistant Executive Secretary referred to Com. Doc. 79/VI/11, which contains a summary of the Commission's research and statistical program during the past 12 months. The Subcommittee also noted the advance release of provisional nominal catches in the Northwest Atlantic for 1978 (Sum. Doc. 79/VI/30), based on data provided by most member countries on STATLANT 21A forms.

The Subcommittee was informed that the failure of one country (Spain) to provide complete catch and effort data for its Northwest Atlantic fisheries in 1977 is the reason for the delay in publishing

Statistical Bulletin Vol. 27, which should have been printed in December 1978. It was noted that data for the same country was also missing from the tables of 1978 provisional catches (Sum. Doc. 79/VI/30). It is with great concern that the Subcommittee finds itself impelled to repeat again the need for all countries to recognize their national obligation to maintain adequate statistical systems that will expeditiously provide the data required by international organizations. Failure to provide timely and adequate catch and effort data has a most serious negative effect on the timely publication of data in the regional statistical bulletins.

The Subcommittee took note of the concern of the Assessments Subcommittee about the inadequacy of advance statistics for stock assessments, such data being needed about two months before its meeting which has usually been held in early April. It was thought that there might be a better chance of obtaining more complete statistics if the meeting was held a month or two later. It was noted that there has been in recent years a significant increase in fishing operations during the last quarter of the calendar year, which could adversely affect the capability of national offices in collecting and processing of data required in the first quarter of the following year.

The Subcommittee recalled that, at the 1978 Annual Meeting, Canadian scientists indicated significant discrepancies in some data which cast doubt on the validity and quality of the statistics of some countries. In response to this, the Subcommittee recommended that each member country submit to the Secretariat prior to the 1979 Annual Meeting a detailed description of its national system for the collection and processing of fishery statistics. The Subcommittee noted that, notwithstanding the recommendation in *Redbook* 1978 (page 87) and the reminders in circular letters distributed in September 1978 and February 1979, only one country, Norway, responded to this request (Sum. Doc. 79/VI/29). The Subcommittee expressed the hope that other countries would supply the Secretariat with their reports in time for consideration at the 1980 Annual Meeting. In an effort to facilitate the acquisition of the reports, the Subcommittee

recommends (9)

that the Secretariat obtain from ICES a set of reports on national statistical systems (provided by some countries) and use these in urging member countries to supply similar reports relevant to their fishing activities in the Northwest Atlantic.

The Assistant Executive Secretary indicated that catches of "blue whiting" and "alfonsinos" have been reported on STATLANT 21A forms for 1978, and that it was necessary to add these two species items to the List of Species as follows:

ICNAF code	Common name	Scientific name	Taxonomic code	3-alpha identifier
140	Blue whiting	*Micromesistius poutassou*	1,43(04)033,01	WHB
442	Alfonsinos	*Beryx* spp.	1,61(02)003	ALF

3. Review of STATLANT and other Statistical Forms

The Subcommittee reviewed the currently used STATLANT 21A and 21B forms and agreed that there was no need to introduce changes in these forms and in the notes for their completion, except to ensure that references to "ICNAF" be substituted by "NAFO" when the forms are reprinted for distribution to national offices early in 1980 to obtain catch and effort data for 1979. The Subcommittee indicated that all national offices which are able to do so could submit their STATLANT 21A and 21B data on computer printout or magnetic tape provided that the latter is compatible with the system used in the Secretariat. It was noted that the Secretariat currently receives data on printouts or magnetic tapes from Canada, Denmark, German Democratic Republic, Norway and USA, and other countries are invited to follow this procedure as soon as the volume of data to be reported justifies the use of automatic data-processing procedures as an alternative to completing the actual STATLANT 21A and 21B forms.

The Subcommittee noted that the Scientific Council of NAFO, at its Inaugural Meeting in March 1979, agreed to a modification of the boundary between Subareas 0 and 1. The Subcommittee agreed that, as soon as charts reflecting this change received final approval, the maps and notes relevant to the completion of STATLANT 21A and 21B forms should be similarly modified.

4. Review of ICNAF Sampling Program

The Assistant Executive Secretary, in reference to the provisional lists of sampling data for 1977 (Sum. Doc. 79/VI/12), indicated that much of the required data are still missing. Noting that these data are scheduled for publication in *ICNAF Sampling Yearbook* Vol. 22 before the end of 1979, the Subcommittee urges that the 1977 lists be checked by national scientists against their records and any errors reported

to the Secretariat together with any additional data not yet submitted. The Subcommittee was informed that all sampling data for 1972-77 have been computerized and are available upon request to scientists and institutes involved in the Commission's work.

The Subcommittee reviewed the "sampling efficiency" achieved in 1977, based on the data available in the ICNAF data base (Sum. Doc. 79/VI/14). The Assistant Executive Secretary stated that, for technical reasons, the data were compiled on a quarterly basis, notwithstanding the 1978 request of the Subcommittee for the data to be provided on a monthly basis. This issue was again discussed, and the Subcommittee decided to rescind its earlier request for monthly data, indicating that quarterly data would be more useful in such a summary. However, it was indicated that users of the material would be able to obtain an improved synoptic view of the "sampling efficiency" situation in the Northwest Atlantic if the Secretariat could provide the quarterly information by major fishing gear categories.

The Subcommittee reviewed Sum. Doc. 79/VI/22 (prepared in response to a recommendation of the Biological Surveys Subcommittee at the 1978 Annual Meeting), which gives an outline of the ICNAF Sampling Program up to 1978. It was considered that, while this outline represents a useful compilation of current standards and conventions, the description of the program should be revised to reflect the changes relevant to the implementation of more detailed sampling requirements as indicated by the introduction of the two new sampling forms (CFS-1 and CFS-2). It was also pointed out that the details of squid sampling, as adopted by STACRES at its Febraury 1978 Meeting, should also be incorporated. The Subcommittee requested the Secretariat to circulate an updated version of the sampling program to scientists for comment, with a view to further expansion and improvement.

The Subcommittee noted that the *ad hoc* Working Group on Standardization of Reporting Procedures for Sampling Data met at Bergen, Norway, in November 1978 (Part A, this volume), and that STACRES had already adopted form CFS-1 for general use in reporting 1979 data. In fact, it was reported that some countries had already submitted some data for 1978 on the new form. The Subcommittee also noted that the draft form CFS-2 for age-length keys was reviewed by the Assessments Subcommittee (see page 84) and that the suggested revisions have been included in the draft form given in Sum. Doc. 79/VI/23. After a careful review of the two forms, the Subcommittee

recommends (10)

that forms CFS-1 and CFS-2, as amended and presented in Annex 1, be adopted for use in the reporting of commercial length frequencies (CFS-1) and age-length keys (CFS-2).

The Assistant Executive Secretary reported that progress is being made in computerizing the sampling data available for the years prior to 1972, and indicated that a new system for computerizing data from the new sampling forms would be operational in the near future.

5. List of Fishing Vessels for 1977

The Subcommittee noted that data pertaining to fishing vessel statistics for 1977 were given in Sum. Doc. 79/VI/13. The Assistant Executive Secretary pointed out that these data should have been published before the end of 1978 in the *List of Fishing Vessels* series, but that at the time of preparing the document data from Romania and Spain were not available. It was noted that data from Romania were now in hand thus leaving outstanding the data on Spanish vessels for 1977.

The Subcommittee was informed that provision for the inclusion of a column to indicate the presenece or absence of a fishmeal plant on board has been made for future lists of fishing vessels, but that this is not given in the 1977 list because requests for the data had been dispatched early in 1978 before the recommendation had been made.

6. Scientific Observer Program

The Subcommittee noted the request of STACRES that it should examine in depth the specific elements of a proposed scientific observer program (Com. Doc. 79/III/4, Sum. Doc. 79/VI/8). It was agreed that detailed consideration of this matter at this time would be premature, until the views of the Scientific Council and the Fisheries Commission of NAFO are clarified. However, in order to expedite consideration of the program later during this Annual Meeting or afterwards, should the need arise, the Subcommittee considered it desirable to establish an *ad hoc* working group for this purpose, and accordingly

recommends (11)

that an ad hoc working group on the scientific observer program be established, consisting of representatives from each of Canada, Cuba, Spain, USSR, USA, and any other interested countries, with Mr J. S. Beckett (Canada) as convener, and that the group meet as soon as possible after a decision on the observer program has been made to formulate its terms of reference.

7. Consideration of Standard Method of Measuring Grenadiers

The Subcommittee reviewed two papers (Res. Doc. 76/VI/93 and 79/VI/119) dealing with possible solutions to the problem of a suitable method of measuring roundnose grenadier. In view of the occurrence in catches of numerous specimens with broken or regenerated tails, it was agreed that some suitable partial length measurement would be appropriate, provided that such a measurement was highly correlated with the total length measurement currently used. The Subcommittee considered that the limited information available was insufficient to use as the basis for a decision at this time, and

recommends (12)

that studies be undertaken as soon as possible to determine the most suitable partial length measurement for grenadiers and be documented for consideration at the 1980 Annual Meeting.

8. Acknowledgement

The Chairman expressed his thanks to representatives and observers, and especially to Mr Gertenbach, Secretary of the CWP, and the Assistant Executive Secretary, for their support and active participation in the activities of the Subcommittee from 1977 to 1979.

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

COMMERCIAL FISHERY LENGTH SAMPLES, 19___

Country	Vessel name	Side no.	National reg. no.
Gear	Mesh size (mm)	Port or sea	Reported by

Date (month/day)															
Starting time of set (GMT)															
ICNAF Division															
Start of set position	Lat.														
	Long.														
Fishing Depth (m)															
SPECIES SAMPLED															
Catch or Landing															
Method of measuring															
Recorded meas.															
Length interval															
1cm	2cm	3cm	5mm	M	F	M	F	M	F	M	F	M	F	M	F
0	16-	15-													
1	18-	18-													
2	20-	21-													
3	22-	24-													
4	24-	27-													
5	26-	30-													
6	28-	33-													
7	30-	36-													
8	32-	39-													
9	34-	42-													
0	36-	45-													
1	38-	48-													
2	40-	51-													
3	42-	54-													
4	44-	57-													
5	46-	60-													
6	48-	63-													
7	50-	66-													
8	52-	69-													
9	54-	72-													
0	56-	75-													
1	58-	78-													
2	60-	81-													
3	62-	84-													
4	64-	87-													
5	66-	90-													
6	68-	93-													
7	70-	96-													
8	72-	99-													
9	74	102-													
0	76-	105-													
1	78-	108-													
2	80-	111-													
3	82-	114-													
4	84-	117-													
5	86-	120-													
Number measured															
Sample weight (kg)															
Catch weight (kg)															
No. for ageing															

Form CFS-1 (5/79)

(See overleaf for Notes)

NOTES FOR COMPLETION OF FORM CFS-1

This form is designed to facilitate the reporting of length frequencies for (a) several species from the same haul, or (b) the same species from different hauls, or (c) for species sampled at the port of landing. In the last case, it will not be possible to provide all of the detailed information required for sampling at sea. However, in order to facilitate data-processing, it is essential that all of the information required for each sample be entered in the appropriate spaces on the form.

1. Year. Record the last two digits of the calendar year in the space provided at the top of the form.

2. Country, Vessel name, Side number, and National registration number should always be recorded to ensure proper identification of the samples.

3. Gear. Record the appropriate abbreviation for the gear type used, based on the ICNAF Gear Classification for reporting sampling data. In the case of otter trawls used in certain fisheries (e.g. squid), special modifications to the gear (e.g. off-bottom chain, off-bottom bobbin, etc.) should be indicated in a note at the bottom of the form. The primary abbreviations are as follows:

   OTB - Bottom otter trawl (side and stern)
   OTM - Midwater otter trawl (side and stern)
   PTB - Bottom pair trawl (2 boats)
   PTM - Midwater pair trawl (2 boats)
   SN - Seine net (Danish and Scottish seines)
   SB - Beach seines
   PS - Purse seines
   GN - Gillnets (set and drift)
   LL - Longlines (set)
   LHP - Handlines and pole-lines
   FPN - Uncovered pound nets
   FWR - Weirs, barriers, fences, etc.
   DRB - Boat dredges
   HAR - Harpoons
   MISC - Miscellaneous (e.g. cast-nets and dip-nets)

4. Mesh size. In the case of trawls, seine nets, gillnets and poundnets, record the effective mesh size; for line gears record the hook size; and for dredges record the ring size.

5. Port or Sea. Indicate whether the samples were taken from the catch at sea or from the landing in port.

6. Date. Record the month and day for each sample taken by observers at sea. In the case of port sampling on a trip basis, record the month and day of landing.

7. Starting time of set. Use Greenwich Mean Time in the case of samples taken at sea; leave blank for port samples.

8. ICNAF Division. Record the appropriate division (or subdivision, where applicable) for both sea and port samples.

9. Start of set position. Applicable only to samples taken at sea.

10. Fishing depth (m). Indicate the mean fishing depth for sea samples and a range of fishing depth for port samples.

11. Species sampled. Record the name of the species sampled, supplemented by the ICNAF 3-digit code. If the 3-alpha species identifier is used, it should always be associated with the 3-digit code (e.g. HAD-102 could be used to designate haddock).

12. Catch or Landing. Insertion of "Catch" implies that the sample was taken at sea before any discarding, if any, had occurred, or in port with the knowledge that no fish were discarded during the trip; insertion of "Landing" implies that the sample was taken with the knowledge that some discarding of the smaller sizes of fish had occurred prior to sampling.

13. Method of measuring. Record one of the following length measurements as appropriate: total, fork, mantle for squid, carapace for shrimp, shell diameter for scallops. If other methods of length measuring are used, please specify in a note at the bottom of the form.

14. Recorded measurement. Record one of the following as appropriate: nearest cm, cm below, nearest half-cm, half-cm below.

15. Length interval. Record the appropriate length group used (i.e. 1 cm, 2 cm, 3 cm, 5 mm, etc.), especially if the sheet is used to report data for more than one species. For the "1 cm" and "5 mm" intervals, ensure that the appropriate length groups are given in the relevant columns.

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

COMMERCIAL FISHERY AGE-LENGTH KEY, 19__

Country	Vessel name	Side no.	National reg. no.
Gear	Mesh size (mm)	Port or sea	Reported by

Month	Day	ICNAF Div.	Start of set position	Lat. Long.	Fishing depth(m)
SPECIES		Sex (where applicable)	Method of measuring		Recorded measurement
Check length group in box below		Sampling method	Catch or landing		Structures for ageing

☐ 1cm	☐ 2cm	☐ 3cm	☐ 5mm	AGE-LENGTH KEY (Insert number sampled by age below)	Average weight* No.	(g)
0	16-	15-				
1	18-	18-				
2	20-	21-				
3	22-	24-				
4	24-	27-				
5	26-	30-				
6	28-	33-				
7	30-	36-				
8	32-	39-				
9	34-	42-				
0	36-	45-				
1	38-	48-				
2	40-	51-				
3	42-	54-				
4	44-	57-				
5	46-	60-				
6	48-	63-				
7	50-	66-				
8	52-	69-				
9	54-	72-				
0	56-	75-				
1	58-	78-				
2	60-	81-				
3	62-	84-				
4	64-	87-				
5	66-	90-				
6	68-	93-				
7	70-	96-				
8	72-	99-				
9	74-	102-				
0	76-	105-				
1	78-	108-				
2	80-	111-				
3	82-	114-				
4	84-	117-				
5	86-	120-				
Number of fish aged						
				If the age-length key is based on more than one subsample, record the number of subsamples in the box to the right		

* If individual fish were weighed, record in the appropriate columns the number of fish weighed (No.) and the average weight-at-length (g).

Form CFS-2 (5/79)

(See overleaf for Notes)

NOTES FOR COMPLETION OF FORM CFS-2

The form is designed to facilitate the reporting of individual age-length samples but may also be used for the reporting of age-length keys based on port sampling or grouped sea samples. With reference to the grouping of samples, STACRES, at its Special Meeting in November 1978, recognized the practical difficulties of obtaining suitable age-length keys corresponding to individual length samples and recommended "*that data from samples taken for ageing not be combined for periods exceeding one calendar month or for areas greater than one ICNAF division (or subdivision, where applicable)*". In order to facilitate data-processing, it is essential that all of the information required for each sample be entered in the appropriate spaces on the form.

1. Year. Record the last two digits of the calendar year in the space provided at the top of the form.

2. Country, Vessel name, Side number, and National registration number should always be recorded to ensure proper identification of the samples.

3. Gear. Record the appropriate abbreviation for the gear type used based on the ICNAF Gear Classification for reporting sampling data. The primary abbreviations are as follows:

OTB - Bottom otter trawl (side and stern)	LL - Longlines (set)
OTM - Midwater otter trawl (side and stern)	LHP - Handlines and pole-lines
PTB - Bottom pair trawl (2 boats)	FPN - Uncovered pound nets
PTM - Midwater pair trawl (2 boats)	FWR - Weirs, barriers, fences, etc.
SN - Seine net (Danish and Scottish seines)	DRB - Boat dredges
SB - Beach seines	HAR - Harpoons
PS - Purse seines	MISC - Miscellaneous (e.g. cast-nets and dip-nets)
GN - Gillnets (set and drift)	

4. Mesh size. In the case of trawls, seine nets, gillnets and poundnets, record the effective mesh size; for line gears record the hook size; and for dredges record the ring size.

5. Port or Sea. Indicate whether the sample was taken from catches at sea or from the landing in port.

6. Date. Record the month and day if the age-length key pertains to an individual haul; indicate the most representative date of the catch if the age-length key pertains to an individual trip or landing; indicate the month if the age-length key is composed of several subsamples, but in no case must the subsamples be grouped over more than a calendar month.

7. ICNAF Division. Record the appropriate division (or subdivision, where applicable) for both sea and port samples. In no case must an age-length key consist of subsamples from more than one division or subdivision.

8. Start of set position. Applicable only if the age-length key is based on a sample from a single haul.

9. Fishing depth (m). Indicate the mean fishing depth for individual sea samples, and a range of fishing depth for grouped and port samples.

10. Species. Record the name of the species sampled, supplemented by the ICNAF 3-digit code. If the 3-alpha species identifier is used, it should always be associated with the 3-digit code (e. g. HAD-102 could be used to designate haddock).

11. Sex. Leave blank if data are not required to be reported by sex. However, separate keys (on separate sheets) are necessary where data are required by sex, using the designation "M" for male and "F" for female.

12. Method of measuring. Record one of the following length measurements as appropriate: total, fork, mantle for squid, carapace for shrimp, shell diameter for scallops. If other methods of length measuring are used, please specify in a note at the bottom of the form.

13. Recorded measurement. Record one of the following as appropriate: nearest cm, cm below, nearest half-cm, half-cm below, etc.

14. Sampling method. Indicate whether the age-length key is based on Random sampling, Supplemented random sampling, or Stratified sampling.

15. Catch or Landing. Insertion of "Catch" implies that the sample was taken at sea before any discarding, if any, had occurred, or in port with the knowledge that no fish were discarded during the trip; insertion of "Landing" implies that the sample was taken with the knowledge that some discarding of the smaller sizes of fish had occurred prior to sampling.

16. Structures for ageing. The usual entry will be either scales or otoliths, but, if any other structures or a combination of two or more structures are used, this should be indicated.

APPENDIX IV. REPORT OF ENVIRONMENTAL SUBCOMMITTEE

Chairman: E. J. Sandeman

Rapporteurs: S. A. Akenhead, J. J. Gagnon, R. W. Trites, K. Sherman

The Subcommittee met at Dartmouth, Nova Scotia, Canada, during 23-25 May 1979 to consider and report on the various matters referred to it by STACRES (see Part D, this volume, for Agenda). Scientists attended from Bulgaria, Canada, Cuba, Denmark, Federal Republic of Germany, France, Japan, Poland, USSR and USA. The following meeting documents were reviewed: Res. Doc. 79/II/7, 9, 30, 37; 79/VI/52, 56, 58, 75, 80, 93, 94, 95, 96, 97, 100, 105, 106, 112, 114, 115, 116, 117, 118; Sum. Doc. 79/VI/19, 25, 26, 27, 28.

1. Results of Meetings of *ad hoc* Working Group on Flemish Cap Project

The Subcommittee noted that the Working Group met during the present meeting and also at the time of the meeting of the Assessments Subcommittee in St. John's, Newfoundland, Canada (2-3 April 1979). At these meetings, progress to date was reviewed as well as preliminary research plans for the remainder of 1979 and for 1980 (see Annex 1).

It was noted that extensive oceanological and biological observations were made on or near the Flemish Cap by Canada and USSR in the latter part of 1978 and early 1979. In addition, the regular oceanographic surveys by the US Coast Guard were carried out and were supplemented by the deployment of satellite-tracked drogued buoys. The Subcommittee reaffirmed its support for this most valuable exercise, and

recommends (13)

that the Convener of the ad hoc Working Group on the Flemish Cap Project convene a meeting of a small group of scientists working on the project to undertake an in-depth examination of the data obtained in 1978 and 1979, and, using these results and following the general strategies developed at the meeting in Murmansk (ICNAF Redbook 1977, pages 83-86) and the plans considered at the meeting of the Working Group in Bonn (Res. Doc. 78/VI/80), to assemble a detailed plan for a well-coordinated sampling scheme for 1980.

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

The Subcommittee was informed that Dr M. D. Grosslein, Task Force Leader of the Larval Herring Program, expressed his regrets for being unable to attend the present meeting. However, a document summarizing the activities and results of the long time-series of observations was presented and reviewed (Res. Doc. 79/VI/112). It was noted that the larval herring survey program, which has been carried out on an international cooperative basis since 1971, was continued, with surveys conducted by vessels of Federal Republic of Germany, Poland, USSR and USA, and collections made of larval herring and associated oceanographic measurements over the standard Gulf of Maine-Georges Bank station grid.

A major international multi-disciplinary, multi-ship larval herring patch experiment was conducted from mid-October to early November 1978 in the Georges Bank-Nantucket Shoals area. The principle objective of the study was to identify and map the distribution of an isolated patch of herring larvae, in order to obtain information on larval growth, mortality and dispersion in relation to changes in the biological and hydrographic conditions. During the first 16 days, operations were conducted on the northeast part of Georges Bank, with the deployment of current meters by Canada (3) and the USA (3) and extensive plankton sampling, but no larval herring patches were found. Following a detailed study of chaetognath distribution in the area, operations were shifted to the Nantucket Shoals area where a patch of herring larvae was located by the Polish research vessel *Wieczno*, which was covering a wide grid of stations in the Georges Bank-Nantucket Shoals region. Micro-distribution studies in horizontal and vertical vectors were made of larval herring, their prey and predators, and micro-hydrographic conditions by the research vessels *Albatross IV, Dawson, Lady Hammond, Anton Dohrn,* and *Atlantis II*. Information on the meso-scale distributions of larval herring and their environment was obtained by research vessels operating over the entire Gulf of Maine-Georges Bank station network, including the *Belogorsk, Canso Condor* and *Wieczno*. A detailed account of the preliminary results of this study is given in Res. Doc. 79/VI/116.

The Subcommittee noted that an extremely valuable time-series (10 years) of biological and oceanographic data was now available, most of which is in machine-readable form, and considered that the time was now ripe for a concentrated, cooperative international effort toward analyzing this extensive data base. Consequently, the Subcommittee strongly

recommends (14)

a) *that the Task Force on the Larval Herring Program be reconstituted to undertake the analysis of the extensive data assembled from the Gulf of Maine-Georges Bank area, with the following terms of reference:*

i) the Task Force will determine the most appropriate and desirable methods of study and carry out such studies through the year with the goal of presenting the results to the Scientific Council of NAFO at its 1980 Annual Meeting;

ii) the Task Force will analyze the data collected over the 10 years of the surveys and the data collected during the patch study in 1978, incorporating in the study such additional environmental data that are available;

iii) the Task Force should also consider the matter of continuing field work and make recommendations to the Scientific Council of NAFO; and

b) that a USA scientist from the Northeast Fisheries Center, Woods Hole, will be the convener of the Task Force.

It is anticipated that at least three meetings of the Task Force will be required to carry out the work. The first meeting should be convened at the Narragansett Laboratory as soon as possible to organize the study and begin analysis of the data. It was agreed that the name of the Task Force leader should be communicated to the Secretariat as soon as possible and that the leader would attempt to assemble a team of scientists by contacting those who have a special interest or have been directly involved in the project. The Secretariat was requested to keep members of STACRES and the Scientific Council of NAFO informed as the study is being organized.

3. Review of Environmental Conditions in the ICNAF Area during 1978

The Subcommittee noted that MEDS has made further progress toward the production, prior to the Annual Meeting, of an annual summary and an assessment of environmental conditions (Res. Doc. 79/VI/118), and indicated its endorsement of this approach. However, the need for the prompt submission of data was emphasized if the report is to achieve its full value. The following highlights of environmental conditions are based on the MEDS summary and augmented by information from various meeting documents and oral presentations.

a) Subarea 1

Physical oceanographic data are available for several of the standard sections off West Greenland, with the Fylla Bank section having been occupied most frequently (Sum. Doc. 79/VI/27; Res. Doc. 79/VI/80). The relatively high temperatures observed in the upper layer west of Fylla Bank during the latter part of 1977 were also observed in January 1978, but thereafter the temperatures seem to have been lower than those observed in 1977. It was noted that the temperature of the deep water layers west of Fylla Bank was dominated by warm water of the Irminger Current, although not so pronounced as in 1977. In July, the mean temperature of the upper 500 m was 0.21°C higher than the mean for the warm period of 1950-66 but decreased to normal levels by the end of the year. Attention was drawn to the two occupations of the Fylla Bank section in December, which show rather striking differences. For example, the depth and thickness of the >5°C water was markedly different. A computation such as the mean temperature in the upper 500 m shows as much within-month variation as is usually reported for year to year variations.

b) Subarea 2

Environmental conditions were reported by Canada (Res. Doc. 79/VI/118; Sum. Doc. 79/VI/19), France (Sum. Doc. 79/VI/26), and USSR (Res. Doc. 79/VI/106; Sum. Doc. 79/VI/25). France reported unusual ice conditions in January, in that open water was observed northward to the southern slope of Hamilton Bank. Canada reported that the total volume of cold water of the Labrador Current, observed for the Seal Island section in August, was significantly less than the 1951-71 average as reported by Templeman (see *ICNAF Spec. Publ.* No. 10, page 17). Also, bottom temperatures were observed to be much higher than in 1977 and significantly higher than the 1951-71 average. USSR observations indicated positive anomalies in temperature for the offshore branch of the Labrador Current, with maximum positive anomalies recorded for its nucleus throughout the winter, spring and summer periods. The autumn period showed a return to more normal conditions.

c) Subarea 3

Environmental data, reported by France (Sum. Doc. 79/VI/26), Canada (Res. Doc. 79/VI/118 and Sum. Doc. 79/VI/19), Cuba (Res. Doc. 79/II/7 and 9), and USSR (Res. Doc. 79/II/30 and 79/VI/106, and Sum. Doc. 79/VI/25) indicated that conditions in Subarea 3 were similar to those recorded for Subarea 2. The total volume of the cold Labrador Current water in July-August for the Bonavista (northwest) and Flemish Cap standard sections was significantly less than the 1951-71 average. Surface temperatures in the Grand Bank, Flemish Cap and inshore areas, as well as the bottom temperatures on the western slope and the plateau of the Grand Bank, were observed to be much higher in 1978 than in 1977, even though 1977 was reported to be an unusually warm year (*ICNAF Redbook*

1978, page 95). USSR observations supported these results by showing high positive temperature anomalies in the 200-500 m layer in Div. 3L and 3N. France also indicated that autumn bottom temperatures in Subdiv. 3Ps were high compared to previous years.

d) Subareas 4 and 5

Environmental data for 1978 were reported by a number of countries (Res. Doc. 79/II/37; 79/VI/56, 58, 75, 93, 94, 95, 96, 97; Sum. Doc. 79/VI/25). Monthly maps of surface temperatures by 1° rectangles for the Northwest Atlantic, prepared by the Atlantic and Pacific Environmental Groups, reveal that temperatures were generally lower than the long-term mean (1948-67) during the first half of the year. Observations from a survey by Cuba on the Scotian Shelf in July showed that surface tempertatures were higher in 1978 than in 1977 while the opposite trend was noted for bottom temperatures. The intrusion of warm water along the slope south of Western Bank was less in 1978 than in 1977. Surface salinities were reported to be lower in 1978 than in 1977, indicating a greater flow of low salinity water from the Gulf of St. Lawrence.

The role played by Gulf Stream eddies and the changing position of the slope-water front in determining hydrographic conditions on the shelf were noted (Res. Doc. 79/VI/94, 97). Off Georges Bank, the front was more onshore than average during early early March but moved offshore as the month progressed, and from April through June it was much farther seaward than average. Two large excursions in May and June may have been related to the development of the large amplitude meanders in the Gulf Stream off Georges Bank during this time. In early July, the front moved shoreward but still stayed seaward of the 1973-77 mean position until mid-October. This shoreward movement is, at least partly, related to the presence of eddies. A large offshore excursion in September is possibly related to the offshore meandering of the Gulf Stream and the absence of eddies. This offshore meandering of the Gulf Stream, in forcing slope water onto the shelf and in drawing slope water away from the shelf, may be of paramount importance to successful year-class production, particularly in the region from the Scotian Shelf southward.

4. Review of MEDS Progress Report for 1978/79 (Res. Doc. 79/VI/118)

a) Data inventory for 1978 oceanographic stations in ICNAF Area

The Subcommittee noted that responses to the inventory form, approved for use at the 1977 Annual Meeting, modified at the 1978 Annual Meeting, and distributed to all member countries by the Secretariat, were received from Canada, Denmark, Federal Republic of Germany, Poland, USA and USSR. A list of temperature and salinity data collected but not yet submitted by season and ICNAF subarea is given in Table 1. There was a substantial increase in data reported as collected in 1978 compared with 1977. A total of 5,206 stations of temperature-salinity and 5,736 stations of temperature observations were reported for 1978, compared with observations from 2,561 and 1,630 stations respectively for 1977. Additionally for 1978, 1,691 temperature-salinity and 1,630 temperature stations have already been received and processed for 1978. Recognizing the considerable improvement from 1977 to 1978, but noting that the inventory is still incomplete, the Subcommittee supported the continued use by all member countries of the inventory forms distributed early in the year by the Secretariat.

Table 1. Oceanographic data reported as collected during 1978 within the ICNAF area but not yet submitted to MEDS.

Sub-area	Country	Season	Number of stations Bottle	MBT/XBT	CTD	Sub-area	Country	Season	Number of stations Bottle	MBT/XBT	CTD
0,1	Canada/BIO	3	-	-	64	4,5	Canada/BIO	4	-	-	681
1	Denmark/GF	1	10	-	-	4,5,6	USA/NMFS	1	342	727	31
1	Denmark/GF	2	7	-	-	4,5,6	USA/NMFS	2	481	655	43
1	Denmark/GF	3	22	-	-	4,5,6	USA/NMFS	3	443	1197	40
1	Denmark/GF	4	6	-	-	4,5,6	USA/NMFS	4	450	709	34
1,2	FRG/BF	4	41	2	50	5	Poland/MIR	2	-	30	-
2	Canada/BIO	1	-	-	130	5	Poland/MIR	4	55	244	-
2	Canada/BIO	4	-	-	22	5,6	USSR/ATL	1	179	179	-
3	Poland/MIR	2	32	83	-	5,6	USSR/ATL	2	1015	1122	-
3	Canada/BIO,MEM	2	-	39	56	5,6	USSR/ATL	3	154	535	-
3	Canada/BIO	4	-	-	7	5,6	USSR/ATL	4	208	-	-
3,4,5	FRG/BF	4	-	148	292	6	Poland/MIR	2	-	14	-
4	Canada/BIO	1	-	-	17	6	Poland/MIR	4	-	52	-
4	Canada/BIO	2	-	-	70						
4	Canada/BIO	3	-	-	224			TOTALS	3445	5736	1761

BIO - Bedford Institute of Oceanography
GF - Grønlands Fiskeriundersøgelser
BF - Bundesforschungsanstalt Fischerei
MIR - Morski Instytut Rybacki
MEM - Memorial University of Newfoundland
NMFS - National Marine Fisheries Service
ATL - AtlantNIRO

MBT - Mechanical bathythermograph
XBT - Expendable bathythermograph
CTD - Conductivity Temperature Depth
Season 1 - January-March
" 2 - April-June
" 3 - July-September
" 4 - October-December

b) Data received and processed for 1978

A total of 1,691 bottle stations and 2,482 bathythermograph stations collected during 1978 have been received and processed (Table 2). Oceanographic data were submitted to MEDS directly by Cuba, Denmark and USSR in time for them to be merged with data collected by Canada and used in preparing an overview of environmental conditions in the ICNAF Area for 1978 (Res. Doc. 79/VI/118). A total of 65 station position cruise tracks were also presented for 1978. Track numbers 1 to 46 in Table 2 are of bathythermograph cruises by Canada, numbers 47 to 53 are of bottle observations submitted to MEDS by member countries, and numbers 54 to 65 are of bottle observations by Canada, the majority of the latter being surface and bottom temperature-salinity observations only.

Table 2. Oceanographic data from the ICNAF area received and processed by MEDS for 1978. (Track chart numbers refer to Figures in Res. Doc. 79/VI/118.)

Track chart no.	MEDS ID	Dates	ICNAF Div.	No. of stations Bottle	BT	Track chart no.	MEDS ID	Dates	ICNAF Div.	No. of stations Bottle	BT
1	180378001	Feb 15-Mar 1	4X	-	44	34	183078001	Aug 2-6	4T	-	97
2	180378002	Mar 12-19	4X,W	-	22	35	183078002	Oct 17-20	4T	-	91
3	180378003	Mar 15-Apr 2	4X	-	94	36	183078003	Jul 11-12	4T	-	12
4	180378004	Apr 8-11	4X	-	19	37	183078004	Nov 13-14	4T	-	8
5	180378005	May 16-24	4T	-	60	38	181878001	Feb 27-Mar 16	6C	-	24
6	180378006	May 17-Jul 14	4X,W,V	-	326	39	181878002	Jan 13-Mar 16	6C	-	63
7	180378010	Jul 9-19	4X,W	-	83	40	181878003	Jan 11-Feb 28	4X	-	26
8	180378011	Jul 23-31	4W,V	-	64	41	181878004	Jan 5-19	2 to 4[1]	-	20
9	180378012	Aug 1-3	4X	-	22	42	181878005	Jan 21-27	4X,5Zw	-	2
10	180378013	Aug 9-16	4X	-	48	43	181878006	Feb 1-15	2 to 4[2]	-	20
11	180378014	Aug 16-20	4X	-	82	44	181878007	Mar 11-23	3L,0,4W	-	15
12	180378015	Aug 20-Sep 1	4W	-	91	45	181878008	Mar 15-17	4X	-	4
13	180378016	Aug 22-30	4X	-	23	46	181878009	Mar 17-23	4X	-	9
14	180578001	Jan 14-24	3L	-	10	47	26--79002	Jan 2-May 19	1C,D	30	
15	180578002	Feb 2-13	3Ps	-	12	48	CU--79001	Jul 16-23	4W,X	40	
16	180578003	Feb 23-28	3Ps	-	43	49	CU--79002	Jul 4-14	3L,N,0	32	
17	180578004	Apr 6-14	3Ps	-	60	50	90PE78001	Oct 15-Jan 12[3]	0 to 3[5]	102	
18	180578005	May 6-17	3L	-	96	51	90PH78001	Nov 26-Feb 27[4]	3K,L,M,N,0	291	
19	180578006	May 26-Jun 8	3N,0	-	80	52	90--79001	Sep 1-Oct 1	3K,L,0	40	
20	180578007	Jun 15-27	3N,0	-	89	53	90PE79001	Sep 6-Dec 21	2J,3K	66	
21	180578008	Jul 28-Aug 12	2J,3K,L,M,0	-	126	54	180378001	Feb 15-Mar 1	4X	62	
22	180578009	Jan 26-27	3L,M	-	13	55	180378002	Mar 12-19	4W,X	22	
23	180578010	Jan 27-Feb 13	3L,M	-	118	56	180378003	Mar 15-Apr 2	4X	113	
24	180578011	Feb 20-25	2J	-	4	57	180378006	May 17-Jul 14	4V,W,X	395	
25	180578012	Apr 11-13	3L	-	10	58	180378009	Jul 2-6	4T	24	
26	180578013	May 5-15	30	-	68	59	180378010	Jul 9-19	4W,X	84	
27	180578014	Jun 13-Jul 3	30	-	93	60	180378011	Jul 23-31	4V,W	64	
28	180578015	Jul 7-21	3L,M,0	-	69	61	180378012	Aug 1-3	4X	22	
29	180578016	Jul 30-Aug 31	2J,3K,L,N	-	160	62	180378014	Aug 16-20	4X	115	
30	180578017	Jan 14-Feb 1	3Ps	-	17	63	180378016	Aug 21-30	4X	61	
31	180578018	Feb 11-16	3Ps	-	4	64	180378020	Nov 1-7	4X	115	
32	180578019	Feb 26-Mar 18	3Ps	-	32	65	180578009	Jan 25-27	3L,M	13	
33	180578020	Jun 16-26	3K	-	9				TOTALS	1691	2482

[1] 2J,3K,L,Ps,4Vs,W
[2] 2J,3L,Ps,4Vn
[3] Oct 15/77 to Jan 12/78
[4] Nov 26/77 to Feb 27/78
[5] 0B,2G,H,J,3K,M

Table 3 summarizes the ICNAF Standard Section (*ICNAF Sel. Papers* No. 3) occupations from the cruises listed in Table 2. Member countries are urged to check their national data banks to ensure that all historical data for the ICNAF Standard Sections have been submitted to MEDS and any outstanding data should be submitted as soon as possible. It was noted that MEDS will endeavour to acquire the data listed in Table 1 from the designated national representatives. The Subcommittee reaffirms its interest in having MEDS attempt to summarize environmental conditions in the Northwest Atlantic prior to the next Annual Meeting.

c) Historical data acquisition from USSR

MEDS reported that some of the data listed in Res. Doc. 77/VI/52 have been received from World Data Centre B in Moscow and have been incorporated into the MEDS data bank. However, included with these data was a comment that data from the *Protsion, Persey III, Ayaks* and *Odyssey* cruises in 1975 were not available for exchange and were not held by World Data Centre B in Moscow. MEDS did not know why the data were unavailable but reaffirms its interest in acquiring the data. The Subcommittee agreed that such a large historical series of oceanographic information was indispensible and that MEDS should continue its efforts to acquire the data. In this regard, the Subcommittee

Table 3. List of ICNAF standard sections for which 1978 data has been processed by MEDS. (Track chart numbers refer to Appendix Figures in Res. Doc. 79/VI/118.)

App. Track chart No.	Sub-area	MEDS LD	Dates	Section	Data type
6	1	26--79002	Jan 2	Fylla Bank	T,S
7	1	26--79002	Feb 8	Fylla Bank	T,S
8	2	180578008	Aug 4-5	Seal Island	T
9	2	90PE79001	Nov 6-7	Seal Island	T,S
10	3	90PH78001	Jan 1-5	Coast Guard 4	T,S
11	3	90PH78001	Jan 8	SW Grand Bank	T,S
12	3	90PH78001	Jan 12-13	Flemish Cap	T,S
13	3	180578009	Jan 26-27	Flemish Cap	T
14	3	180578009	Jan 26-27	Flemish Cap	T
15	3	180578008	Jul 28-30	Flemish Cap	T
16	3	180578008	Aug 2	Bonavista SE	T
17	3	180578008	Aug 3	Bonavista NW	T
18	3	180578008	Aug 6-7	White Bay	T
19	3	180578008	Aug 8	Bonavista SW	T
20	3	180578008	Aug 11	SW Grand Bank	T

recommends (15)

that MEDS liaise directly with the USSR national representative (Dr V. Ponomorenko) in an effort to rectify the situation concerning the availability of USSR oceanographic data for the Northwest Atlantic from cruises of Protsion, Persey III, Ayaks and Odyssey in 1975, and to report on progress at the 1980 Annual Meeting.

d) MEDS involvement with the Flemish Cap Project

In 1977, the *ad hoc* Working Group on the Flemish Cap Project had identified the need for the rapid exchange of oceanographic data by member countries participating in the experiment. It was agreed that IGOSS (Integrated Global Ocean Station System) would be used for the exchange of real-time data, and MEDS further proposed that it would provide graphic products of the data transmitted during the course of the experiment. After the installation in MEDS of a Global Telecommunications System (GTS) link in the autumn of 1978, MEDS has maintained a data bank of all data received over this network. From these data, graphic data products for the Flemish Cap, as outlined in *ICNAF Redbook* 1978, have been produced after the end of each cruise. The primary purpose of these products was to provide to all participants a quick analysis of the data from each cruise in order to aid in the planning of subsequent cruises.

MEDS reported that the quality of the IGOSS data was initially very poor because of the infrequent prior use of the communications system and inexperienced communications operators. However, these have been improved to the extent that an error of only 1% may be attributed to message handling by the communications system. The majority of the errors now appear to originate from on board the ship, due to lack of proper adherence to IGOSS codes and improper structure of the IGOSS radio messages. It noted that an "Instruction Manual for Radio Transmission of Oceanographic Data using BATHY/TESAC Formats" (J. Gagnon, April 1979), which should help to reduce these sources of error, is now available. MEDS also plans to produce a technical data report of all IGOSS data from 1979 Flemish Cap cruises prior to the 1980 Annual Meeting. The Subcommittee noted the progress made in using the IGOSS network for the exchange of basic oceanographic data and encouraged its continued use by member countries.

e) National Representatives for Data Exchange

The Subcommittee was informed of two changes in the list of national representatives responsible for reporting to MEDS the oceanographic data collected within the Northwest Atlantic. The updated list is as follows: Canada (J. Gagnon); 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 (to be named); USSR (V. Ponomorenko); UK (P. Edwards); and USA (R. Ochinero).

5. Standard Oceanographic Sections and Stations

Attention was drawn to the fact that the depths of some stations (published in *ICNAF Sel. Papers* No. 3) are erroneous due to inadequate depth contours on the charts used. It was agreed that, whenever new information based on actual observations becomes available, the Secretariat should be informed so that the necessary changes can be made in the master list and circulated to participating countries. It was

noted that small errors may be present in one or more of the stations on the Seal Island section. Dr R. W. Trites agreed to check these and report any changes to the Secretariat.

6. Plankton Studies

The Subcommittee noted that no data from the Continuous Plankton Recorder Survey Program were reported at this meeting. The coordinator of the program (G. A. Robinson) in a letter to the Secretariat indicated that great difficulty was experienced in maintaining the sampling in the western Atlantic in recent years and that a decision had been made to concentrate on maintaining coverage of the eastern Atlantic.

The Subcommittee reviewed a paper on the results of a joint Canada-USSR study on silver hake spawning efficiency and the distribution and abundance of eggs, larvae and juveniles in relation to environmental conditions in the Scotian Shelf area during August-October 1978 (Res. Doc. 79/VI/100). Water temperature was measured and zooplankton and ichthyoplankton were sampled at 148 standard stations during two sequential surveys in August-September 1978. Charts showing the distribution of eggs and larvae were presented and these support the conclusion that spawning lasts through September in the Sable Island Bank area and ends about mid-September in the Banquereau Bank area. An estimate of 135 larvae per square mile was derived as an abundance index of silver hake larvae over the total area of the Scotian Shelf.

The Subcommittee reviewed a paper on investigations of larvae and pre-recruits of capelin in the Northwest Atlantic during September carried out by USSR scientists on the research vessel *Gemma* (Res. Doc. 79/VI/105). This represented a first examination of the distribution of larval capelin in the offshore areas of Div. 3K and 3L as well as in the northern parts of Div. 3N and 3O. Larvae of 13-26 mm in length were obtained at many of the stations in Div. 3K and 3L. Although it was recognized that the survey did not extend far enough offshore to include the whole range of larval distribution, the study provides most useful information for the planning of future work on the distribution and abundance of capelin larvae off eastern Newfoundland.

7. Other Matters

The Subcommittee draws the attention of STACRES to three important papers by USA scientists (Res. Doc. 79/VI/114, 115 and 117), illustrating some of the results that are beginning to appear from the extensive MARMAP (Marine Resources Monitoring, Assessment and Prediction) Program. This extensive ecosystem program is conducted by the US National Marine Fisheres Service on the continental shelf from southwestern Nova Scotia to Cape Hatteras, with investigations focussing on a broad spectrum of studies dealing with linkages among plankton production, benthos production, and the influence of the environment on the productivity of fish resources, in addition to the systematic monitoring of fish, plankton and benthos in relation to the marine environment. This program has directed considerable effort toward understanding the processes controlling larval survival. A number of key papers (available from the National Marine Fisheries Service Laboratory, Narragansett, Rhode Island, USA) has been prepared on time-scale studies of important processes (recruitment, phytoplankton production, and predator-prey relationship among the principle species). It was pointed out that a significant gap still exists in understanding and evaluating the processes involved in secondary production.

It was noted that ICNAF, like all organizations concerned with the management of fisheries, has long recognized the desirability of managing fisheries on a multi-species or ecosystem basis, and it is most encouraging to see that the data base from these ecosystem studies has now evolved to a stage where multi-species models may be developed which might have immediate relevance to fisheries management. The Subcommittee notes these valuable contributions and encourages participating countries to submit documents on this very relevant topic.

8. Acknowledgements

The Subcommittee expressed its appreciation to MEDS for its contribution to the activities of the Flemish Cap Working Group and the Subcommittee during the year. The Chairman thanked all participants in meetings of the Subcommittee and the Working Group for their cooperation and support during the past three years.

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

Convener: R. Wells

Rapporteur: S. A. Akenhead

The Working Group met at Dartmouth, Nova Scotia, Canada, on 23 May 1979 to review research activities on the Flemish Cap in 1978 and early 1979.

1. Review of Report of April 1979 Meeting of the Working Group

The Working Group reviewed and adopted the draft report of its meeting at St. John's, Newfoundland, Canada, during 3-4 April 1979 (Sum. Doc. 79/VI/28). That report summarized research activity on the Flemish Cap since the time of the 1978 Annual Meeting (see *ICNAF Redbook* 1978, page 99). The Convener noted that research activity by Canada, Cuba, Poland, USSR and USA was more extensive in 1977 and 1978 than had been anticipated when the project was initiated at the 1977 Annual Meeting. He indicated that agreement had been reached on the three standard oceanographic sections for the Flemish Cap study: the 47°N section, the USSR 7A section, and the proposed NW-SE section. He reiterated the recommendations that there should be increased intensity of commercial fishery sampling, and that oceanographic data be transmitted upon collection to MEDS through the IGOSS system.

2. Review of Work Since the April 1979 Meeting

a) Canada. Two trips of the R/V *Gadus Atlantica* in the spring of 1979 resulted in three occupations of the 47°N section and the recommended grids and one occupation of the NW-SE transect. STD and chlorophyll data were supplemented by a study of nitrate, nitrite, phosphate, oxygen, and primary productivity. Bongo tows for larval fish and plankton yielded a great number of redfish larvae, approximately 30 large cod larvae, and only rarely other species, including American plaice and *Ammodytes* larvae.

Four drogued buoys were released on Flemish Cap and tracked by satellite. Two were set in January 1979 and they remained on the bank for 34 and 21 days. They each made one revolution before leaving the bank at the same time, probably due to a storm which affected the surface water movement. Their tracks are illustrated in Sum. Doc. 79/VI/28. The other two buoys were deployed in March 1979. One stayed on the Flemish Cap for 43 days before meandering off over deep water, while the other was still on the bank after more than 70 days.

A cruise, planned for 5-22 July 1979, will involve the recovery of four current meters and the deployment of another for six months, as well as a STD survey and the deployment of drifting buoys.

b) Cuba. No work in 1978 was possible due to the refit schedule of the research vessel.

c) Poland. No activity on Flemish Cap is scheduled for 1979 due to research commitments in other areas. However, the data from the R/V *Wieczno* cooperative cruise in May 1978 have nearly all been analyzed.

d) USSR. Some 800 oceanographic stations were occupied, including the standard sections (47°N, US Coast Guard 3, and NW-SE transect) and an additional section along 45°W. The extensive oceanographic and ichthyoplankton work was carried out by the research vessels *Protsion* (February, May-July 1978), *Persey III* (July-August 1978), *Suloy* (spring 1979), and *Gemma* (March 1979). In addition, bottom trawl surveys were carried out in early 1978 and 1979 by *Persey III* and *Suloy*. It was noted that the R/V *Gemma* will occupy the Flemish Cap oceanographic stations as often as possible during August-November 1979.

e) USA. There are nine current meter arrays (total of 14 meters) in the US Coast Guard International Ice Patrol sections A2B and A3A south of Flemish Cap. The R/V *Gadus Atlantica* supplemented these occupations by a STD survey in May. A program of air-dropped transmitting drogued buoys, begun in August 1978, included deployment in the Flemish Cap region. Three were dropped in early 1979 and two more are planned before July. In 1980, 15 to 18 of these instruments will be deployed. A research document describing the tracks of these drifting buoys will be forthcoming. Part of the International Ice Patrol program involves the gathering of information on the "eastern branch" of the Labrador Current to the north of Flemish Cap.

3. Use of IGOSS System

The Working Group noted that transmissions via the IGOSS system in 1979 were made by Canada (R/V *Hudson*) in January (133), Canada (R/V *Gadus Atlantica*) in January (74), March (19) and May (59), and USSR (*Gemma*) in April (46) and May (79). Oceanographic data from the US Coast Guard are being entered into the world data system through NODC.

4. Review of Current Results and Analyses

The Working Group reviewed the paper by Borovkov and Kudlo (Res. Doc. 79/VI/52). The reported cessation of the Flemish Cap gyre, possibly due to a storm, was of interest.

Geostrophic circulation maps for the area from Labrador to south of the Grand Bank showed the average long-term patterns of the Labrador Current and the Gulf Stream in the May-July period.

It was noted that there was as yet no adequate archiving system for the data on drifting buoys. It was pointed out that the positions of the buoys, as transmitted by satellite, were adjusted using a smoothing technique.

The 400-m isobath was proposed as the boundary of Flemish Cap, based on the distribution of *Iniomi* and copepods. It was suggested that higher temperatures allowed earlier development of phytoplankton in the gyre. It was noted that net clogging was not a problem in shallow water but was a problem both north and south of the Flemish Cap.

Concern was expressed that the low spawning stock of cod on Flemish Cap would lead to continued low abundance of cod larvae in the immediate future. However, it was pointed out that there appears to be no distinct relationship between stock size and larval abundance, as the large 1973 year-class was derived from a small spawning stock.

5. Future Work

The need for detailed planning of future work was emphasized, particularly with regard to the formulation of hypotheses and precise objectives and to the time of research vessel cruises. Consequently, the Working Group recommends that the Convener should arrange a meeting of a small group of scientists involved in the Flemish Cap Project to undertake an in-depth examination of the data obtained in 1978 and 1979, and, following the general strategies developed at the Murmansk Meeting (*ICNAF Redbook* 1977, pages 83-86) and the plans considered at the 1978 Annual Meeting (Res. Doc. 78/VI/80), to assemble a detailed plan for a well-coordinated sampling scheme for 1980.

APPENDIX V. REPORT OF JOINT SESSIONS OF ASSESSMENTS AND BIOLOGICAL SURVEYS SUBCOMMITTEES ON COMMERCIAL FISHERY ABUNDANCE INDICES

Convener: W. G. Doubleday

The Assessments and Biological Surveys Subcommittees met jointly on 5 April 1979 at the Newfoundland Environment Center, St. John's, Newfoundland, Canada, and also on 23 May 1979 at Dartmouth, Nova Scotia, Canada, to evaluate commercial fishery indices of abundance, in accordance with the recommendation of STACRES at the 1978 Annual Meeting (*ICNAF Redbook* 1978, page 39). Participants attended from Canada, Cuba, Denmark, Federal Republic of Germany, France, German Democratic Republic, Japan, Norway, Poland, USSR and USA. The Convener noted that, as a result of discussions between the Assistant Executive Secretary, the Chairman of the Assessments Subcommittee and himself and in order to minimize the workload on individual experts, scientists were requested to examine the precision and accuracy of commercial fishery indices of abundance and include such information in documents on stock assessments for the April 1979 Meeting, as specified in a circular letter distributed in January 1979. Two papers were available for consideration at the first session of the Joint Meeting and two were documented for the second session. It was indicated that the short interval between the receipt of 1978 fisheries statistics and the beginning of the Assessments Subcommittee Meeting prevented most scientists from carrying out the requested analyses.

1. Review of Relevant Contributions

Analyses were presented on the precision of catch per day fished for yellowtail flounder and American plaice by Canadian (Nfld) vessels in Div. 3LNO during 1976-78 (unpublished report by S. J. Smith, Newfoundland Environment Center). Tables 1 and 2 show the results of the analysis of variability in catch per day fished. Only catch per trip and days fished per trip were used in the study and an estimator was derived to overcome this problem. In some cases, negative estimates of variance were calculated as shown by asterisks. Non-zero estimates of coefficients of variation within months were comparable to those observed for research vessel surveys.

A further analysis of catch per unit effort data from Canada (Nfld) vessels for yellowtail flounder and American plaice in Div. 3LNO for 1976-78 (Res. Doc. 79/VI/110) showed that the usual estimates of CPUE were biased toward underestimation. This bias is negligible when more than 50 trips are used to estimate CPUE but becomes large as the number of trips decreases below this level. A jack-knife statistic effectively reduces this bias to negligible levels and is recommended for cases where the CPUE is based on a few trips. Variances in estimated CPUE in this analysis were higher than the earlier estimates. The non-zero intercepts reported for some regressions of catch on effort were puzzling. It was noted that a detailed examination of these might lead to improved estimates.

Analyses were presented on the accuracy of catch per hour fished for cod in Div. 2GH, 3M and 3NO (unpublished report by S. Gavaris, Newfoundland Environment Center). Tables 3 to 5 represent coefficients of variation between mean monthly catch per hour for groups of vessels and months found to be undistinguishable by a multiple range test in studies of standardization of fishing effort. Since data for months and countries are grouped, variation within months is likely to be overestimated. It was noted that the estimates are comparable to those observed for research vessel surveys.

An analysis of catch per unit effort from the Canadian Observer Program data in Subareas 2 to 4 in January and February 1979 was presented (Res. Doc. 79/VI/111). Catch rates in the first few days of the observed fisheries were not lower than those observed later. Strong serial correlation in day to day catch rates was observed. Tow to tow variation in catch per hour was less than that observed for research vessel catches. Catch per hour was found to be more stable than catch per day. The author emphasized that the conclusions should not be extended beyond the cases considered. It was noted that variation in availability, detectable in detailed analysis, appeared to be at least as significant as tow to tow variation in the cases examined. The Subcommittees recognized the value of this analysis in exposing the nature and extent of variance of commercial CPUE estimates and the scope for refinement in methods of analyzing such data.

2. Discussion on Variation in Commercial Fishery Abundance Indices

The great difficulties associated with the definition of fishing effort in mixed fisheries was emphasized. It was noted that fishing power of a fleet may vary even though the number of vessels in a particular tonnage category remains the same, due to changes in mean tonnage or horsepower and to changes in the composition of the mixed fishery. Commercial catch per unit effort, however, is usually considered more reliable than research vessel abundance indices for fully-recruited age-groups but less reliable for estimation of recruitment. It was also noted that the correspondence between research and commercial indices was better at high levels of stock abundance than at low levels due to increasing catchability of commercial fishing at lower stock sizes.

Catch per unit effort data from fisheries on pelagic schools was considered to be of very limited

value. Usually catch per day is a more reliable index than catch per hour which ignores searching time. It was reported that, in the case of the southern Gulf of St. Lawrence herring stock, a significant correlation was found between catch per day of purse seiners and catch per tow from stratified groundfish surveys over a 10-year period. It was noted that cooperative searching by fleets fishing together sometimes occurs.

The expanding use of observers on commercial fishing vessels is permitting the collection of data nearly as detailed (although less accurate) as from research vessel surveys. However, the resulting indices of abundance are not comparable due to the selection of areas of fish concentration by commercial vessels. Due to uncertainty about the distribution of the stock, research vessel coverage of the whole area of distribution of the stock are necessary to interpret such data. The likely inaccuracy of estimates of by-catch weight and catch composition from commercial vessels was pointed out. From the observer data, catch per hour seemed to be a more stable index than catch per day for the cod and witch flounder fisheries.

The Subcommittee recognized the value of evaluating commercial fisheries abundance indices but noted that much background work must be completed by individual scientists before general conclusions can be drawn, and therefore

recommends (16)

that experts be encouraged to critically evaluate commercial fishery based abundance indices used in their assessments, and that general discussion on the problems be delayed until progress is seen in a variety of cases.

3. Acknowledgements

The Convener expressed his thanks to contributors of the papers (S. Gavaris, D. W. Kulka and S. J. Smith of the Newfoundland Environment Center) for their efforts in carrying out the analyses, and to the participants for their involvement in the discussion.

Table 1. Variation in catch per day fished for yellowtail flounder by Canadian (Nfld) stern trawlers in Div. 3LNO, 1976-78.

Year	Month	Catch	Days fished (f)	Catch per day (c/f)	Standard error (c/f)	Coefficient of variation
1976	1	110056	17	6473	3638	0.562
	2	62449	12	5704	1830	0.321
	3	448248	73	6140	3610	0.538
	4	1786241	290	6159	1756	0.285
	5	1653397	349	4738	2286	0.482
	6	91965	18	5109	2535	0.496
	7	33162	12	2764	1196	0.433
	8	36251	8	4531	2762	0.610
	9	64164	15	4277	1466	0.343
	10	98720	25	3949	***	-
	11	32135	10	3214	2218	0.690
	12	27354	4	6838	1321	0.193
1977	1	-	-	-	-	-
	2	20540	2	10270	-	-
	3	20613	3	6871	***	-
	4	58817	9	6536	2216	0.339
	5	789334	135	5847	***	-
	6	544590	102	5339	***	-
	7	695510	107	6500	***	-
	8	607208	104	5838	2421	0.414
	9	147226	28	5258	1937	0.365
	10	40349	9	4483	***	-
	11	1110295	127	8743	***	-
	12	304590	37	8232	1194	0.145

Table 1. (Continued)

Year	Month	Catch	Days fished (f)	Catch per day (c/f)	Standard error (c/f)	Coefficient of variation
1978	1	64351	7	9193	***	-
	2	26934	6	4489	2891	0.644
	3	75972	10	7597	2879	0.377
	4	521003	81	6432	***	-
	5	622459	88	7073	***	-
	6	449212	87	5163	1383	0.268
	7	241948	36	6721	520	0.077
	8	433756	61	7111	***	-
	9	751934	90	8355	***	-
	10	2315655	202	11464	***	-
	11	1864515	220	8475	***	-
	12	412358	53	7780	3915	0.503

Table 2. Variation in catch per day fished for American plaice by Canadian (NFLD) stern trawlers in Div. 3LNO, 1976-78.

Year	Month	Catch	Days fished (f)	Catch per day (c/f)	Standard error (c/f)	Coefficient of variation
1976	1	3173862	474	6696	2927	0.437
	2	2304302	358	6437	2438	0.379
	3	1468651	223	6586	4158	0.631
	4	988469	144	6864	3962	0.577
	5	2239267	442	5066	2359	0.466
	6	4301261	692	6216	2876	0.463
	7	4346847	685	6346	2659	0.419
	8	4479693	645	6945	3071	0.442
	9	5987151	818	7319	3973	0.543
	10	3888018	607	6405	3743	0.584
	11	3256646	600	5428	2405	0.443
	12	1878124	303	6198	2439	0.394
1977	1	-	-	-	-	-
	2	1583169	240	6597	2879	0.436
	3	347521	83	4187	1693	0.404
	4	326753	67	4877	2486	0.510
	5	2099067	325	6459	2884	0.447
	6	4411884	624	7070	2275	0.322
	7	3915143	594	6591	2098	0.318
	8	4243493	655	6479	2013	0.311
	9	3543436	580	6109	2419	0.396
	10	3660567	721	5077	1906	0.375
	11	3800535	583	6519	2845	0.436
	12	2782674	416	6689	2290	0.342
1978	1	1125598	183	6151	2377	0.387
	2	784302	127	6176	3625	0.581
	3	654653	102	6418	2149	0.335
	4	734985	171	4298	2344	0.545
	5	2613159	420	6222	1874	0.301
	6	5151022	745	6914	2445	0.354
	7	5090181	664	7666	3095	0.404
	8	5584416	667	8372	3568	0.426
	9	3829811	485	7897	3863	0.489
	10	4204110	507	8292	2837	0.342
	11	2666119	374	7129	2796	0.392
	12	3404557	364	9353	5606	0.599

Table 3. Coefficients of variation of catch rates (tons/hr) for groups of vessels considered homogeneous in Div. 3M. Values labelled (a) represent the years 1960, 1961 and 1963; (b) the years 1962, 1966-69, 1971 and 1974; and (c) the years 1964-65, 1970, 1972-73 and 1975-76. The numbers of observations are given in parentheses.

Country-gear		Jan, Apr-Dec	Feb, Mar
FRG	OT 7	(a) 0.413 (15)	
POL	OT 7	(b) 0.582 (94)	(b) 0.662 (21)
POR	OT 6	(c) 0.629(118)	(c) 0.854 (28)
USSR	OT 7		
SPA	PT 4		
CAN-N	OT 4		
ICE	OT 5		
NOR	LL 4		
NOR	OT 4	(b) 0.652 (42)	
SPA	PT 5	(c) 0.643 (86)	(c) 1.057 (15)
SPA	OT 6		
USSR	OT 5		
USSR	OT 6		
CAN-N	OT 5		
UK	OT 5	(c) 0.532 (21)	
UK	OT 6		

Tonnage classes: 7 = 2000+; 6 = 1000-1999; 5 = 500-999; 4 = 150-499.

Table 4. Coefficients of variation of catch rates (tons/hr) for groups of vessels considered homogeneous in Div. 2GH during 1958-76, excluding 1972 and 1973. The numbers of observations are given in parentheses.

Country	Gear	Jan, Mar Apr-May	Sep, Dec	Jun-Aug Oct-Nov
POR	OT 7	0.415 (22)		
NON-MEM	OT 7			
FRG	OT 7			
ICE	OT 5			
POL	OT 7	0.621 (82)	0.805 (20)	0.573 (33)
POR	OT 6			
SPA	OT 6			
USSR	OT 7			
FRG	OT 6			
NOR	OT 4			
NOR	OT 6	0.605 (27)		0.911 (14)
USSR	OT 6			
NON-MEM	OT 6			

Tonnage classes: 7 = 2000+; 6 = 1000-1999; 5 = 500-999; 4 = 150-499

Table 5. Coefficients of variation of catch rates (tons/hr) for groups of vessels considered homogeneous in Div. 3NO, and values for some individual country-gears. Values labelled (a) represent the year 1967; (b) the years 1963-64, 1966, 1968, 1970-72, 1974-76; and (c) the years 1959-62, 1965, 1969, 1973. The numbers of observations are given in parentheses

Country-gear		Jan-Mar, Jun-Jul Nov-Dec	Apr-May Sep-Oct
CAN-M	OT 4		
POR	OT 7	(a) 0.767 (39)	(a) 0.356 (19)
SPA	PT 4	(b) 0.664 (236)	(b) 0.741 (118)
SPA	PT 5	(c) 0.821 (135)	(c) 0.473 (69)
SPA	PT 6		
BUL	OT 7		
CAN-M	OT 5		
CAN-N	OT 3		
CAN-N	OT 4		
CAN-N	OT 5	(a) 0.435 (21)	(a) 0.552 (18)
FRA-M	OT 6	(b) 0.765 (103)	(b) 0.629 (53)
ICE	OT 5	(c) 0.635 (54)	(c) 0.494 (36)
NOR	LL 5		
ROM	OT 7		
UK	OT 5		
UK	OT 6		
USSR	OT 5		
USSR	OT 5		
SPA	OT 6	(b) 0.973 (50)	(b) 0.765 (27)
		(c) 0.884 (43)	(c) 0.653 (220
SPA	PT 4	(a) 0.788 (16)	
		(b) 0.650 (141)	(b) 0.556 (78)
		(c) 0.591 (83)	(c) 0.416 (44)
POR	OT 6	(b) 0.506 (22)	
		(c) 0.680 (18)	
USSR	OT 7	(a) 0.557 (14)	

Tonnage classes: 7 = 2000+; 6 = 1000-1999; 5 = 500-999; 4 = 150-499; 3 = 50-149.

APPENDIX VI. REPORT OF JOINT MEETING OF STACRES AND STACTIC ON SCIENTIFIC OBSERVER SCHEME[1]

1. Opening. The meeting was called to order on 1 June 1979 at 1530 hrs by the Executive Secretary. The participants unanimously agreed that Dr R. G. Halliday (Canada) act as Chairman.

2. Rapporteur. The Assistant Executive Secretary was appointed Rapporteur.

3. Agenda. The Chairman indicated that the bases for discussion are as follows:

   a) The March 1979 recommendation to the Commission by STACTIC "that STACRES consider such further steps which might be desirable to implement the scientific observer scheme as adopted in 1975, and that the STACRES report on this subject be further discussed in a joint meeting of STACRES and STACTIC at the time of the 1979 Annual Meeting" (*ICNAF Meet. Proc.* 1979, Part I).

   b) The comments of STACRES, as contained in its report to this Annual Meeting (see page 59, this volume).

   c) The Canadian proposal for an International Scientific Observer Scheme (Com. Doc. 79/VI/24).

4. STACRES Views on International Observer Program

   The Chairman summarized the discussions in STACRES on this matter, indicating that STACRES continues to hold the view that implementation of a scientific observer program would significantly improve scientific knowledge on the effects of fishing on the resources, and that, although the data collected would be utilized to formulate new or revised management measures, the scientific observer progam cannot be used as the basis for enforcement actions without prejudicing its effectiveness. This view is consistent with that expressed to the Commission at the June 1975 Annual Meeting. It was pointed out that STACRES has already set up a working group to consider the most appropriate standardized methods of data collection, reporting and processing.

5. Consideration of Canadian Proposal Regarding Implementation of the Observer Program

   The Canadian proposal (Com. Doc. 79/VI/24) was examined in detail with comments solicited paragraph by paragraph. While recognizing the problems associated with stock assessments based on inadequate data for fisheries outside the 200-mile zone in Subarea 3, it was the opinion of some participants that the problems of implementing a multi-lateral observer scheme were similar to those encountered during the development and implementation of the Scheme of Joint International Enforcement. It was pointed out that, if the observer scheme is to operate in a manner other than on a voluntary basis, an amendment to the Convention would be necessary.

   Recognizing that the legal question of implementing a multi-lateral observer scheme does not allow a decision at this time and that any future decision should preferably be made by NAFO, it was decided to concentrate on the practical aspects of the proposed scheme. The need for precise descriptions of the types of information to be collected, including the authority and duties of the observer, was emphasized. Also the need for coordinating the logistics of such a program was stressed, involving bilateral arrangements for the scheduling of operations so as to make the most efficient use of the available observers. There was some question as to the amount of detail that would be required about the fishing operations, it being pointed out that the present Canadian Observer Scheme within the 200-mile zone required a much more detailed description of the gear than would be necessary for scientific use in assessments. It was noted that the simplest way of implementing the scheme would be on a bilateral basis and that this could be done without reference to STACTIC or the Commission, as is being done now within the 200-mile fisheries zones. However, it was argued that implementation of the scheme on a voluntary basis would be less effective than through a multi-lateral agreement.

   In conclusion, the Joint Meeting agreed that the legal aspects of implementing an international scientific observer scheme should be considered by the General Council of NAFO, and that the practical aspects relating to standards of data collection should be considered by the Scientific Council of NAFO. The Canadian representative agreed to prepare a revised proposal for consideration by the appropriate bodies of NAFO.

6. Adjournment. The meeting adjourned at 1730 hours, 1 June.

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[1] ICNAF Meeting Proceedings No. 6, Serial No. 5518

PART D

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I. AGENDA FOR STACRES MEETINGS, 1978/79

A. SPECIAL MEETING ON SEALS AND SHRIMP, NOVEMBER 1978

1. Opening (Acting Chairman: G. H. Winters)

   a) Appointment of rapporteur
   b) Adoption of agenda
   c) Assignment of work to *ad hoc* working groups

2. *Ad hoc* Working Group on Seals (Convener: A. W. Mansfield)

   a) Conservation of harp seals
      i) Research in 1978
      ii) Population assessment
         - Stock size
         - Pup production
         - Sustainable yield under present regime and under varying options of age composition of catch
         - Trends in stock size with different TACs
      iii) Future research requirements
   b) Conservation of hooded seals
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   a) Review of fishery trends
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4. *Ad hoc* Working Group on Standardization of Reporting Procedures for Sampling Data (Convener: W. G. Doubleday)

   a) Review of present situation and requirements of coastal states
   b) Evaluation of need for standard reporting procedures
   c) Implications on Secretariat and on member countries of reporting individual samples
   d) Design of forms and procedures

5. Other business

6. Future meetings of STACRES

7. Adjournment

B. SPECIAL MEETING ON CAPELIN AND SQUID, FEBRUARY 1979

1. Opening (Chairman: G. H. Winters, Acting)

   a) Appointment of rapporteur
   b) Adoption of agenda
   c) Assignment of work to *ad hoc* working groups

2. *Ad hoc* Working Group on Capelin in Subareas 2 and 3 (Convener: G. H. Winters)

   a) Migrations and stock interrelationships

b) Trends in abundance
   i) Commercial catch-effort analyses
   ii) Research vessel surveys indices, including acoustic data
   iii) Numerical population models
   iv) Other estimates (e.g. tagging)
c) Biological characteristics
   i) Annual variation in growth
   ii) Annual variation in maturity and spawning
   iii) Stock-recruitment considerations
   iv) Environmental effects on biological characteristics
   v) Importance as a major prey species in the Grand Bank area
d) Recruitment estimation and prognosis for 1979
e) Future Research
f) Other matters

3. *Ad hoc* Working Group on Squid in Subareas 3 and 4 (Convener: F. Nagasaki)

   a) Patterns of distribution and migration
   b) Biological characteristics (growth, maturity, fecundity, spawning, predator-prey relations, etc.)
   c) Trends in abundance (commercial catch rates, research vessel surveys)
   d) Description of the 1978 fishery (grounds, season, depth, gear, mesh size, etc.)
   e) Estimation of removals by the fishery (sex and size composition)
   f) Estimation of fishing effort by country, vessel class and gear type
   g) Estimation of exploitation rate in 1978
   h) Mesh selectivity and optimum mesh size for squid
   i) Mixed fishery and by-catch problems
   j) Advice on conservation measures, including interactions with other fisheries
   k) Other matters

4. Consideration of standard form for reporting age-length keys

5. Other business

6. Adjournment

C. ANNUAL MEETING MAY-JUNE 1979

1. Opening (Chairman: R. G. Halliday)

   a) Appointment of rapporteur
   b) Adoption of agenda
   c) Plan of work

2. Assessments (Chairman: G. H. Winters)

   a) Review of catch statistics and fishing activity in 1978
   b) Stock assessments
      i) Stocks lying completely outside the Canadian 200-mile fisheries zone and not overlapping the zone of any other state:
         - Cod (3M)
         - Redfish (3M)
         - American plaice (3M)
      ii) Stocks lying within or partly within the Canadian 200-mile fisheries zone for which Canada requests scientific advice for management (Com. Doc. 79/II/6):
         - Cod (2GH, 2J+3KL, 3NO)
         - Redfish (3LN)
         - Silver hake (4VWX)
         - American plaice (3LNO)
         - Witch flounder (2J+3KL, 3NO)
         - Yellowtail flounder (3LNO)
         - Greenland halibut (2+3KL)
         - Roundnose grenadier (2+3)
         - Argentine (4VWX)
      iii) Stocks in the northern part of the ICNAF area, as suggested by Canada (Com. Doc. 79/VI/6) and agreed to by the EEC (Com. Doc. 79/VI/16):
         - Greenland halibut (0+1)
         - Roundnose grenadier (0+1)
         - Shrimp (0+1)

iv) Stocks lying within the EEC fisheries zone in the northern part of the ICNAF area (Com. Doc. 79/VI/16):
- Redfish (1)
- Cod (1)

c) Other matters
i) Consideration of proposal for changing the mesh regulation for redfish in Div. 3M (*ICNAF Redbook* 1978, pages 45-46)
ii) Consideration of uniform mesh size for silver hake and squid fisheries in Subarea 4 (Part B, this volume, page 31)
iii) Consideration of commencement data for squid fishery (Part B, this volume, page 31)
iv) Review of proposed sampling forms
v) Timing of future meetings for stock assessments

3. Biological Surveys (Chairman: W. G. Doubleday)

a) Review of survey activity in 1978 and proposed activity in 1979
b) Progress in preparing the manual on groundfish surveys
c) Review of stratification schemes and consideration of a standard numbering system for strata
d) Progress in preparing a set of species codes for international exchange of survey data
e) Processing of survey data
f) Progress in improving survey methods
g) Review of any relevant research documents
h) Other matters

4. Joint Session of Assessments and Biological Surveys Subcommittees (Convener: W. G. Doubleday)

a) Evaluation of accuracy of commercial fishery indices of abundance (*ICNAF Redbook* 1978, page 39)

5. Statistics and Sampling (Chairman: J. Messtorff)

a) Review of CWP activities relevant to ICNAF matters
i) Development of 3-alpha species identifiers for the North Atlantic (*ICNAF Redbook* 1978, page 86)
ii) Scheduling of 10th session of CWP
iii) Other relevant matters
b) Review of ICNAF statistical activities
i) Statistical Bulletin, Vol. 27 for 1977
ii) Advance statistics for assessments
iii) Adequacy of national data reporting (*ICNAF Redbook* 1978, page 87)
iv) Review of STATLANT forms and notes
c) Review of ICNAF sampling program
i) Sampling Yearbook, Vol. 22 for 1977 (Sum. Doc. 79/VI/12)
ii) Adequacy of national reporting of sampling data for 1977 (Sum. Doc. 79/VI/14) and 1978
iii) Review of sampling standards (Sum. Doc. 79/VI/22)
iv) Review of new requirements for sampling data (Sum. Doc. 79/VI/23)
v) Implementation of sampling data base
d) List of Fishing Vessels for 1977 (Sum. Doc. 79/VI/13)
e) Scientific observer program (progress report and disposition of data)
f) Review of relevant research documents
g) Other matters
i) Reports on national statistical systems (*ICNAF Redbook* 1978, page 87)
ii) Standard method for measuring roundnose grenadier

6. Environmental Studies (Chairman: E. J. Sandeman)

a) Report of *ad hoc* Working Group on Flemish Cap Project
b) Report of progress on Gulf of Maine-Georges Bank Project on Herring
c) Review of environmental conditions during 1978
d) Marine Environmental Data Service (MEDS)
i) Progress report for 1978/79
ii) Data products presently produced and envisaged
iii) National representatives for data exchange
iv) Annual inventory of oceanographic stations

7. Ageing Techniques and Validation Studies

   a) Report of progress on silver hake otolith exchange program
   b) Guidelines for ageing of silver hake from otoliths (Res. Doc. 79/VI/42)
   c) Guidelines for cod otolith interpretation (R. Wells)
   d) Progress on redfish scale and otolith exchange program (St. John's Laboratory)
   e) Progress in ageing squid from statolith
   f) Need for further workshops and/or otolith exchange programs
   g) Review of relevant papers on ageing and validation studies
   h) Other matters

8. Gear and Selectivity Studies

   a) Selection studies on silver hake
   b) Selection studies on squid (*Illex*)
   c) Selection studies on Greenland halibut
   d) Other gear and selectivity studies

9. Review of Tagging Activities

   a) Report on tagging activities in 1978 (Sum. Doc. 79/VI/21)
   b) Other studies

10. Collaboration with Other Organizations

   a) Status of publication of results of 1972 Greenland Salmon Tagging Experiment by ICES
   b) Report on ICES/ICNAF Symposium on the Biological Basis of Pelagic Fish Stock Management, Aberdeen, Scotland, 3-7 July 1978
   c) Second International Symposium on Early Life History of Fish, Woods Hole, USA, 3-6 April 1979
   d) Tenth Session of CWP, to be held at Madrid, Spain in August 1980

11. Steering and Publications

   a) Review of STACRES meeting timetable and agenda
   b) Organization and operation of STACRES and its subcommittees
   c) Collaboration with Scientific Council of NAFO
   d) Review of ICNAF Publications
   e) Review of editorial policy relating to Research Bulletin and Selected Papers series
   f) Review of research documents for *Selected Papers* No. 6
   g) Indexing of ICNAF publications and documents (Sum. Doc. 79/VI/3 and 10)
   h) Other matters

12. Future Scientific Meetings

13. Election of Officers

14. Other Matters

15. Adjournment

II. LIST OF STACRES RECOMMENDATIONS, 1978/79

III. LIST OF RESEARCH DOCUMENTS - 1978 (CONTINUED)[1]

RESEARCH DOCUMENTS

Doc.	Serial	
78/XI/84	5299	LETT, P. F., R. K. MOHN, and D. F. GRAY. Density-dependent processes and management strategy for the northwestern Atlantic harp seal. (50 pages)
78/XI/85	5301	SERGEANT, D. E. Research on harp seals in 1978. (11 pages)
78/XI/86	5302	SERGEANT, D. E. Results of tagging and branding of hooded seals, 1972-1978. (4 pages)
78/XI/87	5303	JONES, B. C., and D. G. PARSONS. Assessment of pink shrimp (*Pandalus borealis*) fishery potential in Davis Strait and northeastern Canadian waters. (15 pages)
78/XI/88	5304	VEITCH, P. J., D. G. PARSONS, and A. DUTHIE. An exploratory survey for shrimp (*Pandalus borealis*) in Statistical Areas 0A and 0B. (9 pages)
78/XI/89	5305	KANNEWORFF, P. Density of shrimp (*Pandalus borealis*) in 1978 in ICNAF Subarea 1 based on bottom photography. (6 pages)
78/XI/90	5306	LAVIGNE, D. M., J. P. BOGART, R. G. H. DOWNER, R. DANZMAN, W. W. BARCHARD, and M. EARLE. Genetic variability in Northwest Atlantic harp seals, *Pagophilus groenlandicus*. (41 pages)
78/XI/91 (Rev.)	5307	WINTERS, G. H., and B. BERGFLØDT. Mortality and productivity of the Newfoundland hooded seal stock. (6 pages)
78/XI/92	5308	ØRITSLAND, T. Norwegian report on seal research in 1977 and 1978. (4 pages)
78/XI/93	5309	HORSTED, Sv. Aa., P. JOHANSEN, and E. SMIDT. On the possible drift of shrimp larvae in Davis Strait. (13 pages) + Corrigendum (1 page)
78/XI/94	5310	ULLTANG, Ø., and P. ØYNES. Norwegian investigations on the deep sea shrimp, *Pandalus borealis*, in West Greenland waters, 1977 and 1978. (18 pages)
78/XI/95	5311	FONTAINE, B. Data relative to the French fishery for the northern shrimp (*Pandalus borealis*) at West Greenland in 1978. (14 pages)
78/XI/96	5312	HORSTED, Sv. Aa. On the distribution of the shrimp grounds off West Greenland in relation to the local fisheries zone. (11 pages)
78/XI/97	5313	HOYDAL, K. Catch-per-unit-effort estimates from the Faroese prawn fishery off West Greenland, 1974-78. (2 pages)
78/XI/98	5314	KAPEL, F. O. Present catches of harp and hooded seals in West Greenland, and a note on the level of catches in previous periods. (6 pages)

[1] These 1978 documents were issued after *Redbook* 1978 was published.

IV. LIST OF SUMMARY AND RESEARCH DOCUMENTS - 1979

SUMMARY DOCUMENTS

Doc.	Serial	
79/VI/1	5317	ICNAF. Report of Standing Committee on Research and Statistics (STACRES), Special Meeting on Seals and Shrimp, November 1978. (25 pages)
79/VI/2	5320	ICNAF. Report of the 4th Meeting of the ICES/ICNAF/IOC Coordinating Group for the North Atlantic with representatives of international marine research projects in the North Atlantic, Charlottenlund, Denmark, 30 September 1978. (11 pages)
79/VI/3	5329	ICNAF Secretariat. Provisional index and list of titles for ICNAF publications and meeting documents, 1977. (30 pages)
79/VI/4	5330	ICNAF Secretariat. Extracts from Resolutions passed at the 1978 ICES Meeting relevant to the research and statistical activities of ICNAF. (1 page)
79/VI/5	5366	ICNAF. Report of Standing Committee on Research and Statistics (STACRES), Special Meeting on Capelin and Squid, February 1979. (24 pages)
79/VI/6	5367	NEAFC. North-East Atlantic Fisheries Commission, Sixteenth Annual Meeting, 20-22 June 1978 - Press notice. (2 pages)
79/VI/7	5368	NEAFC. North-East Atlantic Fisheries Commission, Seventeenth Annual Meeting, 21-22 November 1978 - Press notice. (1 page)
79/VI/8	5442	ICNAF. Proceedings of the Tenth Special Commission Meeting, Montreal, Canada, 7-9 March 1979. (33 pages)
79/VI/9	5426	ICNAF Secretariat. Historical catches of selected species by stock area and country for the period 1968-1977. (38 pages)
79/VI/10	5424	ICNAF Secretariat. Provisional index and list of titles of ICNAF publications and meeting documents, 1978. (35 pages)
79/VI/11	5419	ICNAF. Report of Assessments Subcommittee, 28 March-9 April 1979. (32 pages) + Addendum (1 page)
79/VI/12	5422	ICNAF Secretariat. Provisional lists of sampling data for 1977. (22 pages)
79/VI/13	5423	ICNAF Secretariat. List of fishing vessels 50 GRT and over, 1977. (30 pages) + Addendum (1 page)
79/VI/14	5433	ICNAF Secretariat. Efficiency of sampling the major fisheries of the Northwest Atlantic in 1977. (13 pages)
79/VI/15	5389	SATO, T. Japanese Research Report for 1978. (7 pages)
79/VI/16	5400	PACIORKOWSKI, A. J. Polish Research Report, 1978. (12 pages) + Addendum (1 page)
79/VI/17 (Rev.)	5405	DANKE, L. German Democratic Republic Research Report, 1978. (6 pages)
79/VI/18	5421	ICNAF Secretariat. ICNAF list of species items. (6 pages)
79/VI/19	5428	SANDEMAN, E. J., and J. S. SCOTT. Canadian Research Report, 1978. + Addendum
79/VI/20	5431	MAXIM, C., I. PANAIT, and I. STAICU. Romanian Research Report, 1978. (9 pages)
79/VI/21	5435	ICNAF Secretariat. Tagging activities reported by member countries for 1978. (10 pages)
79/VI/22	5439	ICNAF Secretariat. Outline of ICNAF sampling program up to 1978. (6 pages)

Doc.	Serial	
79/VI/23	5440	ICNAF Secretariat. Standardization of new reporting procedures for sampling data. (9 pages)
79/VI/24	5443	ICNAF Secretariat. Codification of survey stratification schemes for the Northwest Atlantic. (16 pages)
79/VI/25	5465	KONSTANTINOV, K. G., and A. S. NOSKOV. Report of USSR investigations in the ICNAF area, 1978. (28 pages)
79/VI/26 (Rev.)	5464	MINET, J. P. French research report, 1978. (7 pages)
79/VI/27	5466	HORSTED, Sv. Aa. Denmark (Greenland) research report for 1978. (13 pages)
79/VI/28 (Rev.)	5484	WELLS, E. Draft Report of Meeting of Flemish Cap Working Group, 2-3 April 1979, St. John's, Nfld. (9 pages)
79/VI/29	5485	ICNAF Secretariat. National reports on collecting and processing fisheries statistics. (4 pages)
79/VI/30 (Rev.)	5487	ICNAF Secretariat. Provisional nominal catches in the Northwest Atlantic, 1978. (53 pages)
79/VI/31	5492	ICNAF Secretariat. Nominal catches (1968-77) by country and stock area, with TACs and allocations (1974-79) for species and stocks reviewed by STACRES since the 1978 Annual Meeting. (54 pages)
79/VI/32	5495	LOURDES M. GODINHO, M. Portuguese research report, 1978. (15 pages)
79/VI/33	5513	MESSTORFF, J. Federal Republic of Germany research report, 1978. (8 pages)
79/VI/34	5517	DOMINGUEZ, R., and E. VALDÉS. Cuban research report, 1978. (8 pages)

RESEARCH DOCUMENTS

Doc.	Serial	
79/II/1	5324	ULLTANG, Ø., and G. SANGOLT. Norwegian capelin fishery and capelin investigations in Newfoundland waters in 1978. (4 pages)
79/II/2 (Rev.)	5325	CLAY, D. Current mesh selection studies on the Scotian Shelf in relation to historical selectivity data. (11 pages)
79/II/3	5326	CLAY, D. Mesh selection of silver hake (*Merluccius bilinearis*) in otter trawls on the Scotian Shelf with reference to selection of squid (*Illex illecebrosus*). (36 pages)
79/II/4	5327	TIBBETTS-LANGE, A. M., and K. L. JOHNSON. Dorsal mantle length-total weight relationships of squids (*Loligo pealei* and *Illex illecebrosus*) from the Northwest Atlantic, off the coast of the United States. (37 pages)
79/II/5	5328	DUPOUY, H. Distribution and biological characteristics of the short-finned squid, *Illex illecebrosus*, off southern Newfoundland (ICNAF Subdiv. 3Ps) in the autumn of 1978. (7 pages)
79/II/6 (Rev.)	5331	LETACONNOUX, R. Squid (*Illex*) catches by the French fleet in 1978. (4 pages)
79/II/7 (Rev.)	5332	MARI, A. An acoustic estimate of capelin biomass in ICNAF Divisions 3NO. (12 pages)
79/II/8	5333	MARI, A., E. VALDÉS, and R. DOMINGUEZ. Abundance estimates and fishing mortality rates of squid (*Illex illecebrosus*) in Subareas 3 and 4. (8 pages)
79/II/9	5334	GOMEZ, J. A. Temperatures and salinities on the Southeast Shoal of the Grand Bank in July 1978. (3 pages)

Doc.	Serial	
79/II/10	5335	VALDÉS, E., A. MARI, and R. DOMINGUEZ. Biomass estimates of capelin in Divisions 2J and 3K, 1978. (5 pages)
79/II/11	5336	AMARATUNGA, T., J. D. NEILSON, D. J. GILLIS, and L. G. VALDRON. Food and feeding of the short-finned squid, *Illex illecebrosus*, on the Scotian Shelf in 1978. (24 pages)
79/II/12	5337	O'DOR, R. K., R. D. DURWOOD, R. W. M. HIRTLE, and T. AMARATUNGA. Tagging trials on captive squid (*Illex illecebrosus*). (10 pages)
79/II/13	5338	DURWARD, R. D., E. VESSEY, R. K. O'DOR, and T. AMARATUNGA. Aspects of maturation, mating, spawning, and larval development of *Illex illecebrosus* relevant to field studies. (14 pages)
79/II/14	5339	DUFOUR, R. Update of the distribution, biomass estimates and length frequency of *Illex illecebrosus* from Canadian research cruises, 1970–78. (7 pages)
79/II/15	5341	CLAY, D. A preliminary review of silver hake (*Merluccius bilinearis*) stock distribution and differentiation on the Scotian Shelf. (15 pages)
79/II/16	5342	O'DOR, R. K., R. D. DURWOOD, E. VESSEY, and T. AMARATUNGA. Feeding and growth rates in captive squid (*Illex illecebrosus*) and the influence of food availability on growth in the natural population. (16 pages)
79/II/17	5343	WALDRON, D. E. Preliminary results of a joint international observer program to evaluate the silver hake small-mesh gear line in ICNAF Divisions 4VWX. (38 pages)
79/II/18 (Rev.)	5344	WALDRON, D. E. Catch and effort statistics for the 1978 international squid (*Illex illecebrosus*) fishery in Subarea 4. (10 pages)
79/II/19 (Rev.)	5345	WALDRON, D. E. Assessment of the 1978 Div. 4VWX squid (*Illex illecebrosus*) fishery. (11 pages)
79/II/20	5346	NAGAI, T., and S. KAWAHARA. Estimation of the *Illex* biomass on the edge along the Scotian Shelf, 1978. (8 pages)
79/II/21	5347	KAWAHARA, S. Optimum rate of exploitation and virtual population analysis for short-finned squid, *Illex illecebrosus*, in Subareas 3 and 4. (10 pages)
79/II/22	5348	SATO, T. Outline of Japanese squid fishery in Subareas 3 and 4, 1978. (24 pages)
79/II/23	5349	HATANAKA, H. Outline of Japanese capelin fishery in Subareas 2 and 3, 1975–78. (8 pages)
79/II/24	5350	HURLEY, G. V., and R. K. MOHN. Considerations on the management of the international squid (*Illex*) fishery in ICNAF Subarea 4. (11 pages)
79/II/25 (Rev.)	5351	HURLEY, G. V., and P. BECK. Assessment of the short-finned squid (*Illex illecebrosus*) in ICNAF Subarea 3 for 1978. (19 pages)
79/II/26	5352	HURLEY, G. V., P. BECK, J. DREW, and R. L. RADTKE. A preliminary report on validating age readings from statoliths of the short-finned squid (*Illex illecebrosus*). (6 pages)
79/II/27	5353	HURLEY, G. V., P. BECK, and J. DREW. Breakdown of squid catches in ICNAF Subarea 3, 1978, with length and sex composition from offshore and Newfoundland inshore samples. (13 pages)
79/II/28 (Rev.)	5354	FROERMAN, Y. M. Biomass estimates of the short-finned squid, *Illex illecebrosus*, in ICNAF Division 4W, 1978. (9 pages)
79/II/29	5355	CARSCADDEN, J. E., and R. K. MISRA. Multivariate analysis of meristic characters of capelin (*Mallotus villosus*) in the Northwest Atlantic. (11 pages)

Doc.	Serial	
79/II/30	5336	SELIVERSTOV, A. S., and L. I. SEREBROV. Status of capelin stocks in Divisions 2J and 3K in 1978. (12 pages)
79/II/31 (Rev.)	5357	ERMOLCHEV, V. A., S. M. KOVALEV, and A. S. SELIVERSTOV. Methods and results of echometric surveys on the assessment of the Grand Newfoundland Bank capelin abundance in spring-summer 1978. (11 pages)
79/II/32 (Rev.)	5358	MILLER, D. S., and J. E. CARSCADDEN. Biological characteristics and biomass estimates of capelin in ICNAF Div. 2J+3K using a sequential capelin abundance model. (15 pages)
79/II/33 (Rev.)	5359	CARSCADDEN, J. E., and D. S. MILLER. Biological aspects of capelin and a sequential capelin abundance model for the Divisions 3LNO stock. (20 pages)
79/II/34	5360	MILLER, D. S., and J. E. CARSCADDEN. An acoustic estimate of capelin biomass on ICNAF Divisions 2J and 3K, October 1978. (8 pages) + Corrigendum. (1 page)
79/II/35 (Rev.)	5361	AMARATUNGA, T., S. KAWAHARA, and H. KONO. Mesh selection of the short-finned squid, *Illex illecebrosus*, on the Scotian Shelf using a bottom trawl: a joint Canada-Japan 1978 research program. (29 pages)
79/II/36	5362	AMARATUNGA, T., and I. H. McQUINN. Abundance estimation of *Illex illecebrosus* during a joint Canada-Japan selectivity research program on the Scotian Shelf in 1978. (18 pages)
79/II/37	5363	LIPINSKI, M. Assessment of *Illex illecebrosus* (LeSueur, 1821) stocks in ICNAF Div. 4W, determined by area-density method. (12 pages)
79/II/38	5364	LIPINSKI, M. Universal maturity scale for the commercially-important squids (Cephalopoda: Teuthoidea): the results of maturity classification of the *Illex illecebrosus* (LeSueur, 1821) populations for the years 1973-1977. (40 pages)
79/VI/39	5369	KONSTANTINOV, K. G. On distribution and spawning of witch flounder in the Newfoundland area. (8 pages)
79/VI/40	5370	WARING, G. T., M. P. SISSENWINE, and H. DORNHEIM. The spring 1978 age composition of herring stocks off the northeastern USA. (19 pages)
79/VI/41	5377	GIEDZ, M. The sex ratio of the herring spawning population in the Georges Bank area. (11 pages)
79/VI/42	5378	HUNT, J. J. Age and growth studies of silver hake (*Merluccius bilinearis*) in the Northwest Atlantic. (30 pages)
79/VI/43	5382	STEVENSON, S. C. Results of redfish mesh selection experiment on Flemish Cap, August 1978. (7 pages)
79/VI/44	5383	BOWERING, W. R. Distribution and abundance of witch flounder (*Glyptocephalus cynoglossus*) in Subarea 2 and Divisions 3KLNO, in relation to the fishery. (8 pages)
79/VI/45	5384	GAVARIS, S. Update of the cod stock assessment for Divisions 3NO. (5 pages)
79/VI/46	5385	GAVARIS, S. Update of the Flemish Cap cod stock assessment. (6 pages)
79/VI/47 (Rev. 2)	5386	GAVARIS, S. Assessment of the cod stock in Divisions 2GH. (5 pages)
79/VI/48 (Rev.)	5387	CLAY, D. Silver hake (*Merluccius bilinearis*) in Divisions 4VWX: a stock assessment and an estimate of the total allowable catch for 1980. (10 pages)
79/VI/49	5388	SWAN, B. K., and D. CLAY. Feeding study on silver hake (*Merluccius bilinearis*) taken from the Scotian Shelf and ICNAF Subarea 5. (14 pages)

Doc.	Serial	
79/VI/50	5390	ISAKOV, V. I. Assessment of mackerel stock and possible catch in the Northwest Atlantic in 1978-80. (6 pages)
79/VI/51	5391	CHEKHOVA, V. A., and K. G. KONSTANTINOV. A contribution on the beaked redfish commercial fishery at Flemish Cap Bank. (11 pages)
79/VI/52	5392	BOROVKOV, V. A., and B. P. KUDLO. Preliminary results of oceanographic observations undertaken by PINRO according to the program of international research on the Flemish Cap Bank in 1977-78. (20 pages)
79/VI/53	5393	IVANOVA, R. V. Summarized data on trawl selectivity for the redfish fishery in the Northwest Atlantic areas. (10 pages)
79/VI/54 (Rev.)	5394	JENSEN, J. M. Redfish at West Greenland, Subarea 1. (22 pages)
79/VI/55	5395	RIKHTER, V. A. An estimate of total allowable catch of red hake on Georges Bank (Subdivision 5Ze) for 1980. (4 pages)
79/VI/56	5396	SIGAEV, I. K. Inter-year seasonal variation in heat content of Northwest Atlantic Shelf waters and their correlation with temperature indices by region. (16 pages)
79/VI/57	5397	ATKINSON, D. B. Roundnose grenadier stocks in ICNAF Subareas 0+1 and 2+3. (9 pages)
79/VI/58	5398	SIGAEV, I. K. Seasonal distribution of water temperature, 1962-76, along standard AtlantNIRO transects on the Northwest Atlantic Shelf from the Laurentian Channel to Hudson Canyon. (18 pages)
79/VI/59 (Rev.)	5399	HORSTED, Sv. Aa. Subarea 1 cod: data from 1977-78 and early 1979, and estimates of biomass and yield, 1979-81. (40 pages)
79/VI/60	5401	BOWERING, W. R. Recruitment prospects for Greenland halibut in Statistical Area 0. (6 pages)
79/VI/61	5402	VALDÉS, E., J. A. ROSALES, and R. DOMINGUEZ. An assessment of Divisions 3LN redfish using a production model. (9 pages)
79/VI/62	5403	GAVARIS, C. Flemish Cap redfish assessment. (10 pages)
79/VI/63 (Rev. 2)	5404	WELLS, R. Observations on the distribution abundance, growth, mortality and sex and maturity of cod from the Flemish Cap. (20 pages)
79/VI/64	5406	BOWERING, W. R. Trends in the witch flounder fishery in Divisions 2J, 3K and 3L. (10 pages)
79/VI/65 (Rev.)	5407	BOWERING, W. R. General production and cohort analyses of witch in Divisions 3NO. (10 pages)
79/VI/66	5408	MARI, A., and I. RAMOS. Fecundity of silver hake on the Scotian Shelf. (6 pages)
79/VI/67 (Rev.)	5409	BISHOP, C. A., and R. WELLS. Status of the cod stock in Divisions 3NO. (23 pages)
79/VI/68 (Rev.)	5410	BATTEN, W. N., and R. WELLS. On the consistency of ageing cod otoliths at St. John's laboratory. (8 pages)
79/VI/69 (Rev.)	5411	SCHUMACHER, A. Assessment of the redfish (*Sebastes marinus*) stock at West Greenland (ICNAF Subarea 1). (25 pages)
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