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INTERNATIONAL COMMISSION
FOR THE
NORTHWEST ATLANTIC FISHERIES



REDBOOK 1977

STANDING COMMITTEE ON RESEARCH AND STATISTICS

**PROCEEDINGS
OF**

**SPECIAL MEETING DECEMBER 1976
ANNUAL MEETING MAY-JUNE 1977**

**Dartmouth • Canada
August 1977**

PREFACE

Redbook 1977 contains the reports of the Standing Committee on Research and Statistics (STACRES) from meetings held at Tenerife, Canary Islands, Spain, in December 1976, and at Ottawa, Canada in May-June 1977. A meeting of the Assessments Subcommittee was held at ICNAF Headquarters, Dartmouth, Canada, in April 1977 and a meeting of the Environmental Working Group on Flemish Cap Research was held at Murmansk, USSR, in May 1977. Reports of these meetings are appended to the STACRES report of the 1977 Annual Meeting. Also included in this volume are the reports of meetings of Scientific Advisers to Panel 1, 2, 3 and 4, held during the course of the 1977 Annual Meeting, and to Panel A (Seals), held at Charlottenlund, Denmark, in October 1976.

The STACRES reports in Parts A and B of this volume correspond to Proceedings No. 1 of the Ninth Special Meeting of the Commission in December 1976, and to Proceedings No. 1 of the 1977 Annual Meeting respectively. Part C contains the reports of meetings of Scientific Advisers to Panels, the inclusion of which was agreed by STACRES at the 1976 Annual Meeting (*ICNAF Redbook* 1976, page 64). Part D contains the agenda for meetings of STACRES and Scientific Advisers to Panels held since the 1976 Annual Meeting, a list of STACRES recommendations from the December 1976 and May-June 1977 Meetings, lists of summary and research documents issued in the last half of 1976 after *Redbook* 1976 had been published, lists of summary and research documents presented to scientific meetings held during the first half of 1977, and a list of participants in scientific meetings of the Commission held during the year from July 1976 to June 1977.

15 July 1977

V. M. Hodder
Assistant Executive Secretary

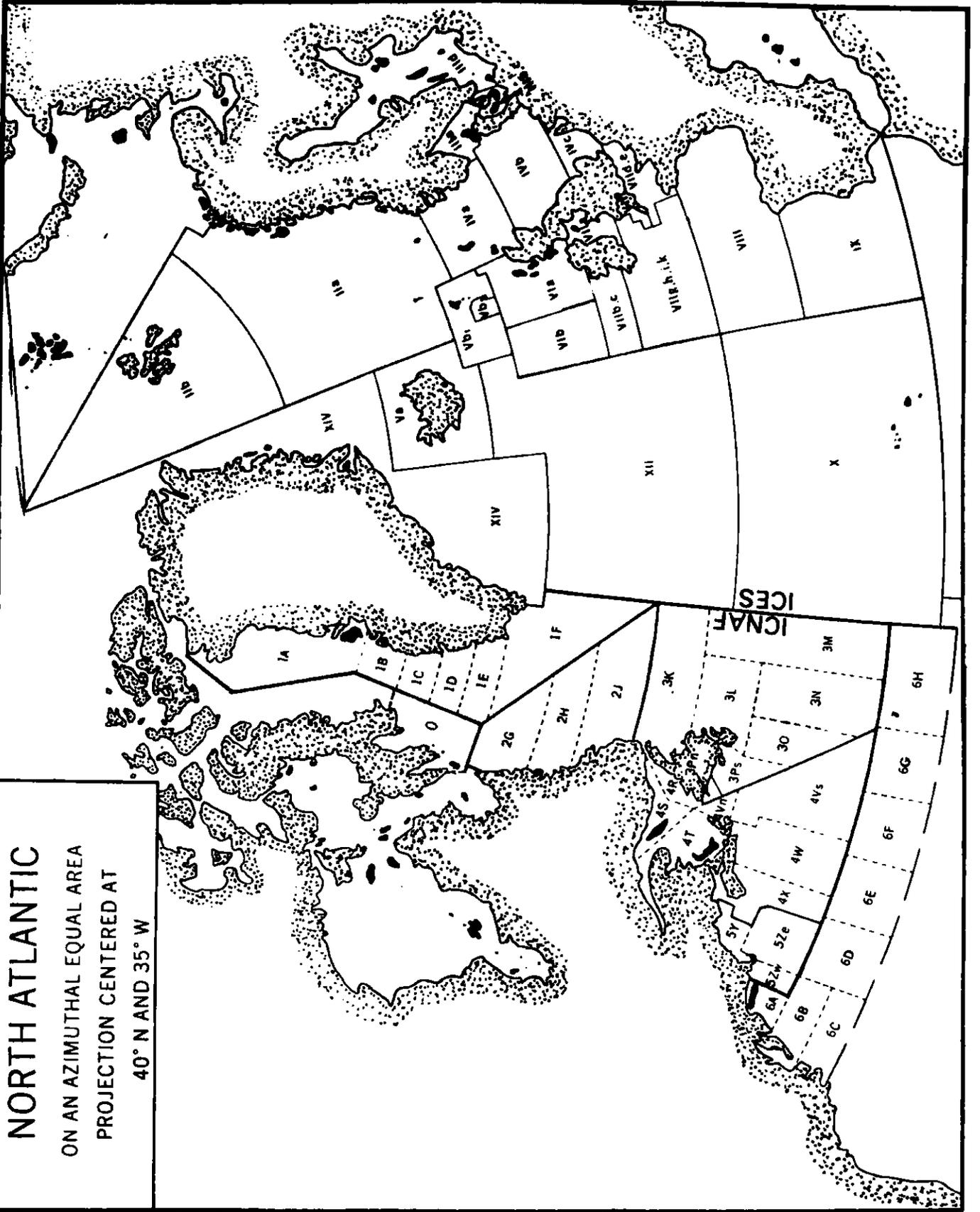
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NORTH ATLANTIC

ON AN AZIMUTHAL EQUAL AREA
PROJECTION CENTERED AT
40° N AND 35° W



PART A

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

Ninth Special Commission Meeting - December 1976

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¹ Presented to the Ninth Special Commission Meeting as Proceedings No. 1.

REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Ninth Special Commission Meeting - December 1976

Chairman: M. D. Grosslein

Rapporteur: V. M. Hodder

STACRES met at Puerto de la Cruz, Tenerife, Canary Islands, Spain, during 24 November-2 December 1976 to consider the Commission's request for a review of conservation measures for the northern deepwater prawn (*Pandalus borealis*) in Subarea 1, silver hake in Subarea 4 and mackerel in Subareas 3 to 5 and Statistical Area 6. A further meeting was held on 6 December 1976 to deal with "other business" items and to give final approval to its report. Representatives were present at one or more sessions from Bulgaria, Canada, Cuba, Denmark, Federal Republic of Germany, German Democratic Republic, Japan, Norway, Poland, Spain, Union of Soviet Socialist Republics, United Kingdom, and United States of America, and observers from FAO and ICES.

Ad hoc Working Groups on Shrimp (convened by E. C. Lopez-Veiga), Silver Hake (convened by V. C. Anthony) and Mackerel (convened by A. T. Pinhorn) were assigned the tasks of considering the above-mentioned conservation measures, and their reports, as approved by STACRES, are given in Appendices I, II and III. Brief summaries of these reports, together with other matters considered by STACRES, are given below.

1. Summary of Recent Catches and TACs

A listing of recent nominal catches and total allowable catches (TACs) by species and stock area is presented in Table 1. The preliminary 1976 nominal catches are estimated from data reported for approximately the first three-quarters of the year with projections for the remaining months of 1976. Advice on TAC levels for 1977 is given in the last column of the Table.

Table 1. Nominal catches (1972-76) and TACs (1973-76) for stocks deferred from June 1976 Annual Meeting, with TACs as recommended by STACRES for 1977 in parentheses.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)				
		1972	1973	1974	1975	1976 ¹	1973	1974	1975	1976	1977 ²
Shrimp ³	1(offshore) ⁴	2	5	12	28	41	-	-	-	-	(40)
		(10)	(13)	(22)	(38)	(48)					
Silver hake	4VWX	114	299	96	116	90+	-	100	120	100	(70)
Mackerel	3+4	22	38	45	36	30	-	55	70	56	} (105-133) ⁵
	5+6	387	381	295	251	205	450	304	285	254	

¹ Preliminary estimated nominal catches.

² TACs recommended by STACRES.

³ Northern deepwater prawn (*Pandalus borealis*).

⁴ Catches in parentheses are total catches (inshore + offshore).

⁵ TAC options were not agreed to by USSR and Bulgarian scientists who proposed 180,000 tons.

2. Shrimp in Subarea 1

Considerable new information was presented on the general biology of the northern deepwater prawn (= shrimp), including age and growth, reproduction, distribution and mortality rates. An important feature of the life history of this species is that the females are exposed to one full year of fishing mortality before they produce eggs. In addition, it is possible that natural mortality may be very high after the first spawning of females, in which case the stock-recruitment relationship may be a critical factor in the stability of this stock. However, ageing is done by length frequency analysis and the growth of mature females is thought to be slow. Therefore, the growth and mortality estimates are very uncertain, and the assessment must thus be viewed as a first approximation.

The estimated total catch for 1976 is 48,000 tons (41,000 tons from offshore fishing grounds), based on reported catches for about three-quarters of the year and projections for the remaining months. Five independent estimates were made of the size of the fishable stock (part of age-group 4 plus older ages) for the whole or for parts of the West Greenland area. Taking into account all of the factors affecting the accuracy of these estimates which were based on research and commercial trawl catches, the Working Group concluded that 100,000 tons is a reasonable minimum estimate of the off-shore fishable stock size in 1976 for the whole of the West Greenland area.

A model was used to estimate allowable removals, using assumed values of natural mortality (after first spawning), the duration of time between recruitment to the fishery and first egg production, fishing mortality, and the ratio of spawning stock to virgin spawning stock. It was concluded that the spawning stock should be maintained at a level above 50% of the virgin spawning stock size. Accordingly the recommended TAC for 1977 is 40,000 tons, including all discards. Although there was no new data on mesh selection, STACRES reiterates its recommendation of the June 1976 Annual Meeting that a minimum mesh size of 40 mm (stretched, nylon) be adopted.

Consideration was also given to possible closed areas and partitioning of the TAC by smaller areas. Knowledge of the inter-relationships between the various fishing grounds is insufficient to recommend specific measures for the whole region. However, since the area outside Disko Bay is believed to be the source of larval and adult shrimp for the Disko Bay fishery, STACRES recommends that offshore catches outside the Disko Bay area, between 68°00'N and 69°30'N latitude east of 59°W longitude, be restricted to 3,200 tons annually.

The uncertainties surrounding the population dynamics of this species make it very important to continue the intensive sampling and reporting of catches, by-catches and discards for the shrimp fisheries in Subarea 1.

3. Silver Hake in Divisions 4V, 4W and 4X

A major obstacle to the proper assessment of this stock continues to be the lack of agreement on ageing. The latest silver hake ageing workshop scheduled for October 1976 could not be held, and STACRES again

recommends (1)

that a silver hake ageing workshop be held at St. Andrews, Canada, in early March 1977 with Mr. J. J. Hunt as Convener.

STACRES requested that representatives attend from Bulgaria, Canada, Cuba, USSR, USA and other countries with silver hake fisheries, and that the participants be the persons who are directly engaged in the ageing of silver hake.

Three assessments were examined based on a range of partial recruitment and mortality rates as well as different length-at-age data. The resulting estimates of allowable catches in 1977 for $F_{0.1}$ levels were 64,000, 67,000 and 79,000 tons. However, these assessments did not allow for the effects of the 60-mm manila (55-mm synthetic) mesh restriction to be imposed in April 1977 (1976 Annu. Meet. Proc. No. 8, App I). The available data on mesh selection were considered inadequate for precise estimates of the effects of the mesh size on different age-groups. However, the direction of the effects can be predicted and some first approximations were calculated. The increased mesh size will increase the mean age of recruitment of silver hake, resulting in an increase in $F_{0.1}$ and a reduction in fishing mortality on fish less than 28 cm in length. Canadian length-at-age data suggest that, if the mesh size corresponds to a mean age of recruitment of about 24 months, the partial recruitment of age 2 fish may be 75% while age 1 fish will be effectively excluded from the catches. USSR length-at-age data suggest that the increased mesh size might result in partial recruitment factors of 0% for ages 1 and 2, 50% for age 3 and 67% for age 4 fish.

If traditional patterns of fishing mortality were to continue in 1977, the recommended TAC associated with $F_{0.1}$ would be 70,000 tons, the average of the three estimated catch levels. An estimate of the effect of the increased mesh size suggests that the catch corresponding to $F_{0.1}$ with the new pattern of fishing mortality might be as much as 12,000 tons less, and a catch of 58,000 tons would be recommended. If a catch of 70,000 tons is taken in 1977 with the increased mesh size, $F_{0.1}$ will be exceeded but the spawning stock is expected to increase slightly. Thus, a 1977 TAC of 70,000 tons appears to pose no threat to the spawning stock, and the beneficial effects of the mesh size restrictions will be visible within 2-3 years.

Data on by-catches in the USSR, Bulgarian and Cuban fisheries in Subarea 4 were reviewed but were not considered adequate to estimate the full magnitude of the by-catch problem in fishing for silver hake with bottom trawls because of area and seasonal limitations in the coverage. Several areas on the Scotian Shelf were identified and ranked in order of their potential importance for by-catch based on the distribution of various fish species in relation to the distribution of the silver hake bottom trawl fishing grounds. In particular, areas and depths were delineated where potential by-catch of haddock would occur.

4. Mackerel in Subareas 3 to 5 and Statistical Area 6

After extensive analysis of a considerable body of new data on the mackerel stock, including results from both research vessel surveys and commercial catch data, the Working Group agreed on two options

which represent a range of parameters based on the most up-to-date estimates calculated at this meeting. A summary of the results of these options is given in Table 2. There were differences in the parameters used for the two options with respect to fishing mortality at age 3+ in 1976, size of the 1975 year-class at age 1 and partial recruitment values for ages 1 and 2. There was disagreement about the reliability of the USSR age-length keys for the first quarter of 1976 from Subarea 5 and Stat. Area 6. This disagreement could not be resolved in the Working Group, but it was provisionally agreed to pool the Polish and USSR age-length keys.

Table 2. Mackerel in Subareas 3 to 5 and Statistical Area 6: projections of catch in 1977 and spawning stock size in 1977 and 1978 for the various parameters of Options 1 and 2.

Parameters		Option 1	Option 2
Fishing mortality	F ₇₆ (3+)	0.6	0.75
Partial recruitment (%)	F (age 1)	10	14
	F (age 2)	67	53
	F (age 3+)	100	100
Recruitment at age 1 (10 ⁶)	1974 year-class	2,150	2,150
	1975 year-class	1,250	750
	1976 year-class	1,500	1,500
1977 projections	Spawning stock (000 tons)	475	381
	F (age 3+)	0.35	0.35
	Catch (000 tons)	133	105
1978 projections	Spawning stock (000 tons)	485	392

Both options indicate that the fishing mortality estimates (age 3+ fish) in 1976 are higher than previously recorded in the fishery. Fishing at $F_{0.1} = 0.35$ in 1977 will result in a catch of 133,000 tons under Option 1 and 105,000 tons under Option 2. The predicted catch under either option will allow for some increase in spawning stock size from 1977 to 1978.

Calculations of the possible effects of adopting either Option 1 or Option 2, given that the underlying assumptions of the other option were in fact true, are given in Table 3. Specifically, if Option 2 were adopted but the assumptions of Option 1 were in fact true, there would be a reduction in fishing mortality in 1977 and a 6% increase in the spawning stock estimated for 1978. On the other hand, if Option 1 were adopted but the assumptions of Option 2 were true, fishing mortality would increase in 1977 above the $F_{0.1}$ level and a 16% decrease in spawning stock size would be projected for 1978.

Table 3. Possible effects of adopting either of the two options under the two sets of conditions indicated in the heading.

Option	Effect if assumptions of options are correct			Effect if assumptions of alternative option are correct					
	TAC in 1977 (tons)	F in 1977	Spawning stock in 1978 (000 tons)	Catch in 1977 (tons)	F in 1977	Catch in 1978 ¹ (tons)	Cumulative 1977 and 1978 catch (tons)	Spawning stock in 1978 (000 tons)	% change in spawning stock by weight
1	133,000	0.36	485	105,000	0.26	141,000	246,000	513	+6
2	105,000	0.35	392	133,000	0.46	87,000	220,000	328	-16

¹ Represents the catch of age 2 and older mackerel.

In addition to the above calculations, the general implications of the present level of spawning stock biomass in relation to historical trends were discussed. It was pointed out that, although the level of the present spawning stock biomass is in the same range as that which produced the moderate 1966 year-class and the large 1967 year-class, the mean age of the spawning stock at present is 3.2 years compared with a mean age of 4.5 years in 1966 and 4.2 years in 1967. Since fecundity is related to the weight of individuals, this implies a significantly reduced egg production from the present spawning biomass, although recent work in the Gulf of St. Lawrence has indicated that the number of eggs may be more related to the production (growth rate × biomass) of the stock than to the biomass. It was also pointed out that the numbers of ages 4 and 5 fish are expected to in-

crease in 1978 under both options, thus causing a slight increase in the size and mean age of the spawning biomass. The estimates of spawning stock size in 1978 are heavily dependent on the estimates of the recruiting year-classes used in the assessments. Although it was not possible to evaluate precisely the effects of the various factors on recruitment success and spawning, it was agreed that the present level and condition of the spawning biomass is reason for concern (see Appendix III, Fig. 1).

STACRES notes that, in view of the concern regarding any future reduction in the size of the spawning stock, the projected catch of 105,000 tons would clearly be the more prudent choice, since an increase in spawning stock would be more probable. Furthermore, it was noted that the estimated cumulative catch in 1977 and 1978 would be greater under Option 2 than under Option 1 if, in fact, the assumptions of the other option were true (Table 3). However, in view of the uncertainty regarding factors controlling spawning success and the fact that the spawning stock is expected to increase under both options (given that the assumptions for the adopted option are, in fact, true), STACRES was unable to make a clear choice between the two options. Therefore, with the exception of USSR and Bulgarian scientists, STACRES advises that the TAC in 1977 be in the range of 105,000-133,000 tons associated with Options 1 and 2.

The two paragraphs and the table which follow is an exact copy of the part of the Working Group Report (App. III) which presents the views of USSR and Bulgarian scientists on the mackerel assessment:

"However, in the opinion of the USSR scientists, the pooling of age-length keys for 1976 was done without sound scientific evidence because some factors which could be the reason for the differences were not taken into account. For example, the areas fished by Polish and USSR fishing fleets, and consequently the sampling areas, were considerably different. A possibility of the existence of some differences in age-reading techniques should not be completely excluded. In this particular case, the doubts can be eliminated only by the joint work of experts of these countries. The mechanical pooling of "keys" resulted in a 50% decrease in the estimated 1973 year-class abundance at age 1 in comparison with the value obtained when using separate age-length keys (Res. Doc. 76/XII/169). The mackerel stock size in 1977 to a great extent depends on 1974 and 1975 year-class abundance. The estimation of these year-classes based on US bottom trawling surveys, in the opinion of the USSR scientists, failed to be scientifically justified because its procedure does not allow reliable information to be obtained on mackerel, whose distribution is extremely unequal and to a great extent depends on environmental factors. The US bottom trawling surveys, conducted in 1969, vividly showed to what extent the results could be distorted due to the above-mentioned reasons. Thus, the estimates of year-class strength run with abundance indices of these surveys are subject to very substantial errors. The commercial data of all countries fishing for mackerel evidently indicate a high abundance of the 1974 year-class. The estimates of this year-class used in the calculations are apparently extremely under-estimated in the opinion of the USSR scientists.

"The abundance of the 1975 year-class using trawling survey data ranges from 750 to 1,250 million fish. The Soviet scientists are of the strong opinion that, until more reliable information becomes available, a more valid approach is associated with estimation of the above-mentioned year-class as a mean value of the abundance of age 1 fish in 1969-74, i.e. 2,765 million fish (Res. Doc. 76/XII/169). The estimation of F for 1976 is 0.6. This figure obtained in Res. Doc. 76/XII/169 using commercial data is slightly over-estimated. Based on scientific evidence presented in Res. Doc. 76/XII/169 (and also on the very similar evidence presented in Res. Doc. 76/XII/135)¹, the USSR scientists consider it possible to recommend a TAC at the level of 180,000 tons. This catch and the resultant stock size are presented in the following table of catch and stock size predictions (from Res. Doc. 76/XII/169)."

Mackerel in SA 3-6	1976	1977	1978
Spawning stock (000 tons)	635.9	604.1	743.0
F (age 3+)	0.60	0.35	0.35
Catch (000 tons)	252.2	183.7	218.5
Partial recruitment - F (age 1) = F (age 3+) × 0.05 - F (age 2) = F (age 3+) × 0.60			
Recruitment - 1975 year-class = 2765.4 million fish 1976 year-class = 2624.0 million fish			

¹ This statement in parentheses was added by STACRES.

5. Other Business

a) Statistical and Sampling Requirements

STACRES noted the discussions which took place at the 1976 Annual Meeting on the need for more detailed reporting of sampling data and also that a small group of experts (one nominee from each of Canada, USSR, USA and the Secretariat) is scheduled to meet at the Office of the Secretariat before the 1977 Annual Meeting to specify the requirements and costs of implementing a detailed base of sampling data. Pending the completion of this study, STACRES noted the immediate need for more detailed age-length keys for mackerel, and accordingly

recommends (2)

that the usual requirements for the submission of 1976 sampling data for the April 1977 Meeting of the Assessments Subcommittee include the request that member countries provide individual age-length keys for individual samples of mackerel.

STACRES was informed that the CWP Secretary and the Assistant Executive Secretary have made the necessary adjustments to the STATLANT 21 Form and the instructions for completing the form, preparatory to the implementation of the Commission's Resolution regarding the reporting of catch and effort data by 30 x 30 minute unit areas and twice-monthly time periods (1976 Annu. Meet. Proc. No. 18, App. I). It was noted that the Secretariat has already provided member countries with advance information on the implementation of the new system for reporting 1976 data through the Circular Letter series. STACRES urges that member countries pay particular attention to completing the new STATLANT 21B forms in accordance with the revised requirements.

b) Progress Report on Herring Tagging Program

A brief review of the 1976 herring tagging program in Subarea 5 was presented by the USA representative. More than 29,000 herring were tagged on Georges Bank in October through the cooperation of Canadian, USSR and USA scientists and utilizing the USSR purse seiner *Ubileiniy* and the USSR *R/V Belogorsk* as the support vessel. Although practical problems were encountered in conducting the tagging operations offshore, the research teams nearly reached their goal of tagging 30,000 herring. Tagging was also carried out on Jeffrey's Ledge (Div. 5Y) in October but only 10,693 herring were tagged in relation to the goal of 30,000 because of rough seas during much of the period assigned to the operation. Finally it was noted that herring tagging along the coast of Maine was in progress with 21,000 fish tagged up to 19 October, the goal for this area being 25,000 tagged herring. The coordinator of the ICNAF herring tagging program (W. T. Stobo, Canada) reported on progress of tagging in Subarea 4, noting that goals had been reached, or nearly so, in a number of tagging operations there.

STACRES was pleased with the progress of the tagging program to date and noted that there was a good possibility that most of the tagging operations planned for 1976 and 1977 could be completed. In particular, it was noted that returns from herring tagged in the winter and spring in Div. 6A or Subdiv. 5Zw would be especially important for determining the possible extent of mixing of these fish with stocks to the north and east. Attention was drawn to the fact that vessel support for the tagging of 30,000 herring in April 1977 in this area had not yet been arranged. The USSR representative indicated that a Soviet purse seiner and a support vessel could be made available for this offshore tagging operation in Div. 6A or Subdiv. 5Zw during the period of 15 April-15 May 1977. Assuming, therefore, that herring can be located and successfully tagged during this period, the outlook for completing this very important part of the tagging program appears encouraging.

STACRES recommends that the proposed 1977 tagging operations be completed in so far as possible, including the seeding experiments and the complete reporting of all recaptures as outlined in *Redbook* 1976, pages 153-155, and in Circular Letter 76/40. STACRES noted that, in order to obtain the maximum information from the tagging experiments, it will be necessary to have tag recaptures from all offshore and inshore fishing grounds throughout the year.

c) Steering and Publications

A meeting of the Steering and Publications Subcommittee was held on 5 December 1976 to consider the scheduling of the next meeting of the Assessments Subcommittee and the matter of selecting papers from research documents presented to this Special Meeting for possible publication in the *Selected Papers* series.

STACRES noted its decision at the 1976 Annual Meeting that the Assessments Subcommittee meet for 10 days in the last half of April 1977 at ICNAF Headquarters in Dartmouth, Canada, and agreed that the period of 19-29 April would be appropriate if the Commission holds its next Annual

Meeting during the usual period in June. Should the time of the 1977 Annual Meeting be changed, the time of the Assessments Subcommittee Meeting could be adjusted accordingly, if required.

STACRES noted that much data on the biology and size of the shrimp stocks in Subarea 1 and on the status of the fishery were submitted as research documents to this Special Meeting, and considered it desirable that these reports be published in a single volume of the *Selected Papers* series after appropriate revision and editing. It was noted that a number of the Danish papers might be condensed and/or integrated into a smaller set to avoid as much repetition as possible. STACRES was informed that the Secretariat would be unable to cope with the additional editorial work represented by this special volume and agreed that an ICNAF scientist familiar with shrimp biology be requested to serve as editor. The Chairman of STACRES agreed to seek an appropriate editor for the task. It was also noted that, in order for the shrimp papers to be ready for the next issue of *Selected Papers*, the final revised drafts of the papers must be in the hands of the editor no later than 30 June 1977, but preferably earlier. During the early months of 1977, the editor will communicate with the authors regarding the suggested revisions of their papers. Regarding the selection of other papers (i.e. mackerel and silver hake) for possible publication, STACRES agreed that these be referred to the Steering and Publications Subcommittee for consideration at the 1977 Annual Meeting.

6. Future Research and Status of STACRES

Concern was expressed by some members of STACRES because of the uncertainty about the future of co-ordinated research programs and the role of STACRES itself. In addition to the herring tagging program, there are, for example, two other coordinated research programs on herring where continuity with past work is important, namely the autumn larval herring surveys and the spring trawl surveys for juvenile herring. Both of these surveys have been going on for some time with the resultant development of a time series of data which represent some significant potential for monitoring and evaluating factors related to spawning success and the recovery of the herring stocks. In a more general sense, it was noted that progress in understanding the natural factors controlling fish production (e.g. testing hypotheses on factors controlling year-class success) would require well co-ordinated research programs conducted on a broad scale on both biological and physical environmental factors, as outlined by the Environmental Working Group (*Redbook* 1976, pages 141-151). Consequently, STACRES again strongly endorses the view that there be continued international cooperation in research and that STACRES and its Subcommittees can continue to be an effective forum for the formulation and conduct of research in the Northwest Atlantic.

7. Adjournment

The Chairman expressed his appreciation for the efforts of the Working Group conveners and participants in completing their tasks and thanked the STACRES representatives for their cooperation.

APPENDIX I. REPORT OF AD HOC WORKING GROUP ON SHRIMP IN SUBAREA 1

Convener: E. C. Lopez-Veiga

The *ad hoc* Working Group on Shrimp met during 24-27 November 1976 to assess the status of the off-shore shrimp stocks in Subarea 1. Scientists attended from Canada, Denmark (Greenland and Faroese laboratories), Japan, Norway, Spain and USSR. At the June 1976 Annual Meeting, STACRES recommended that the total allowable catch (TAC) from the offshore fishing grounds should not exceed 26,000 tons annually, including all discards, but the Commission decided to defer the setting of the TAC and allocations for 1977 to this Special Meeting when new information would be available. Consequently, the Working Group reviewed a considerable amount of new information relating to both the general biology of the species and stock size estimates: Res. Doc. 76/XII/149, 150, 151, 152, 154, 155, 156, 166, 168, 172 and several working papers.

1. General Information on Biology

The spawning of shrimp in the West Greenland area ends in September and the berried (oviferous) period extends generally from August to April-May, which is considered to be a relatively long period compared with that for other areas. It seems that some of the females which have spawned do not become berried for spawning in the following year. In some areas, at least, most of the berried females develop eggs for a new spawning to take place about four months after the eggs have hatched. Since ecdysis cannot occur in the berried animals, their growth is very small, and this could lead to an accumulation of several age-groups around the last mode in a length-frequency diagram. Only those relatively few females which do not develop roe within a season can be expected to grow. *Pandalus borealis* is a protandric hermaphrodite, and, since the females enter the exploited phase of their life before any spawning occurs, they are exposed to fishing mortality for a full year before they make their first contribution to the production of larvae. This point is important with regard to the stock-recruitment relationship.

This species shows a strong diurnal variation in the catches due to vertical migration off the bottom during the night with the greatest concentrations on the bottom during the day at noon. The diurnal variation is most pronounced when the variation in light intensity is maximum. Underwater observations made by USSR during July-October 1976 (Res. Doc. 76/XII/156) show that the density of shrimp concentrations in the near-bottom 10-m layer was considerably higher in the daytime than at night. Transitional individuals (i.e. changing from male to female) constituted 92.5% in the pelagic trawl catches with only 7.5% females, whereas in the bottom trawl catches 42% were transitionals and 58% were females. The size composition was the same in the bottom and pelagic trawl catches during the period when the observations were made.

2. Fishery Trends

The estimated total catch of shrimp in Subarea 1 for 1976, based on reported landings for about three-quarters of the year and projections for the remaining months, is 48,360 tons, of which 41,060 tons were taken in the offshore areas. The breakdown of the offshore catch by country is as follows: Denmark (13,500 tons), France (1,100 tons), Japan (<100 tons), Norway (12,000 tons), Spain (7,860 tons) and USSR (6,500 tons). The recent rapid development of the offshore fishery is demonstrated by the following nominal catch figures for Subarea 1:

Fishing areas	Nominal catches (000 tons)				
	1972	1973	1974	1975	1976 ¹
Inshore grounds	8	8	10	10	7
Offshore grounds	2	5	12	28	41
Total	10	13	22	38	48

¹ Preliminary data

3. Mortality Estimates (Res. Doc. 76/XII/168)

Using a method developed by the Danish scientist, K. P. Andersen, to estimate growth and mortality parameters directly from length composition data, total mortality coefficients (Z) of 1.5 and higher have to be assumed for the female group in order to obtain estimates of growth parameters which seem reasonable. These values compare well with those estimated for the same species in Norwegian fjords (Z = 1.8) by other methods. However, the lack of adequate data at present makes it impossible to judge with any certainty if the growth described by the model is realistic.

The method mentioned above was applied only to those length groups greater than 29 cm lateral carapace length from the length frequency samples of the catches. Doubt was expressed as to the applicability of the method to the female group, as the method would not apply if there is nil growth (in terms of carapace length) or if there is a strong dominance of one age-group. If, however, the mode and distribution mentioned always represents only one age-group, a high natural mortality rate (including migration out of the exploited area) would have to be assumed for that group, since it is followed only by very small groups in the length frequencies.

4. Fishable Stock Size Estimates

Several estimates of the fishable stock size in 1976, relating to the whole of the offshore West Greenland area or to parts of it, were presented, most being based on the area swept method. The Working Group also reviewed several papers on this subject which were presented to the April 1976 Meeting of the Assessments Subcommittee. Estimates of the fishable stock size, i. e. the stock size of length groups (mainly age-group 4 and older) represented in the commercial catches, were as follows:

- a) A Danish research vessel cruise in Div. 1B gave a fishable stock size of 54,000 tons for July 1976, including corrections for diurnal variation (Res. Doc. 76/XII/150).
- b) Observations from Spanish commercial vessels during October 1976 for a part of Div. 1B, including only the main fishing grounds, gave an estimate for the fishable stock size of 42,000 tons (Res. Doc. 76/XII/166).
- c) Stock size estimates obtained using CPUE data of Norwegian trawlers in 1976 ranged from 99,000 to 127,000 tons (Res. Doc. 76/XII/155). The Norwegian CPUE data for 1975 gave stock size estimates which were similar to those based on the CPUE of Faroese trawlers for 1975 (Res. Doc. 76/VI/15).
- d) An estimate of 124,000 tons for the fishable stock was obtained for part of Div. 1B (southwest of Store Hellefiske Bank and Holsteinborg Deep) where the Norwegian *M/S Pero* worked during May 1976 (Res. Doc. 76/XII/155).
- e) USSR investigations in July-October 1976, based on instrumented trawl survey and underwater observations, which avoids many of the causes of under-estimation by the swept area method as it takes into account the vertical distribution of shrimp within the water column, gave an estimate of the fishable stock size of 184,000 tons for Div. 1B (Res. Doc. 76/XII/156).

The swept area method basically implies that the stock size estimates are minimum estimates for the following reasons: (i) it is assumed that the trawl effectively catches every shrimp in the volume of water swept, but this is hardly the case; (ii) the method does not take into account the fact that the vertical distribution of shrimp may exceed the height of the trawl headline, but the results of the Danish survey does to some extent take into account the diurnal variation with corrections to the actual catches; and (iii) some significant escapement may occur under the footrope as some of the trawls used have the footrope about 1 m off the bottom.

The swept area method could, on the other hand, lead to severe over-estimates if the actual catches used are higher than those which would have been obtained in the other parts of the areas to which the observations are extrapolated. This bias occurs when the actual catches used are those from the commercial fishery which tends to concentrate in areas where catch rates are highest, and when these catches are extrapolated to the overall area of distribution. Indeed, there was great variation in abundance of shrimp in 1976, not only between areas but also between times of the year within areas. For example, in an area where catch rates were very high at the start of the fishing season (April-May), the Danish survey showed the nearly complete absence of shrimp later in the year. A critical factor in using the swept area method with commercial data involves, therefore, the assumptions made about the size of the areas with shrimp concentrations, as the stock size estimates would increase substantially if all areas with suitable depths for shrimp were included in the calculations. It should also be noted that discards have not been included in the Norwegian, Spanish and Faroese CPUE values used in the calculations from which the fishable stock size estimates were obtained: Norwegian observations indicated a discard rate of 9.1% by weight, and Spanish observations showed discards of 6.2% in October with the suggestion that this figure could have been higher in the summer months.

After considerable discussion, the Working Group agreed that 100,000 is a reasonable minimum estimate of the fishable stock size (offshore component) for West Greenland in 1976.

5. Allowable Removals

In general production models, it is assumed that the maximum yield is obtained when the fishable

stock biomass is reduced to 50% of that of the virgin stock. In reducing the virgin fishable stock size by 50%, the spawning stock may, however, be reduced by a much higher percentage, depending on the relationship between age of recruitment to the fishery and the age of first spawning. In the case of shrimp, the Working Group concluded that a safer position would be to maintain the spawning (hatching) stock level at about 50% of the virgin spawning stock size. A method for calculating how much the fishery will reduce the spawning stock biomass is outlined in Res. Doc. 76/XII/172. The key parameters are the value of natural mortality (M_1) after first spawning (hatching) and the period (t) between the time of recruitment to the fishery and the time of first hatching. Table 1 presents the values of the ratio S/S_0 , where S is the resultant spawning stock and S_0 the virgin spawning stock, for different values of F , M_1 and t . If $M_1 = 1.5$ and $t = 1.5$, an $F = 0.4$ will reduce the spawning stock to 50% of the virgin spawning stock, whereas if $M_1 = 1.0$ the spawning stock will be reduced to 46% of the virgin stock for the same fishing mortality.

Table 1. Ratio of spawning stock size to virgin spawning stock size (S/S_0) for a range of fishing mortality (F), two values of natural mortality after first spawning (M_1) and three values of the time (t) between recruitment to the fishery and first hatching.

F	t = 1.0		t = 1.5		t = 2.0	
	$M_1 = 1.5$	$M_1 = 1.0$	$M_1 = 1.5$	$M_1 = 1.0$	$M_1 = 1.5$	$M_1 = 1.0$
0.1	0.88	0.86	0.84	0.82	0.80	0.78
0.2	0.78	0.74	0.70	0.67	0.64	0.61
0.3	0.69	0.64	0.59	0.55	0.51	0.48
0.4	0.61	0.56	0.50	0.46	0.41	0.38
0.5	0.54	0.49	0.42	0.38	0.33	0.30
0.6	0.49	0.43	0.36	0.32	0.27	0.24
0.7	0.43	0.38	0.31	0.27	0.22	0.19
0.8	0.39	0.34	0.26	0.23	0.17	0.15
0.9	0.35	0.30	0.22	0.19	0.14	0.12
1.0	0.31	0.27	0.19	0.16	0.11	0.10

Assuming a natural mortality of 1.5 after spawning (hatching) and a difference of 1.5 years between the age of recruitment to the fishery and the age of first spawning (hatching), the fishing mortality which would lead to a 50% reduction of the spawning is therefore 0.4. With a mean annual fishable stock biomass of at least 100,000 tons, this fishing mortality would correspond to a catch of 40,000 tons. Therefore, the Working Group recommends that the level of catch for 1977 should not, in any case, exceed 40,000 tons, including all discards, from the offshore grounds.

The Working Group stresses that the present knowledge about the stability of the size of the offshore shrimp stocks is very limited. Observations indicate that on some of the grounds great variations can occur between months and years, and it is likely that the size of the total biomass of shrimp also fluctuates greatly. For example, cod, which is known to be one of the major predators on shrimp, is at present very scarce in Div. 1A and 1B where the greatest shrimp concentrations are found.

The Working Group also points out that the consequence of using high natural mortality values in the models, and the fact that the catch composition consists of only two modes, makes forecasting of potential shrimp yields extremely dependent upon a knowledge of recruitment to the fishable stock in the forecast year. Thus, the application of $F = 0.4$ and $M_1 = 1.5$ in the model will mean that only 15% of the female part of the 1976 fishable stock will be available to the 1977 fishery, whereas that component accounted for about one-half of the estimated mean annual fishable stock size in 1976. It would therefore seem proper to evaluate the situation at the beginning of each fishing season so that possible corrections to the management scheme can be made. The Working Group also stresses that, to ensure the highest possible long-term yield from the stock, the relative level of removal might be lower than the level described above, that is, in cases where the spawning stock has been reduced (by fishing and/or extreme environmental factors) to a level where recruitment would be too low to ensure a rebuilding to the high potential level if the relative level of removal is continued.

6. Mesh Size Regulation

There was no substantial new information on mesh selection, so the Working Group agreed that a minimum mesh size of 40 mm (stretched nylon), as recommended by STACRES at the 1976 Annual Meeting, should be adopted.

7. Closed Area Regulation

Although there seems to be an indication that the mean size of shrimp is smaller on the shallower parts of the grounds, there is not at present enough information on the delineation of particular nursery grounds. The Working Group agreed that such measures should be considered when more information becomes available.

8. TAC Breakdown by Area

The Working Group had a lengthy discussion about the desirability and feasibility of breaking down the TAC by areas. The desirability of a breakdown is generally related to two considerations: (i) the inter-relationship between offshore and inshore areas, specifically in Disko Bay where an important local fishery has been established, and (ii) the inter-relationship between the various offshore grounds.

With reference to (i) above, it has been documented that some of the southernmost inshore fisheries are greatly dependent upon the inflow of adult shrimp from coastal and offshore areas, and there are also indications of an inflow of adult shrimp to the Disko Bay area from the offshore grounds. Furthermore, the recruitment to nursery grounds and subsequently to the exploited stock of Disko Bay is assumed to be dependent upon the supply of larvae from the offshore spawning stock. Lacking detailed knowledge, especially about larval drift, the Working Group considers that, if the Commission wishes to take precautionary action to maintain the established Disko Bay fishery and to take into account the possible inter-relationship between Disko Bay and the offshore grounds, such action should be to ensure that an area adjacent to Disko Bay be fished at a relatively low level of exploitation. Such an area could probably be defined as between latitudes 68°N and 69°30'N, east of 59°W longitude. The lowest of the fishable stock size estimates for that area, based on the size of a part of the area covered by the Spanish fleet in 1975, is about 8,000 tons. A fishery of not more than 40% of that minimum stock size, i.e. a catch of not more than 3,200 tons annually within the defined area, should therefore ensure that the stock is fished at a level not higher than, and possibly well below, that which corresponds to $F = 0.4$ under the general assumption underlying the suggested overall removal of 40,000 tons. Should the Commission wish to consider such precautionary action, the Working Group recommends that annual catches in the offshore area adjacent to Disko Bay, between latitudes 68°N and 69°30'N east of 59°W longitude, not exceed 3,200 tons, this figure being adjusted in the light of future new evidence about the inter-relationship between fishing grounds.

With reference to (ii) above, the inter-relationships between offshore grounds is presently unknown, although the general assumption is that larval drift is in a northward direction such as is observed for the drift of fish larvae. However, the movement of the adult stock between grounds is at present unknown, although the fishery trend in Div. 1B during 1976 suggests a northward movement of shrimp concentrations in that year. It would therefore seem desirable to ensure that the spawning stocks of the more southerly grounds are not reduced to a level below the mean level for the offshore grounds as a whole. In this connection, it was pointed out that, if the overall TAC is not broken down by areas, there is a risk that local stocks (including important spawning stocks) may be heavily exploited in areas where such stocks concentrate, for example, due to environmental conditions or to possible schooling behaviour.

Variation in catch per unit effort has been observed between fishing grounds. If the TAC is not broken down by areas, it seems most likely that fishing activity on the grounds with the highest CPUE would continue until catch rates corresponding to or lower than those on the other grounds are achieved. However, it is not certain that a unit of fishing activity in one area exerts the same fishing mortality in that area as it would in other areas. Thus, if good fishing in an area is due to a relatively greater degree of concentration than in other areas, there could be a high level of F in that region. Under such circumstances, it would also seem desirable to distribute a part of the fishing effort to less important areas (in terms of larval production and larval drift) by a breakdown of the TAC.

It was pointed out that, if the TAC is broken down by area without having good data for doing so, there is the risk of forcing the fleet to over-exploit some components of the stock compared with others. Without an area breakdown, there is the chance that, if a certain component of the stock is fished too heavily, the CPUE will decrease and the fleet will move to other areas. It was also pointed out that it could be dangerous to base an area breakdown of the TAC on data for one or two years only, because the shrimp distribution may change from year to year. Possible seasonal variation in shrimp distribution will also make it difficult to determine the most appropriate breakdown.

In view of the above-mentioned arguments for and against a breakdown of the TAC, the Working Group was not able to advise on any specific scheme for allocating the TAC by area, except for the aforesaid advice concerning the area adjacent to Disko Bay.

9. By-catches in the Shrimp Fishery

The Working Group noted that information on by-catches in the shrimp fishery had been collected during the research surveys and by observers on commercial vessels in 1976. Analysis of the material has not yet been completed but preliminary observations indicate that small redfish formed the major part of the by-catches in the 1976 fisheries while the very small quantities of cod in the offshore areas of Div. 1B at present do not cause problems in the shrimp fisheries there. The Working Group stressed the need for the continuous collection of data on by-catches in the shrimp fisheries.

10. Future Research Requirements

The present uncertainty about the assessment of the shrimp stocks are related mainly to (i) areal and seasonal distribution and density of the stocks, (ii) the inter-relationship between grounds regarding the drift of larvae and migration of adult shrimp, and (iii) interpretation of the length compositions, especially of female shrimp in terms of age and growth.

Items (i) and (ii) above can only be elucidated by establishing stratified surveys in the offshore areas similar to that carried out by Denmark in Div. 1B in 1976. Item (iii) requires the detailed study of shrimp samples, including possible alternatives to the present criteria (carapace length) for age and growth. The Working Group also stressed the need for continuously sampling the commercial catches and for the reporting of catch and effort data, as well as discards, by small area and time units. The Working Group accordingly

recommends (3)

- i) that a scheme for stratified trawl surveys of the offshore shrimp grounds be established and used as part of the annual research program in Subarea 1;*
- ii) that detailed studies of shrimp samples be carried out, with special attention to characters usable to illustrate the age composition of female shrimp;*
- iii) that a minimum sampling level for shrimp be established, and that an adequate system of reporting catch and effort data, including discards, be set up for the 1977 fishing season.*

APPENDIX II. REPORT OF AD HOC WORKING GROUP ON SILVER HAKE IN DIVISIONS 4VWX

Convener: V. C. Anthony

Rapporteur: M. D. Grosslein

The *ad hoc* Working Group on Silver Hake met during 24-29 November 1976 to further review the status of the silver hake stock in Div. 4VWX, a matter which was deferred by the Commission from the 1976 Annual Meeting. Representatives attended from Bulgaria, Canada, Cuba, USSR and USA. The Working Group reviewed all available new information on silver hake: Res. Doc. 76/XII/157, 158, 160, 163, 164, 165 and several working papers.

1. Catch Statistics

The estimated total catch of silver hake in Div. 4VWX for 1976, based on reported landings for approximately three-quarters of the year and projections for the remaining months by most countries, is about 90,000 tons, slightly below the 1976 TAC of 100,000 tons. This is a reduction in catch from 1975 when 112,000 tons were taken, which was also slightly less than the 1975 TAC of 120,000 tons. The breakdown of the provisional 1976 catch by country is as follows: Bulgaria (2,151 tons), Canada (22 tons), Cuba (9,464 tons, Jan. to Aug.), Federal Republic of Germany (83 tons), USSR (77,614 tons) and USA (1 ton).

2. Review of the Age and Growth Problem

A major obstacle to the proper assessment of this silver hake stock continues to be the lack of agreement on ageing. Significant discrepancies still exist between Canadian age-at-length data (based on length frequency modal analysis) and USSR data (based on ageing whole otoliths) for young age-groups. Another special workshop (the third) had been planned for October 1976 at Woods Hole, USA, in order to resolve the problem, but it could not be held because USSR representatives were unable to attend.

Some further examination of the problem was possible, however, through USA-USSR exchange of whole otoliths and otolith sections (23 pairs of otoliths). The age readings of these specimens by USSR scientists were in very close agreement (nearly 100%) with the age readings previously done by USA scientists. The USSR representative noted, however, that there were biological discrepancies in relation to growth rate and time of sexual maturity, but that these discrepancies could be explained by a single approach to the interpretation of annual rings. The Working Group again

recommends (1)

that a silver hake ageing workshop be held in the near future.

New information on the length-at-age and growth of silver hake was presented in Res. Doc. 76/XII/164. USSR and Canadian research vessel samples of silver hake on the Scotian Shelf for 1970-75 were examined by modal analysis. The availability of length frequency data by 1-cm groupings and by sex facilitated a more precise analysis than is possible with commercial length frequency data reported by 2-cm length groups. A clear and consistent pattern of growth with differentiation between sexes at lengths greater than 25 cm was obtained. The length-at-age and growth estimates from these data support the earlier results of modal analysis of USSR commercial length samples. Von Bertalanffy growth curves were fitted to the data for each sex. The calculated asymptotic length for females (38 cm) is lower than some observed values. However, a related species, *Merluccius albidus*, sometimes occurs in the catches of silver hake and these larger specimens (>40 cm) may be mistaken for silver hake.

3. By-catches in the Silver Hake Fisheries

The Working Group reviewed a summary of by-catches by USSR scouting and fishing vessels engaged in the Subarea 4 silver hake fishery during 1970-76 (Res. Doc. 76/XII/158). Species composition of catches were reported for a total of 815 bottom trawl hauls (about 60% on scouting vessels) directed toward silver hake, the pooled catches being recorded by 30' x 30' unit areas covering about 80% of the silver hake fishing grounds. A total catch of 3,300 tons was recorded for all 815 hauls combined, of which only 4% represented species other than silver hake. Most of the by-catch consisted of herring, argentine, mackerel and redfish. Gadoids made up less than 1% of the total catch and were reported chiefly from the western part of Div. 4W. Surprise was expressed by some representatives that such consistently pure silver hake catches could be taken with bottom trawls, given the known occurrence of other species in these areas. It was stated that the low by-catch in this fishery was due to the fact that silver hake prefer warmer water than some other groundfish and also are found in deeper areas particularly in the winter.

The Working Group found it difficult to judge the significance of these results because data were not available by season, year or depth of hauls and because the types of haul (scouting vs commercial)

were not given separately for each 30' x 30' unit area. It was noted that about two-thirds of the hauls were made along the edge of the Scotian Shelf and most of the remainder in the Emerald Basin area. Only five hauls were reported for four 30' x 30' unit areas in the region to the west of Sable Island, where a major part of the summer fishery has occurred in some years. The available data were clearly not adequate for estimating by-catch in this region, as this is an area where significant quantities of other groundfish occur, including adult and juvenile cod and haddock, yellow-tail flounder, winter flounder and American plaice, and where the potential for by-catch in the silver hake fishery with bottom trawls is higher than in other areas of the shelf.

Information on by-catch was also reported for the Bulgarian and Cuban fisheries in 1976. In July 1976, about 9% of the Cuban catches consisted of species under catch quota regulation other than silver hake and squid, and the figure was about 12% for the year to the end of August. The Bulgarian representative noted that, in July 1976, his country's vessels fishing for silver hake with pelagic trawls had less than 2% by-catch, composed chiefly of mackerel. He also noted that the by-catch would be somewhat higher if the vessels had fished for squid.

4. Distribution of Silver Hake Fishing Grounds and Silver Hake in Relation to Other Groundfish

The USSR scientists presented a brief description of the silver hake fishing grounds in Subarea 4, including a chart showing the geographic distribution of major silver hake concentrations. It was noted that 80% of the annual catch is taken at depths of 110-350 m in Div. 4W. Aggregations of silver hake sometimes break up a short time after fishing commences (4-5 days) and the fleet must search for new aggregations in other areas. These movements of silver hake are believed to be related to changes in water temperature. Commercial concentrations of mature silver hake are found chiefly in areas where the water temperature is 7 to 9°C. The schools often lie close to the bottom, sometimes only 5-10 m off the bottom, and, therefore, pelagic trawling could not entirely substitute for bottom trawling in the silver hake fishery.

The summer distribution of silver hake on the Scotian Shelf was described from Canadian research vessel data for 1970-74 (Res. Doc. 76/XII/164). They are distributed widely over the shelf with the greatest concentrations in the Emerald Bank-Sable Island area. In general, larger silver hake (>24 cm) are found farther offshore than the smaller ones. Concentrations of adult fish were found in the west Sable Island area. Previous USSR studies showed this region to be a major spawning area.

General fish distribution in relation to hydrographic conditions on the Scotian Shelf was studied as a secondary objective on a Cuban research cruise in July 1976 (Res. Doc. 76/XII/165). It was suggested that temperature conditions and fish distribution may have been abnormal in 1976 compared with those of the early 1960's. However, examination of the hydrographic regime in 1970-74 (Res. Doc. 76/XII/163) suggested that the 1976 conditions were not greatly different from those of the early 1970's.

The geographical and seasonal distribution of the silver hake fishery in relation to the distributions of other important groundfish species in Div. 4VWX were examined. Three primary areas were identified in which silver hake fishing with bottom trawl is concentrated: (a) the west bar of Sable Island in depths less than 100 m from July to November; (b) in the Scotian Gully north of Emerald, Western and Middle Banks and as far west as Emerald Basin in depths greater than 110 m from March to November; and (c) along the edge of the Continental Shelf from the eastern tip of Sable Island to the eastern tip of Browns Bank in depths of 110-350 m during January-August and November-December (Fig. 1). Knowledge of the distribution of other finfish species and squids (Res. Doc. 76/XII/159, 163) indicates that there could be potential by-catches in these areas as follows:

- a) West bar of Sable Island Bank. In the months fished, concentrations of juvenile cod and haddock occur in this area. Also, there are resident populations of flatfish, particularly yellowtail flounder but also winter flounder and American plaice. Juvenile Atlantic halibut also occur there in summer as do species of lesser commercial importance such as thorny and eyed skates, sea raven and ocean pout. Squid (*Illex*) are also usually present in small quantities.
- b) North of Emerald, Western and Middle Banks. In the shallowest parts of this area, cod and haddock can be caught, and this would be most likely at the beginning and end of the silver hake season when cod and haddock are concentrated in deeper water. Redfish are concentrated in this area throughout the year in depths greater than 140 m. Other species of commercial importance occurring in this area in lesser abundance are American plaice, pollock, white hake and squid.
- c) The edge of the Continental Shelf. Commercial concentrations of redfish occur in the depth range fished for silver hake, particularly at the eastern and western ends of the area fished, and Atlantic argentine, common grenadier, cusk, longfin hake, white hake and thorny skate also occur in the area. Squid are abundant in summer, and haddock occur in the winter, to some degree, in the depths fished for silver hake in the Emerald, Western and LaHave Bank areas.

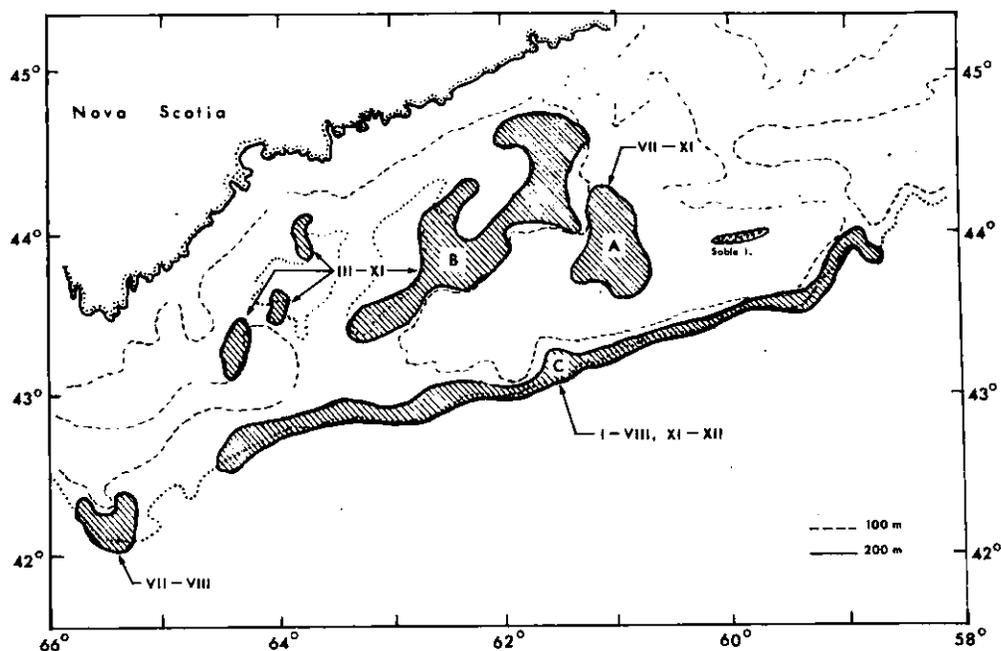


Fig. 1. Distribution of silver hake concentrations by season in Div. 4VWX, based on summed data of the USSR fishing fleet.

It is apparent that there are overlaps in the distributions of important commercial fish species in all of the major areas of silver hake fishing. Hence, there is the potential for by-catches to occur in bottom trawling for silver hake. The importance of the effects of such by-catches on the productivity of these stocks is contingent on the quantities caught and the state of the stocks in question. For stocks subject to minimum mesh size regulations (e.g. cod, haddock and flatfishes), by-catches in small-meshed gears result in some reduction in productivity. It has been demonstrated (*ICNAF Redbook 1976*, pages 86-87) that relatively small catches by weight can have very substantial effects under these circumstances. For some resources such as redfish, although not regulated by a minimum mesh size, small fish are avoided by some national fishing fleets for processing and marketing reasons. By-catches of small fish, such as redfish, reduce the productivity of the resources. They do represent a conflict of interest between fishermen of different nations, lesser allocations being available to those fishermen who wish to engage in directed fisheries for these species. There are other resources (e.g. squid) for which by-catches in small-meshed trawls do not represent a loss in potential yield if such by-catches are utilized. In such cases, and when the Commission has agreed that a particular nation should have an allocation of that resource, by-catches do not constitute a problem unless these result in the nation's total catch exceeding its allocation.

In reviewing the information on fish distribution in relation to potential by-catch problems, the Working Group considered that their importance decreases from area A through area B to area C (see Fig. 1). Certain deeper parts of area B may present minor by-catch problems with the exception of redfish, but the central part of area C between approximately Western Bank and east of LaHave Bank is the area of silver hake fishing where overlaps of distribution with other important commercial species are the least. It was noted, however, that the northern limit of this fishing area is critically important, as haddock could be subject to potential by-catch problems, particularly in the winter when they are aggregated in pre-spawning and spawning concentrations. These aggregations can occur to a depth of 155 m (85 fath) in winter (November to March or April inclusive), depending on hydrological conditions. However, in summer (May to October inclusive), haddock occur in shallower areas, and fishing for silver hake along the edge of the continental shelf in depths as shallow as 120 m (65 fath) would avoid the main areas of haddock distribution.

5. The TAC Level for 1977

The Working Group reviewed assessments presented by Canada and USSR, both suggesting TACs for 1977 (Res. Doc. 76/XII/157, 160). Both assessments allowed for estimates of 1976 catch-at-age data not previously available, and one assessment utilized new research survey data. The age composition of the commercial catch was very different in the two assessments. The Canadian assessment used a modal length analysis from Canadian age-length keys, which indicated a large number of young silver hake in the catches. The catch composition, as determined by USSR age analysis, on the other hand,

was composed of a greater proportion of older individuals. The USSR assessment assumed $M = 0.5$ and the Canadian assessment used $M = 0.4$. The USSR assessment determined $F_{0.1} = 0.7$, whereas $F_{0.1} = 0.5$ was calculated in the Canadian assessment. Both assessments were revised to include the most recent estimate of the 1976 catch. This resulted in an increase of 42% in the estimated 1976 catch in the USSR assessment (Res. Doc. 76/XII/157) and an increase of 18% in the estimated catch in the Canadian assessment (Res. Doc. 76/XII/160).

The USSR assessment was recalculated following the procedure suggested by the author but correcting for uncertainties in the analysis. Partial recruitment values were determined from Anderson (Res. Doc. 76/VI/98) for ages 1, 2 and 3 as 0.035, 0.135 and 0.565 respectively. These were applied to an estimate of F for fully recruited age groups. The resulting values of F for ages 1, 2 and 3 and an F -value of 1.23 for age 4 and older were used to determine the stock size at the beginning of 1976 and 1977. The application of $F = 0.7$ ($F_{0.1}$ in USSR assessment) for fully recruited silver hake and $M = 0.5$ to the stock size at the beginning of 1977 gave a projected catch of 67,000 tons. In the Canadian assessment, the application of $F_{0.1} = 0.5$ and $M = 0.4$ to its stock size composition at the start of 1977 indicated a catch of 64,000 tons. Even though the two assessments were very different, the projected 1977 catches ranged only from 64,000 to 67,000 tons.

At the request of USSR and Bulgarian representatives, a third assessment was carried out on the assumption that full recruitment occurs at age 3 rather than age 4, using (i) USSR estimates of catch composition, (ii) partial recruitment rates as originally proposed for ages 1 and 2 in the USSR assessment, (iii) $F_{0.1} = 0.7$ for 1977, and (iv) $M = 0.5$. The calculations in this assessment indicated a 1977 catch of 79,000 tons.

Initial TAC calculations in these three assessments did not allow for the likely effects of the 60-mm manila (55-mm synthetic) mesh regulation to be imposed in April 1977 (1976 Annu. Meet. Proc. No. 8, App. I). No analysis was available to demonstrate the effects of the mesh size on different age-groups, but some general conclusions can be made. A 55-mm (synthetic) minimum mesh size with a selection factor of 5.1 indicates a mean selection length of 28 cm (ICNAF Redbook 1976, page 61). According to Canadian growth curves for silver hake (Res. Doc. 76/XII/164), this mean selection length occurs at age 2.0 years. The length-at-age used in the USSR assessments (Res. Doc. 76/VI/57) indicates that 28 cm occurs at an age of about 3.0 years. The increased mesh size will increase the mean age of recruitment of silver hake, resulting in an increase in $F_{0.1}$ and a reduction in fishing mortality on fish less than 28 cm in length.

Yield calculations, based on Canadian length-at-age and natural mortality estimates, indicate that, if the mean age of recruitment is increased to 24 months, $F_{0.1}$ increases from 0.5 (15 months) to 0.65 (24 months). A similar increase in $F_{0.1}$ with increased mean age of recruitment would apply for USSR growth and mortality parameters. While calculations were not available, it was assumed, as a first approximation, that the USSR estimate of $F_{0.1}$ would increase from 0.7 to 0.9 in proportion to the Canadian estimates. Canadian length-at-age data suggest that, if the mesh size corresponds to a mean age of recruitment of about 24 months, the partial recruitment of age 2 fish may be 75%, while age 1 fish would be effectively excluded from the catches and age 3 and older fish would be fully recruited. The USSR length-at-age data, on the other hand, suggest that the mesh size might result in partial recruitment factors of 0% for ages 1 and 2, 50% for age 3 and 67% for age 4 fish.

To examine the sensitivity of the calculations to the mean age of recruitment, projected catches were calculated for 1977 showing the effects of the 55-mm (synthetic) mesh size. These catches, together with those for no mesh size effects are given in Table 1 for all three assessments. Also given are the calculated long-term catches allowing for mesh size effects and based on median recruitment of 1.0×10^9 fish (Canadian) and 1.7×10^9 (USSR). A further calculation, based on Canadian data and using 1.0×10^9 as the year-class size of age 1 fish in 1976 and 1977, gave an estimated 1978 catch of 68,000 tons.

Table 1. Calculated catches for 1977 with and without the effects of a 55-mm (synthetic) mesh size beginning in 1977 and the long-term annual catch at $F_{0.1}$.

Assessment	Assessment results for 1977		Long-term annual catch allowing for mesh size
	No mesh size effects	Possible mesh size effects	
Canadian	64,000	51,000	92,000
USSR	67,000	67,000	92,000
Third	79,000	56,000	92,000
Average	70,000	58,000	92,000

If traditional patterns of fishing mortality were to continue in 1977, the TAC associated with $F_{0.1}$ would be recommended as 70,000 tons. It is impossible to accurately predict the effects of the mesh size restriction after its introduction in April 1977. However, the available information suggests that the TAC, corresponding to $F_{0.1}$ in 1977 with a new pattern of fishing mortality, might be as much as 12,000 tons less (Table 1). If a TAC corresponding to $F_{0.1}$ is required, a TAC of 58,000 tons must be recommended. However, the spawning stock is expected to increase slightly, even with a TAC of 77,000 tons in 1977, and the beneficial effects of the mesh size regulation will be visible within 2-3 years. The Working Group therefore advises that a TAC of 70,000 tons may be taken in 1977 with a probable increase in stock size even though $F_{0.1}$ will be exceeded.

APPENDIX III. REPORT OF AD HOC WORKING GROUP ON MACKEREL

Chairman: A. T. Pinhorn

Rapporteur: W. T. Stobo

The *ad hoc* Working Group on Mackerel met during 25 November-1 December 1976 to review the status of the mackerel stock in Subareas 3 to 5 and Statistical Area 6 in accordance with the Commission's request for further consideration at this Special Meeting. Representatives attended from Bulgaria, Canada, Cuba, Poland, USSR and USA. Research Documents 76/XII/135-148, 158, 161, 162, 167, 169-171 were reviewed.

1. Catch Statistics

Since reported catches of mackerel were not available for the whole of 1976, it was necessary to estimate the quantities that would be expected to be taken during the remaining months following the latest reports. Catch projections were provided by Canada, USSR and USA for the periods not covered in the monthly reports of these countries. For Bulgaria, Cuba, Federal Republic of Germany, German Democratic Republic, Poland and Romania, the projections were obtained by subtracting the reported overall total catch of finfish and squids in Subarea 5 and Stat. Area 6 from the second-tier TAC for each country and further reducing this value by each country's TAC for herring (assuming that this would be fully utilized) and also making some allowance for by-catch. For Bulgaria, German Democratic Republic and Poland, the estimated mackerel catch in the last quarter of the year was limited by the second-tier TAC and this is reflected in the estimates given in Table 1. However, Cuba, Federal Republic of Germany and Romania may be able to reach their mackerel TACs. For the remaining countries with small catches, estimates were assigned for by-catch on the basis of fishing patterns in 1975 and 1976.

Table 1. Estimated nominal catches of mackerel in 1976 by country, based on reported and projected catches.

Country	Reported to date	Latest report	Estimated remainder	Total
Bulgaria	12,736	Aug	504	13,240
Canada	9,555	Oct	945 ¹	10,500
Cuba	6,304	Sep	1,096	7,400
France	-	-	500 ²	500
FRG	1,257	Oct 15	143	1,400
GDR	32,122	Aug	4,898	37,020
Italy	530	Sep	50	580
Japan	40	Sep	10	50
Poland	36,639	Sep	16,601	53,240
Romania	2,818	Feb	385	3,200
Spain	132	Jul	18	150
USSR	101,812	Oct	2,908 ¹	104,720 ³
USA	1,808	Sep	642 ¹	2,450
Total	205,750		28,700	234,450

¹ Estimates provided by countries involved.

² Estimated inshore catch in Subarea 3 for the year.

³ Estimated catch is 17,621 in SA 3+4 and 87,099 in SA 5+6.

For assessment purposes, the estimated total catch of mackerel in 1976 was rounded to 235,000 tons. This estimate represents a decline of about 20% in Subareas 3 and 4 and about 12% in Subarea 5 and Stat. Area 6 from 1975 levels of catch in these regions.

2. Biological Studies and Fishery Information

A first report was presented in which the catch levels of mackerel in the USA recreational fishery were estimated (Res. Doc. 76/XII/142). Catches as high as 32,000 tons (1970) have been taken in this fishery, but recent catches are similar to the much lower ones of the early 1960's. Information on USSR mackerel fisheries in terms of geographic location and by-catches (Res. Doc. 76/XII/158, 167) indicated that the range of mackerel distribution in Subarea 5 and Stat. Area 6 is from Chesapeake Bay to Georges Bank and that the by-catch in the mackerel fisheries with pelagic trawls was no more than 2%. Examination of the influence of environmental factors on recruitment (Res. Doc. 76/XII/139) indicates an inverse relationship with temperature in Stat. Area 6, which is opposite to that found in the Gulf of St. Lawrence (Res. Doc. 75/33); the possibility of offshore wind stress affecting recruitment showed no consistent relationship although poor year-classes seemed to be

associated with years of high wind stress. Laboratory experiments with mackerel (Res. Doc. 76/XII/143) indicated preferred temperatures of 7-13°C and the capability of maintaining swimming speeds in excess of 12 km/hr for periods up to 43 seconds.

3. Abundance Indices for 1976

The 1976 USA research vessel trawl surveys (Res. Doc. 76/XII/137) indicate a slight increase in mackerel abundance over that of 1975 but a substantial decrease in the number of age 1 mackerel in the spring surveys from 1975 to 1976. There is, however, considerable variability in these survey indices, and other papers were presented examining some of the factors involved (Res. Doc. 76/XII/138, 144, 170). Commercial catch per unit effort data (Res. Doc. 76/XII/169) for selected vessel categories showed an increase of 4% for GDR vessels, 50% for Bulgarian vessels, 8-12% for Polish vessels and a decrease of 4% for USSR vessels from catch per hour fished data. Interpretation of commercial catch per unit effort data, however, continues to be complicated by possible changes in efficiency and by possible continued accessibility of schooling species to fishing gear, even at low abundance levels.

4. Catch Composition

The age composition of the catches for the years 1968-75 were recalculated (Res. Doc. 76/XII/137) on the basis of data published in the ICNAF Sampling Yearbook and Statistical Bulletin. Substantial differences from the previously used age compositions were evident in some cases, due possibly to the use of provisional catch statistics and incomplete sampling data in preparing previous assessments. Estimates of the age composition of the catches for 1962-67 were also calculated from Canadian samples and other data sources (Res. Doc. 76/XII/137), but these were considered to be less reliable than those for recent years because of the small number of samples and the nature of the fisheries involved. The Working Group agreed that these recalculated age compositions of the catches for 1969-75 would be used in the present assessment (Table 2).

Table 2. Age compositions of mackerel catches from Subareas 3 to 5 and Stat. Area 6 for the years 1969 to 1976.

Year class	Age composition of catch (millions of fish)							
	1969	1970	1971	1972	1973	1974	1975	1976
1959	7.6	2.6						
1960	2.0	3.5	6.9					
1961	2.8	9.3	7.8	5.4				
1962	1.8	9.2	4.1	3.6	1.6			
1963	2.7	4.9	3.4	7.9	3.7	0.8		
1964	5.2	6.6	8.5	4.1	4.0	2.4	1.0	
1965	59.9	25.8	33.1	23.2	10.6	6.3	2.2	0.6
1966	146.2	152.3	194.8	84.2	30.4	25.1	12.2	6.6
1967	238.5	488.0	535.1	376.5	192.2	105.9	49.6	16.5
1968	6.5	51.0	122.0	176.1	187.5	109.4	50.9	30.5
1969	3.6	180.9	281.7	247.0	227.5	111.8	66.6	30.6
1970		4.5	71.4	82.7	277.6	99.3	57.6	31.5
1971			2.3	21.3	275.8	258.6	99.1	59.8
1972				3.4	157.7	236.9	111.7	66.8
1973					3.9	93.8	423.7	257.9
1974						2.0	367.1	367.3
1975							3.6	62.9
Total	476.8	938.6	1271.1	1035.4	1372.5	1052.3	1245.3	931.0
W_o (000 t) ¹	131.8	230.6	373.0	409.7	419.3	339.6	287.1	235.0
W_c (000 t) ¹	115.5	242.9	396.7	376.5	425.3	339.3	301.8	255.9
W_o/W_c	1.141	0.949	0.940	1.088	0.986	1.001	0.951	0.918

¹ W_o = observed weight, and W_c = calculated weight using mean weight-at-age values from Table 4 of Res. Doc. 76/XII/137.

At the 1976 Annual Meeting, the Commission, in deferring a decision on the 1977 TAC for mackerel, requested that all countries participating in the fishery during 1976 submit data on individual samples to the Secretariat for examination and analysis at the present meeting. Such data for the Bulgarian and GDR fisheries were not available at the meeting for detailed analysis, and the reported age compositions of the catches were accepted as presented. The Working Group also agreed to accept

the Canadian (Res. Doc. 76/XII/162) and USSR (Res. Doc. 76/XII/169) age compositions for Subareas 3 and 4 as well as the Polish age compositions for Subarea 5 and Stat. Area 6. However, there was disagreement on the USSR age compositions for Subarea 5 and Stat. Area 6 in the first quarter of 1976 (Res. Doc. 76/XII/146). It was noted that the difference may have been due to the relatively small samples taken for the age-length key and to other reasons indicated by USSR scientists later in this report. A provisionally agreed solution was to pool the USSR and Polish age-length key data to obtain a quarterly age-length key for application to the USSR length compositions of the catch. (It was noted that the pooling of age-length key data of all countries may also need to be done for previous years in order to improve the estimates of the age compositions of the catches in Subarea 5 and Stat. Area 6). The 1976 age composition data were next prorated to the estimated 1976 catches of the various countries and then adjusted to 235,000 tons, the estimated total mackerel catch for 1976 (last column of Table 2).

5. Assessment Parameters

Several papers on the status of the mackerel stock were presented to the Working Group. Estimates of the minimum stock biomass based on egg surveys in Stat. Area 6 (Res. Doc. 76/XII/140) were discussed but they were considered to be of minimal value for the present assessment because of the large variability associated with the data. A modification of the surplus yield model (Res. Doc. 76/XII/145) was presented but this was not considered to have immediate applicability due to the need for testing the robustness of the model. The Working Group reviewed three assessment papers (Res. Doc. 76/XII/135, 137, 169) which implied 1977 catches in the range of 35,000-184,000 tons at the fishing mortality level of $F_{0.1}$. The information in these papers was used as the basis for deciding the parameters for additional calculations. The Working Group agreed on two sets of assessment parameters which are referred to below as Option 1 and Option 2.

a) Fishing Mortality

Regression of distant water fleet effort data against fishing mortality estimates from cohort analysis gave 1976 values of F in the range of 0.47-0.55. A fishing effort index was also calculated by dividing the international catch by the smoothed mean of the log transformed values of the spring survey abundance index (Res. Doc. 76/XII/169). This fishing effort index was then regressed against cohort analysis estimates of fishing mortality which resulted in a value of 0.43 for F in 1976. After considering these various estimates, the Working Group agreed to use $F_{76} = 0.6$ (near the upper end of the range of estimates) as the value for Option 1.

Another estimate of 1976 fishing mortality was obtained by smoothing the re-transformed spring survey catch-per-effort values (Res. Doc. 76/XII/137) using an exponential curve and by dividing these into the international catch to determine a fishing effort index. Cohort analyses using three starting values of F (0.6, 0.7 and 0.8) provided mean fishing mortalities on age 3 and older fish for the years 1968 to 1974. The fishing effort index was then regressed against the mean fishing mortalities for these years, resulting in a range of 0.62-0.67 for F in 1976. Also, the 1975 fishing mortality estimates and stock sizes from these cohort analyses were used to estimate the stock size at the beginning of 1976. With a knowledge of both the 1976 stock size and catch, the fishing mortality in 1976 was estimated to be in the range of 0.85-1.00. These two sets of estimates were then averaged, giving a range of 0.73-0.84 for F . The Working Group agreed to use $F_{76} = 0.75$ (near the lower end of the range) as the value for Option 2.

For both options, the catch projections for 1977 were made on the basis of $F_{0.1} = 0.35$.

b) Recruitment Estimates

For the 1974 year-class, the regression of catch-per-tow in numbers of age-group 0 from autumn surveys and age-group 1 from spring surveys against estimates of year-class size at age 1 from three cohort analyses (with terminal F 's of 0.6, 0.7 and 0.8) gave a range of 2,000-2,300 million fish at age 1. An estimate of the 1974 year-class at age 1 from cohort analysis (with $F_{76} = 0.6$) is 2,300 million fish. Considering the variance associated with these estimates of year-class size, the Working Group agreed to use 2,150 million fish as the size of the 1974 year-class at age 1 for both options.

With regard to the 1975 year-class, research survey abundance indices indicate its size to be in the range of 851-934 million fish from spring surveys and 548-568 million fish from autumn surveys. The possibility of this year-class being poor is also indicated from information on various environmental factors, although these are not consistent. The Working Group agreed to use for Option 2 the 1975 year-class size of 750 million fish, the approximate mean of the estimates from both surveys. However, it was recognized that the variance associated with research vessel survey data may cause large fluctuations in estimates of year-class size. Estimates, derived from the regression of the log-transformed mean of spring survey abundance indices against estimates of year-class size at age 1 from cohort analyses, suggest that this year-class

at age 1 may be larger than that indicated above for Option 2. Consequently, the Working Group agreed to 1,250 million fish as the size of the 1975 year-class at age 1 for use in Option 1.

For the 1976 year-class, the only information available is from the 1976 autumn survey which suggests a level of 1,400 million fish. However, 1,500 million fish is about the median value for the sizes of the 1968-73 year-classes at age 1, and it was decided to use this value for both options.

c) Partial Recruitment

The Working Group considered that age 3 and older fish are fully recruited to the fishery and agreed to the following partial recruitment factors for 1976, calculated as the proportion of the fishing mortality of age-groups 1 and 2 in 1976 to the fishing mortality of age 3 and older fish, using the observed catch-at-age data and the estimated year-class size for 1976. These partial recruitment factors were then used for the 1977 projections.

	1976 partial recruitment (%)	
	Option 1	Option 2
Age 1	10	14
Age 2	67	53

6. Results of Assessments

The summarized results of the assessments for the two options are given in Table 3, and the calculated fishing mortalities and stock sizes for 1959-76 are listed in Tables 4 and 5 for Options 1 and 2 respectively. The results of both options indicate that the fishing mortality estimates for age 3 and older fish in 1976 are higher than previously recorded for the mackerel fishery. Fishing at $F_{0.1} = 0.35$ in 1977 will result in a catch of 133,000 tons under Option 1 and 105,000 tons under Option 2. It is noted that the predicted catch under either option will allow for some increase in spawning stock size from 1977 to 1978.

Table 3. Mackerel in Subareas 3 to 5 and Statistical Area 6: projections of catch in 1977 and spawning stock size in 1977 and 1978 for the various parameters of Options 1 and 2.

	Parameters	Option 1	Option 2
Fishing mortality	F_{76} (3+)	0.6	0.75
Partial recruitment (%)	F (age 1)	10	14
	F (age 2)	67	53
	F (age 3+)	100	100
Recruitment at age 1 (10^6)	1974 year-class	2,150	2,150
	1975 year-class	1,250	750
	1976 year-class	1,500	1,500
1977 projections	Spawning stock (000 tons)	475	381
	F (age 3+)	0.35	0.35
	Catch (000 tons)	133	105
1978 projections	Spawning stock (000 tons)	485	392

However, in the opinion of the USSR scientists, the pooling of age-length keys for 1976 was done without sound scientific evidence because some factors which could be the reason for the differences were not taken into account. For example, the areas fished by Polish and USSR fishing fleets, and consequently the sampling areas, were considerably different. A possibility of the existence of some differences in age-reading techniques should not be completely excluded. In this particular case, the doubts can be eliminated only by the joint work of experts of these countries. The mechanical pooling of "keys" resulted in a 50% decrease in the estimated 1973 year-class abundance at age 1 in comparison with the value obtained when using separate age-length keys (Res. Doc. 76/XII/169). The mackerel stock size in 1977 to a great extent depends on 1974 and 1975 year-class abundance. The estimation of these year-classes based on US bottom trawling surveys, in the opinion of the USSR scientists, failed to be scientifically justified because its procedure does not allow

reliable information to be obtained on mackerel, whose distribution is extremely unequal and to a great extent depends on environmental factors. The US bottom trawling surveys, conducted in 1969, vividly showed to what extent the results could be distorted due to the above-mentioned reasons. Thus, the estimates of year-class strength run with abundance indices of these surveys are subject to very substantial errors. The commercial data of all countries fishing for mackerel evidently indicate a high abundance of the 1974 year-class. The estimates of this year-class used in the calculations are apparently extremely under-estimated in the opinion of the USSR scientists.

Table 4. Results of mackerel assessment for Subarea 3 to 5 and Stat. Area 6 stock, using the parameters specified in the text for Option 1 (with F = 0.60 in 1976).

Year class	Fishing mortality and stock size by year									
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
<u>Fishing mortality</u>										
1959	0.296	(0.172) ¹								
1960	0.033	0.082	(0.254) ¹							
1961	0.036	0.180	0.252	(0.308) ¹						
1962	0.041	0.337	0.276	0.473	(0.443) ¹					
1963	0.049	0.131	0.141	0.645	0.849	(0.485) ¹				
1964	0.068	0.129	0.273	0.228	0.412	0.532	(0.492) ¹			
1965	0.223	0.157	0.349	0.503	0.515	0.778	0.810	0.600	0.350	
1966	0.118	0.193	0.458	0.413	0.287	0.463	0.489	0.600	0.350	
1967	0.054	0.168	0.315	0.434	0.469	0.558	0.708	0.600	0.350	
1968	0.002	0.026	0.089	0.199	0.382	0.455	0.450	0.600	0.350	
1969		0.071	0.168	0.244	0.420	0.425	0.555	0.600	0.350	
1970			0.051	0.085	0.519	0.399	0.484	0.600	0.350	
1971				0.014	0.281	0.529	0.447	0.600	0.350	
1972					0.165	0.451	0.451	0.600	0.350	
1973						0.057	0.444	0.600	0.350	
1974							0.219	0.399	0.350	
1975								0.060	0.235	
1976									0.035	
F (age 3+)	0.125	0.172	0.254	0.308	0.443	0.485	0.492	0.600	0.350	
<u>Stock size (age 1 and older)</u>										
1959	34.4	19.0								
1960	72.3	51.8	35.4							
1961	91.9	66.7	40.6	23.4						
1962	52.5	37.3	19.7	11.1	5.1					
1963	65.5	46.2	30.0	19.3	7.5	2.4				
1964	91.8	63.6	41.4	23.4	13.8	6.8	2.9			
1965	348.0	206.2	130.6	68.2	30.6	13.5	4.6	1.5		
1966	1531.7	1008.8	616.3	288.9	141.5	78.7	36.7	16.7	7.4	3.9
1967	5233.2	3671.5	2299.9	1243.3	597.0	276.8	113.9	41.7	17.0	8.9
1968	3129.3	2312.6	1669.3	1131.7	686.8	347.4	163.2	77.1	31.3	16.3
1969		3071.0	2119.3	1327.6	770.9	375.3	181.8	77.3	31.4	16.4
1970			1663.1	1170.6	796.0	350.8	174.4	79.6	32.4	16.9
1971				1789.8	1307.6	731.3	319.2	151.2	61.5	32.1
1972					1206.5	758.1	357.7	168.8	68.6	35.8
1973						1961.3	1372.2	651.9	265.0	138.3
1974							(2150.0) ²	1279.5	636.0	332.0
1975								(1250.0) ²	872.1	510.8
1976									(1500.0) ²	1073.0
Total (10 ⁶)	10650.6	10553.7	8665.6	7097.3	5563.0	4902.4	4876.6	3795.3	3522.7	
Wt. (000 t) ³	2250.9	2172.0	2084.6	2063.8	1518.7	1195.2	960.6	745.3	692.9	
<u>Spawning stock (50% age 2, 100% age 3 and older)</u>										
Total (10 ⁶)	4904.7	5326.4	5942.8	4722.2	3703.0	2562.0	2040.5	1905.6	1586.6	1647.9
Wt. (000 t) ³	1389.2	1703.1	1761.8	1767.4	1292.8	942.3	652.1	533.5	474.1	483.3

¹ Mean F for age 3+ assumed.

² Estimated year-class size at age 1.

³ Adjusted according to correction factors (ratio of observed to calculated weights) in Table 2.

Table 5. Results of mackerel assessment for Subarea 3 to 5 and Stat. Area 6 stock, using the parameters specified in the text for Option 2 (with F = 0.75 in 1976).

Year class	Fishing mortality and stock size by year									
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
<u>Fishing mortality</u>										
1959	0.299	(0.174) ¹								
1960	0.033	0.083	(0.260) ¹							
1961	0.037	0.183	0.258	(0.317) ¹						
1962	0.041	0.342	0.282	0.487	(0.463) ¹					
1963	0.050	0.133	0.143	0.656	0.882	(0.522) ¹				
1964	0.069	0.131	0.279	0.236	0.431	0.573	(0.557) ¹			
1965	0.224	0.158	0.352	0.510	0.528	0.816	0.902	0.750	0.350	
1966	0.119	0.196	0.468	0.429	0.302	0.499	0.553	0.750	0.350	
1967	0.055	0.170	0.320	0.443	0.484	0.622	0.789	0.750	0.350	
1968	0.002	0.027	0.092	0.207	0.402	0.493	0.511	0.750	0.350	
1969		0.073	0.172	0.252	0.440	0.456	0.626	0.750	0.350	
1970			0.033	0.089	0.546	0.431	0.549	0.750	0.350	
1971				0.015	0.295	0.571	0.508	0.750	0.350	
1972					0.174	0.488	0.512	0.750	0.350	
1973						0.063	0.505	0.750	0.350	
1974							0.219	0.399	0.350	
1975								0.102	0.186	
1976									0.049	
F (age 3+)	0.126	0.174	0.260	0.317	0.463	0.522	0.557	0.750	0.350	
<u>Stock size (age 1 and older)</u>										
1959	34.2	18.8								
1960	71.0	50.9	34.7							
1961	90.5	64.6	39.9	22.8						
1962	51.9	36.9	19.4	10.9	4.9					
1963	64.9	45.8	29.7	19.1	7.3	2.2				
1964	90.2	62.3	40.5	22.7	13.3	6.4	2.7			
1965	346.1	204.9	129.6	67.5	30.0	13.1	4.3	1.3		
1966	1511.5	993.9	605.2	280.7	135.5	74.2	33.4	14.2	5.5	2.9
1967	5182.8	3634.2	2272.3	1222.8	581.8	265.6	105.6	35.5	12.4	6.5
1968	3036.1	2243.6	1618.2	1093.8	658.7	326.6	147.8	65.7	23.0	12.0
1969		3001.7	2068.0	1289.6	742.7	354.4	166.3	65.9	23.1	12.1
1970			1610.3	1131.5	767.1	329.3	158.5	67.8	23.7	12.4
1971				1715.5	1252.6	690.5	289.0	128.8	45.1	23.5
1972					1145.1	712.6	324.0	143.9	50.4	26.3
1973						1785.5	1242.0	555.4	194.4	101.5
1974							(2150.0) ²	1279.5	636.0	332.0
1975								(750.0) ²	501.7	308.6
1976									(1500.0) ²	1058.1
Total (10 ⁶)	10479.2	10357.6	8467.8	6876.9	5339.0	4560.4	4623.6	3108.0	3015.3	
Wt. (000 t) ³	2220.2	2137.0	2042.8	2007.5	1462.3	1122.8	890.8	637.9	567.2	
<u>Spawning stock (50% age 2, 100% age 3 and older)</u>										
Total (10 ⁶)	4851.7	6234.1	5823.5	4595.7	3567.6	2418.6	1852.6	1718.3	1264.5	1366.8
Wt. (000 t) ³	1373.7	1680.0	1729.0	1722.4	1246.9	890.6	593.2	469.8	380.8	391.7

¹ Mean F for age 3+ assumed.

² Estimated year-class size at age 1.

³ Adjusted according to correction factors (ratio of observed to calculated weights) in Table 2.

The abundance of the 1975 year-class using trawling survey data ranges from 750 to 1,250 million fish. The Soviet scientists are of the strong opinion that, until more reliable information becomes available, a more valid approach is associated with estimation of the above-mentioned year-class as a mean value of the abundance of age 1 fish in 1969-74, i.e. 2,765 million fish (Res. Doc. 76/XII/169). The estimation of F for 1976 is 0.6. This figure obtained in Res. Doc. 76/XII/169 using commercial data is slightly over-estimated. Based on scientific evidence presented in Res. Doc. 76/XII/169, the USSR scientists consider it possible to recommend a TAC at the level of 180,000 tons.

This catch and the resultant stock size are presented in the following table of catch and stock size predictions (from Res. Doc. 76/XII/169).

Mackerel in SA 3-6	1976	1977	1978
Spawning stock (000 tons)	635.9	604.1	743.0
F (age 3+)	0.60	0.35	0.35
Catch (000 tons)	252.2	183.7	218.5
Partial recruitment - F (age 1) = F (age 3+) × 0.05 - F (age 2) = F (age 3+) × 0.60			
Recruitment - 1975 year-class = 2765.4 million fish 1976 year-class = 2624.0 million fish			

7. Effect of Size Regulation

The Working Group noted that the minimum size regulation must be considered in setting the 1977 TAC for mackerel. However, the predicted catches under both options apparently do not require adjustments to take account of the size regulation, as the partial recruitment factors were calculated from the catch-at-age data for 1976 when the minimum size regulation was in effect and the effect of the regulation has been incorporated into the assessments under both options. If the estimated fishing mortality on age 1 mackerel in 1977 is correct, the quantity of these fish taken unavoidably in the catches could be within the tolerance allowed by the minimum size regulation on an annual basis.

8. Consequences of the Advice on the Mackerel TAC

In order to allow the Commission to evaluate the consequences of the action it may take in regard to the 1977 TAC for mackerel, the Working Group calculated the effects of catching the TAC under one option if the assumptions of the other option are correct. The resulting effects on the catch and fishing mortality in 1977 and on the catch and spawning stock in 1978 are indicated in the following table:

Option	Effect if assumptions of options are correct			Effect if assumptions of alternative option are correct					
	TAC in 1977 (tons)	F in 1977	Spawning stock in 1978 (000 tons)	Catch in 1977 (tons)	F in 1977	Catch in 1978 ¹ (tons)	Cumulative 1977 and 1978 catch (tons)	Spawning stock in 1978 (000 tons)	% change in spawning stock by weight
1	133,000	0.36	485	105,000	0.26	141,000	246,000	513	+6
2	105,000	0.35	392	133,000	0.46	87,000	220,000	328	-16

¹ Represents the catch of age 2 and older mackerel.

The fishing mortality (F) would decrease from 0.35 (F_{0.1}) expected under Option 1 to 0.26 in 1977 and the spawning stock in 1978 would increase by 6% from that expected under Option 1, if Option 2 is adopted but the assumptions of Option 1 are correct. Similarly, F would increase from 0.35 (F_{0.1}) expected under Option 2 to 0.46 in 1977 and the spawning stock in 1978 would decrease by 16% from that expected under Option 2, if Option 1 is adopted but the assumptions of Option 2 are correct.

In addition to the above calculations, the Working Group discussed the general implications of the present level of spawning stock biomass in relation to historical trends (Fig. 1). It was pointed out that, although the level of the present spawning biomass is in the same range as that which produced the moderate 1966 year-class and the large 1967 year-class, the mean age of the spawning stock at present is 3.2 years, compared with a mean age of 4.5 years in 1966 and 4.2 years in 1967. Since fecundity is related to the weight of individuals, a significantly reduced egg production from the present spawning biomass could be implied, although recent work in the Gulf of St. Lawrence has indicated that the number of eggs may be more related to the production (growth rate × biomass) of the stock than to the biomass. It was also pointed out that the numbers of ages 4 and 5 mackerel are expected to increase in 1978 under both options, thus causing a slight increase in the size and mean age of the spawning biomass. The estimates of the spawning stock in 1978 are greatly dependent on the estimates of recruiting year-classes used in the assessments. Although the Working Group could not evaluate the precise effects of the various factors on recruitment success and spawning, it did agree that the present level and condition of the spawning biomass is reason for concern.

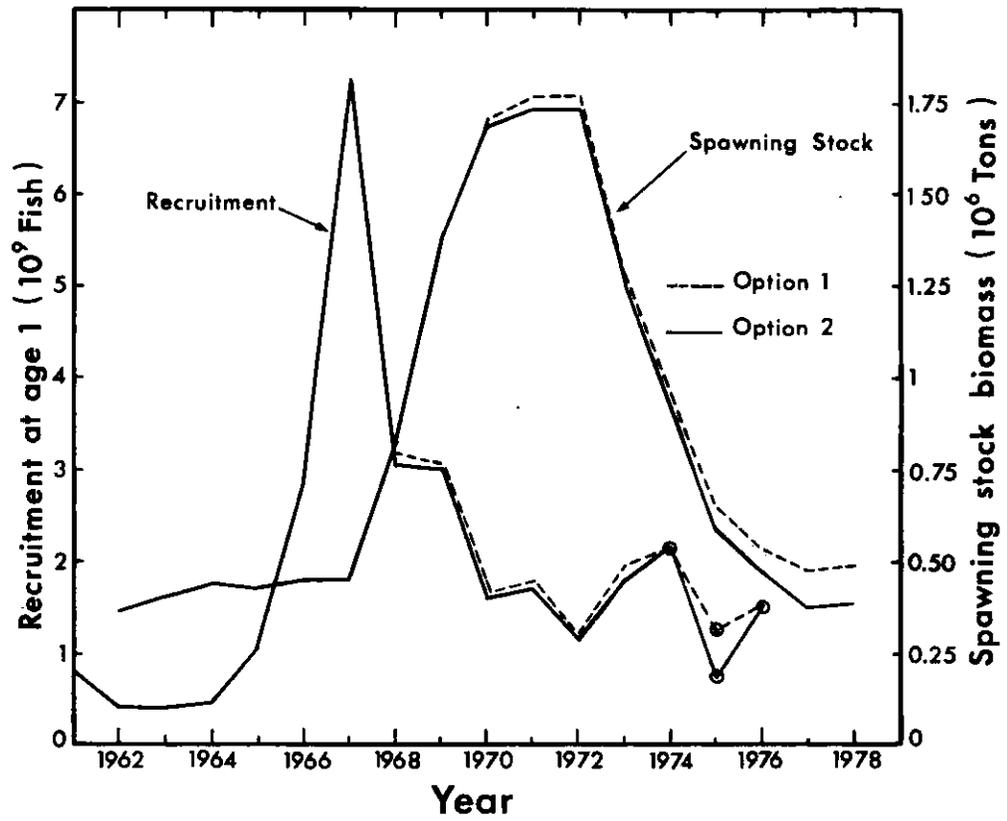


Fig. 1. Mackerel in Subareas 3 to 5 and Stat. Area 6: spawning stock biomass in 1962-78, and abundance at age 1 of the 1961-76 year-classes. (Open circles indicate estimated year-class sizes.)

PART B

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

Annual Meeting - May-June 1977

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REPORT OF STANDING COMMITTEE ON RESEARCH AND STATISTICS (STACRES)

Annual Meeting, May-June 1977

Chairman: Sv. Aa. Horsted (Denmark)
F. Nagasaki (Japan) (7 June)

Rapporteurs: V. M. Hodder
A. T. Pinhorn

Meetings of STACRES and its Subcommittees were held at Ottawa, Canada, during 24-30 May and on 1 June 1977, to consider and report to the Commission on matters listed in its Agenda (Part D, this volume). With the resignation of Dr M. D. Grosslein (USA) as Chairman, following the withdrawal of USA from the Commission on 31 December 1976, Mr Sv. Aa. Horsted agreed, with the unanimous approval of all representatives present, to act as Chairman for this meeting. In addition, Dr F. Nagasaki agreed to act as Chairman for any sessions which might be requested by the Commission following Mr Horsted's departure. Such a session was held on 7 June to consider the Commission's request for additional projections of catch and biomass for the cod stock in Divisions 2J, 3K and 3L. Representatives were present for the various sessions from all Member Countries, except Italy, Iceland, Norway and Romania, and observers attended from the Food and Agriculture Organization of the United Nations (FAO), the International Commission for the Southeast Atlantic Fisheries (ICSEAF), and United States of America (USA).

These meetings were preceded on 19-27 April 1977 by a meeting of the Assessments Subcommittee at ICNAF Headquarters, Dartmouth, Canada, and on 16-19 May 1977 by a meeting of the *ad hoc* Flemish Cap Working Group at Murmansk, USSR. A workshop on the ageing of cod was held at St. John's, Newfoundland, Canada, during 31 January-5 February 1977 (Summ. Doc. 77/VI/12), and a workshop on the ageing of silver hake was held at St. Andrews, New Brunswick, Canada, during 14-18 March 1977 (Summ. Doc. 77/VI/13). Since its 1976 Annual Meeting, STACRES also met during the Ninth Special Commission Meeting at Tenerife, Canary Islands, Spain, in December 1976 (Part A, this volume; also Summ. Doc. 77/VI/1).

The reports of the various Subcommittees and Working Groups, as adopted by STACRES at this Annual Meeting, are given in Appendix I (Assessments), Appendix II (Statistics and Sampling), Appendix III (Biological Surveys), and Appendix IV (Environmental). Brief summaries of these reports, together with other matters considered by STACRES, are given below. The STACRES Agenda, a list of recommendations, lists of Summary and Research Documents, and a list of participants at scientific meetings are given in Part D of this volume.

I. ASSESSMENTS (APP. I)

1. Fishery Trends

Details of nominal catches for 1976 are given in Summ. Doc. 77/VI/29. The total nominal catch of all species in the Northwest Atlantic (Subareas 1 to 5 and Statistical Areas 0 and 6) was 3.45 million tons, a decline from 3.8 million tons in 1975 and from 4.0 million tons in 1974. Substantial declines occurred in the catches of cod (18%) mainly in Subareas 1 to 3, redfish (18%) mainly in Subarea 4, silver hake (24%), herring in Subareas 4 and 5 (28%), mackerel (16%), and in the "other fish" category (excluding argentine and capelin) (37%). Significant increases in catch occurred in the "other pelagics" category (excluding herring and mackerel) (45%) due to an increase in the menhaden catch in Statistical Area 6. Increases also occurred in the catches of squid (24%) and shrimp (19%). With respect to the total nominal catch of all species by subarea, increases were recorded for Statistical Area 0 (from 2,000 tons in 1975 to 8,000 tons in 1976) and declines were recorded for Subarea 1 (8%), Subarea 2 (39%), Subarea 4 (15%) and Subarea 5 (18%). Catches in Subarea 3 and Statistical Area 6 did not change much between the two years. It should be noted that fluctuations in catches between years do not necessarily imply corresponding fluctuations in the stocks but may in some instances be due to conservation measures and to changes in fishing pattern.

2. Stock Assessment

The Assessments Subcommittee met at ICNAF Headquarters, Dartmouth, Canada, in April 1977 to review the assessments for 18 stocks for which Canada requested advice and which lie within or partly within its 200-mile fisheries management zone in Subareas 2 to 4 and for 3 stocks which overlap the Canadian and Danish fisheries zones in Statistical Area 0 and Subarea 1 (Comm. Doc. 77/VI/4) for which both coastal states requested advice. The Subcommittee also reviewed the cod stock in Subarea 1 at the request of Denmark and the 3 regulated stocks which lie completely outside of the national fisheries zones in Div. 3M. The report of that meeting is at Appendix I.

Advice on total allowable catch (TAC) levels for 1978 is summarized in the last column of Table 1. When it was possible to do so for some stocks, management options at various levels of fishing

mortality and the long-term effects on catch and biomass were presented rather than a single TAC associated with a particular level of fishing mortality. This is in accordance with the Canadian request in Comm. Doc. 77/VI/12. Such management options and their long-term effects were presented for cod in Subarea 1, cod in Div. 2J+3KL and American plaice in Div. 3LNO. Two management options (catches associated with fishing at F_{MSY} and at $2/3 F_{MSY}$) were presented for cod in Div. 3NO but the long-term effects of these options in terms of stock rebuilding are unknown at present.

Table 1. Summary of recent catches (1972-76) and TACs (1974-77) for stocks reviewed at the April 1977 Meeting of the Assessments Subcommittee, together with advised TACs for 1978 in parentheses.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)				
		1972	1973	1974	1975	1976 ¹	1974	1975	1976	1977	1978
Cod	1	111	63	48	48	33	107	60	45	31	() ⁶
	2GH	14	+	4	7	6	20	20	20	20	(20)
	2J+3KL	458	355	373	288	214	657	554	300	160	() ⁷
	3M	58	23	25	22	22	40	40	40	25	(40)
	3NO	103	80	73	44	24	101	88	43	30	() ⁸
Redfish	2+3K	20	39	30	26	26	30	30	30	30	(30)
	3M	42	22	35	16	17	40	16	16	16	(16)
	3LN	29	33	22	18	21	28	20	20	16	(16)
	3O	16	9	13	15	15	16	16	16	16	(20)
Silver hake	4VWX	114	299	96	116	97	100	120	100	70	(81)
A. plaice	2+3K	9	5	6	6	6	10	8	8	8	(6)
	3M	1	1	2	2	1	2	2	2	2	(4)
	3LNO	59	53	46	43	52	60	60	47	47	() ⁹
Witch	2J+3KL	17	24	16	12	11	22	17	17	17	(17)
	3NO	9	7	8	6	6	10	10	10	10	(10)
Yellowtail	3LNO	39	33	24	23	8	40	35	9	12	(15)
G. halibut	0+1	14	10	14	25	16	-	-	20	20	(25)
	2+3KL	30	29	27	29	25	40	40	30	30	(30)
R. grenadier	0+1	8	5	12	5	9	-	10	14	8	(8)
	2+3	24	18	28	27	21	32	32	32	35	(35)
Argentine	4VWX	6	1	17	15	7	25	25	25	20	(20)
Capelin	2+3K	46	136	127	199	216	110 ²	160 ²	160 ²	212.5 ²	(300)
	3LNOPs	25	132	161	167	144	148 ³	180 ³	180 ³	200	(200)
Squid- <i>Illex</i>	3+4	2	10	+	18	39	-	25 ⁴	25 ⁴	25 ⁴	(25)
Shrimp	1	10	13	18	38	50	-	-	-	36 ⁵	() ¹⁰

¹ Based on statistics compiled for the 1977 Annual Meeting (Summ. Doc. 77/VI/29, Rev.) which may differ slightly from those given in Table 1 of the Report of the Assessments Subcommittee (Appendix I) which were based on preliminary statistics compiled in April 1977.

² In addition, countries without specific allocations may each take up to 10,000 tons.

³ In addition, countries without specific allocations may each take up to 5,000 tons.

⁴ In addition, countries without specific allocations may each take up to 3,000 tons.

⁵ TAC pertains to offshore fishing grounds in Subarea 1.

⁶ See section III (1) of Assessments Report (Appendix I) for TAC options.

⁷ See section III (3) of Assessments Report (Appendix I) for TAC options.

⁸ See section III (5) of Assessments Report (Appendix I) for TAC options.

⁹ See section III (13) of Assessments Report (Appendix I) for TAC options.

¹⁰ Conservation measures for 1978 depend largely on data derived from the fishery during 1977; see section III (24) of Assessments Report (Appendix I) for assessment advice.

Increases in TACs for 1978, compared with 1977, were advised for cod in Div. 3M, redfish in Div. 3O, silver hake in Div. 4VWX, American plaice in Div. 3M, yellowtail flounder in Div. 3LNO, and Greenland halibut in Statistical Area 0 and Subarea 1. A decrease in TAC was advised for American plaice in Subarea 2 and Div. 3K. The TACs advised for other stocks were the same as those for 1977. No TAC was advised for shrimp in Subarea 1 because it was considered too risky to use events

from the 1976 fishery to extrapolate conservation measures for shrimp in 1978. STACRES considered it more appropriate to assess this stock near the end of 1977 when information about the 1977 fishery would be available.

STACRES noted the Assessments Subcommittee's concern about the difficulty in advising TACs for *Illex* well in advance of the fishing season due to the short life-span and large fluctuations in abundance, and indicated that the effectiveness of effort regulation *versus* TAC regulation for this species in Subareas 3 and 4 should be evaluated. It was pointed out that detailed catch and effort data should be readily available for those countries with specialized squid fisheries, but, in fisheries where squid are largely taken as by-catch, the feasibility of effort regulation might be more difficult to evaluate. After discussion of this matter, STACRES

recommends (4)

that those countries with directed fisheries for squid (Illex) in Subareas 3 and 4 and other countries with significant catches of squid in fisheries directed toward other species provide detailed catch and effort data at least on a monthly basis, but preferably for shorter time intervals, and by individual vessels, if possible, for consideration by the Assessments Subcommittee at its April 1978 Meeting.

STACRES also noted that a proper assessment of the Greenland halibut stock in Subarea 2 and Div. 3KL was impossible due to very inadequate sampling from the various components of the fishery, and accordingly

recommends (5)

that scientific investigation of the probable segregation of mature and immature Greenland halibut be continued and expanded, together with intensive sampling of the commercial catches.

3. Further Consideration at Annual Meeting of Cod in Divisions 2J, 3K and 3L

Following adoption of the Report of the Assessments Subcommittee and after discussion in the Commission about the projections of catch and spawning biomass provided for the cod stock in Div. 2J+3KL at 3 levels of F (0.10, 0.15 and 0.20, the last being $F_{0.1}$), STACRES was convened at the request of the Commission on 7 June 1977 to provide further projections of catch and biomass as follows:

- a) The catch and spawning biomass in each year of 1978-85 at a level of F in each year corresponding to the F in 1978 generating a catch of 135,000 tons; and
- b) The F and spawning biomass in each year corresponding to a constant catch of 100,000 tons, 120,000 tons, 140,000 tons, 150,000 tons and 160,000 tons.

The projections for (a) are given in Table 2, together with projections previously given by the Assessments Subcommittee (Appendix I) and also projections corresponding to a catch in 1978 of 120,000 tons. These projections (see also Fig. 1) indicate that the spawning biomass may recover to the target spawning biomass (1.5 million tons) by 1985, if the TAC is set at 125,000 tons in 1978 and a fishing mortality of 0.15 is maintained until 1985. The relative change in catch per unit effort (CPUE) is shown in Fig. 3(A).

The projections for (b) are given in Table 3 and displayed graphically in Fig. 2. These indicate that catches of 160,000 tons and less, if maintained during 1978-85, will result in a spawning biomass in 1985 greater than the target biomass. In fact, extrapolation of these projections (Fig. 2) indicates that even a constant catch of 200,000 tons, if maintained until 1985, is predicted to result in a biomass equivalent to the target spawning biomass by 1985. The relative change in CPUE for these projections is shown in Fig. 3(B).

STACRES noted that the Commission in the past has regulated stocks on the basis of maintaining a constant fishing mortality (F) rather than maintaining a constant catch, and the catch (TAC) has been adjusted each year as updated recruitment estimates become available to enable the maintenance of the constant level of F. In this way, a constant proportion of the stock is removed each year. The effects of this management strategy on future yields and biomass has also been evaluated, using a constant level of F.

If the Commission decides to manage the cod stock in Div. 2J+3KL on the basis of a constant catch rather than a constant F, STACRES wishes to point out that the effects of these constant catches and the F's generated by them were calculated using average recruitment values. From previous assessments of this stock, it is known that recruitment fluctuates substantially from year to year.

Table 2. Projections at various constant levels of F showing effects on the catches of cod on the stock in Div. 2J+3KL.

Fishing mortality (F)	Year	Stock size		Spawning stock		Relative CPUE	
		Number (10 ⁶)	Biomass (000 t)	Number (10 ⁶)	Biomass (000 t)		
0.100	1978	84.8	1,161	153	392	1.00	
	1979	111.8	1,468	223	533	1.26	
	1980	139.7	1,765	390	849	1.52	
	1981	162.3	2,028	457	1,039	1.75	
	1982	180.5	2,256	549	1,267	1.94	
	1983	196.4	1,810	618	1,479	2.12	
	1984	211.1	1,863	671	1,675	2.29	
	1985	226.7	1,902	710	1,849	2.44	
	0.145	1978	120.8	1,161	153	392	1.00
		1979	153.9	1,425	212	509	1.23
1980		186.2	1,671	356	776	1.44	
1981		212.0	1,877	403	914	1.62	
1982		232.0	1,645	474	1,085	1.76	
1983		247.9	1,697	526	1,240	1.90	
1984		262.9	1,735	564	1,380	2.02	
1985		278.1	1,762	591	1,500	2.12	
0.150		1978	124.2	1,161	153	392	1.00
		1979	158.0	1,420	211	506	1.22
	1980	191.7	1,661	352	768	1.43	
	1981	216.3	1,566	397	901	1.60	
	1982	236.4	1,635	467	1,067	1.75	
	1983	252.5	1,685	517	1,217	1.88	
	1984	267.8	1,722	553	1,351	1.99	
	1985	282.7	1,748	580	1,467	2.09	
	0.165	1978	134.9	1,161	153	392	1.00
		1979	171.1	1,407	208	499	1.21
1980		204.2	1,632	342	746	1.41	
1981		229.3	1,818	381	864	1.57	
1982		249.4	1,969	445	1,015	1.70	
1983		265.3	2,104	491	1,150	1.81	
1984		280.0	1,686	524	1,271	1.92	
1985		294.0	1,709	547	1,373	2.00	
0.200		1978	162.3	1,161	153	392	1.00
		1979	199.3	1,375	200	481	1.18
	1980	232.5	1,565	318	695	1.35	
	1981	256.7	1,716	345	781	1.48	
	1982	275.7	1,543	397	900	1.58	
	1983	290.4	1,579	433	1,004	1.67	
	1984	303.4	1,604	458	1,095	1.75	
	1985	316.9	1,622	476	1,171	1.81	

Table 3. Effects of keeping catches at constant levels during 1978-85 for the cod stock in Div. 2J+3KL.

Year	Fishing mortality (F)	Catch (000 t)	Stock size		Spawning stock		Relative CPUE
			Number (10 ⁶)	Biomass (000 t)	Number (10 ⁶)	Biomass (000 t)	
1978	0.119	99.9	1,117	1,161	153	392	1.00
1979	0.090	100.3	1,338	1,450	218	522	1.25
1980	0.071	100.1	1,522	1,760	387	843	1.52
1981	0.059	100.0	1,676	2,070	470	1,068	1.78
1982	0.051	100.3	1,803	2,371	590	1,361	2.04
1983	0.046	99.9	1,910	2,677	694	1,661	2.31
1984	0.041	100.1	2,002	2,984	783	1,965	2.57
1985	0.037	100.1	2,080	3,282	858	2,260	2.83
1978	0.144	120.1	1,117	1,161	153	392	1.00
1979	0.111	120.0	1,323	1,426	213	509	1.23
1980	0.089	120.0	1,495	1,712	369	805	1.47
1981	0.074	119.8	1,639	1,997	443	1,005	1.72
1982	0.065	119.8	1,759	2,275	555	1,274	1.96
1983	0.058	120.3	1,862	2,559	653	1,552	2.20
1984	0.052	119.7	1,951	2,846	737	1,834	2.45
1985	0.047	119.9	2,026	3,125	810	2,110	2.69
1978	0.171	139.9	1,117	1,161	153	392	1.00
1979	0.133	139.5	1,307	1,401	207	495	1.21
1980	0.108	140.1	1,468	1,663	352	767	1.43
1981	0.091	140.1	1,603	1,925	417	943	1.66
1982	0.079	140.0	1,716	2,180	521	1,189	1.88
1983	0.071	139.9	1,814	2,443	612	1,445	2.10
1984	0.064	140.1	1,899	2,709	692	1,705	2.33
1985	0.058	139.8	1,972	2,970	762	1,962	2.56
1978	0.183	150.0	1,117	1,161	153	392	1.00
1979	0.145	149.8	1,301	1,391	204	490	1.20
1980	0.118	150.1	1,455	1,640	343	749	1.41
1981	0.100	149.8	1,585	1,890	404	914	1.63
1982	0.087	149.7	1,695	2,134	504	1,147	1.84
1983	0.078	149.6	1,789	2,385	592	1,391	2.05
1984	0.070	150.3	1,872	2,641	669	1,641	2.27
1985	0.064	150.0	1,943	2,891	737	1,886	2.49
1978	0.200	162.3	1,117	1,161	153	392	1.00
1979	0.159	160.1	1,291	1,375	201	481	1.18
1980	0.129	160.6	1,439	1,611	333	726	1.39
1981	0.110	160.0	1,565	1,848	389	879	1.59
1982	0.097	160.0	1,671	2,081	485	1,101	1.79
1983	0.086	160.1	1,762	2,321	569	1,332	2.00
1984	0.077	160.0	1,843	2,565	644	1,570	2.21
1985	0.070	160.3	1,913	2,806	710	1,806	2.42

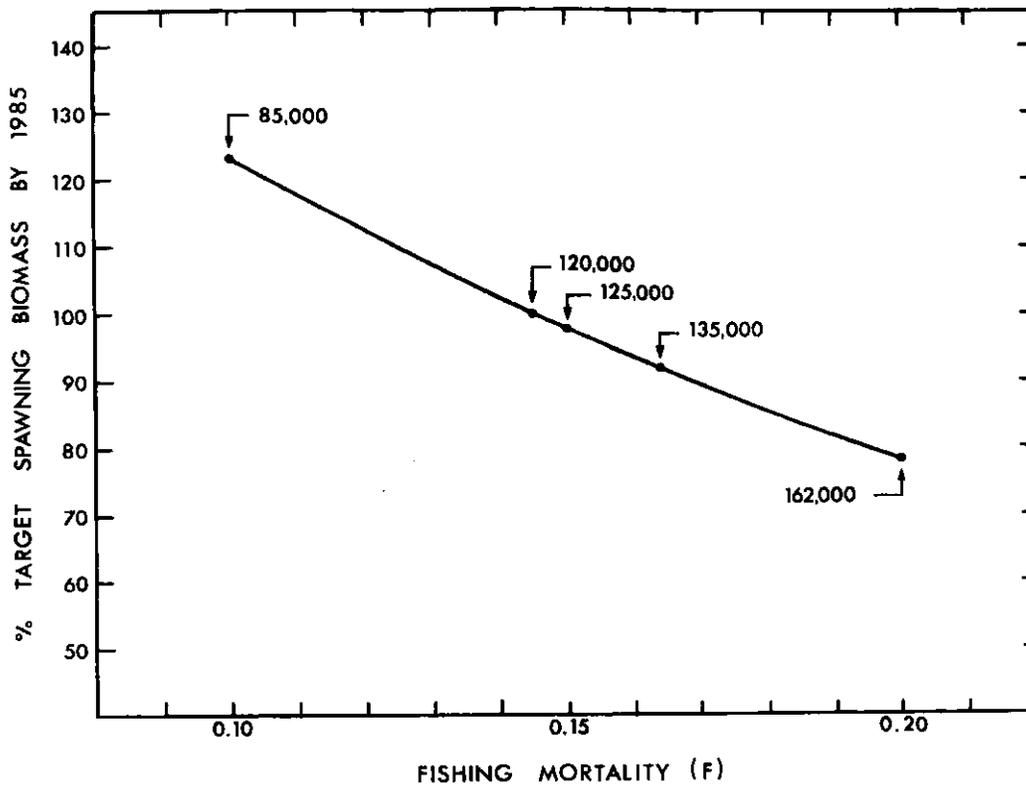


Fig. 1. Percent of target spawning biomass (1.5 million tons) achieved by 1985 under various levels of constant F. (Values indicated at the arrows are TACs for 1978.)

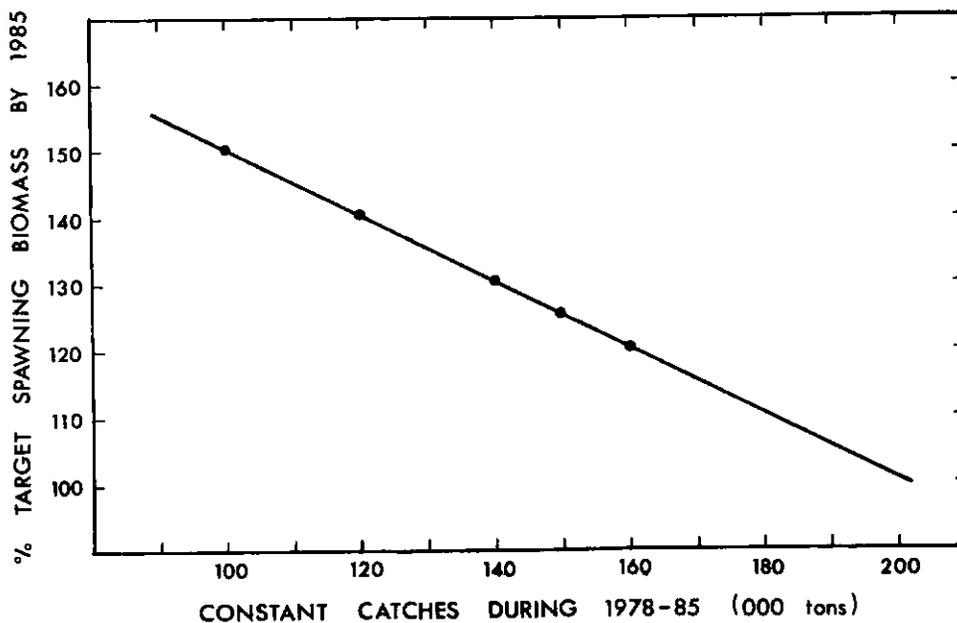


Fig. 2. Percent of target spawning biomass (1.5 million tons) achieved by 1985 under various levels of constant catch (TAC).

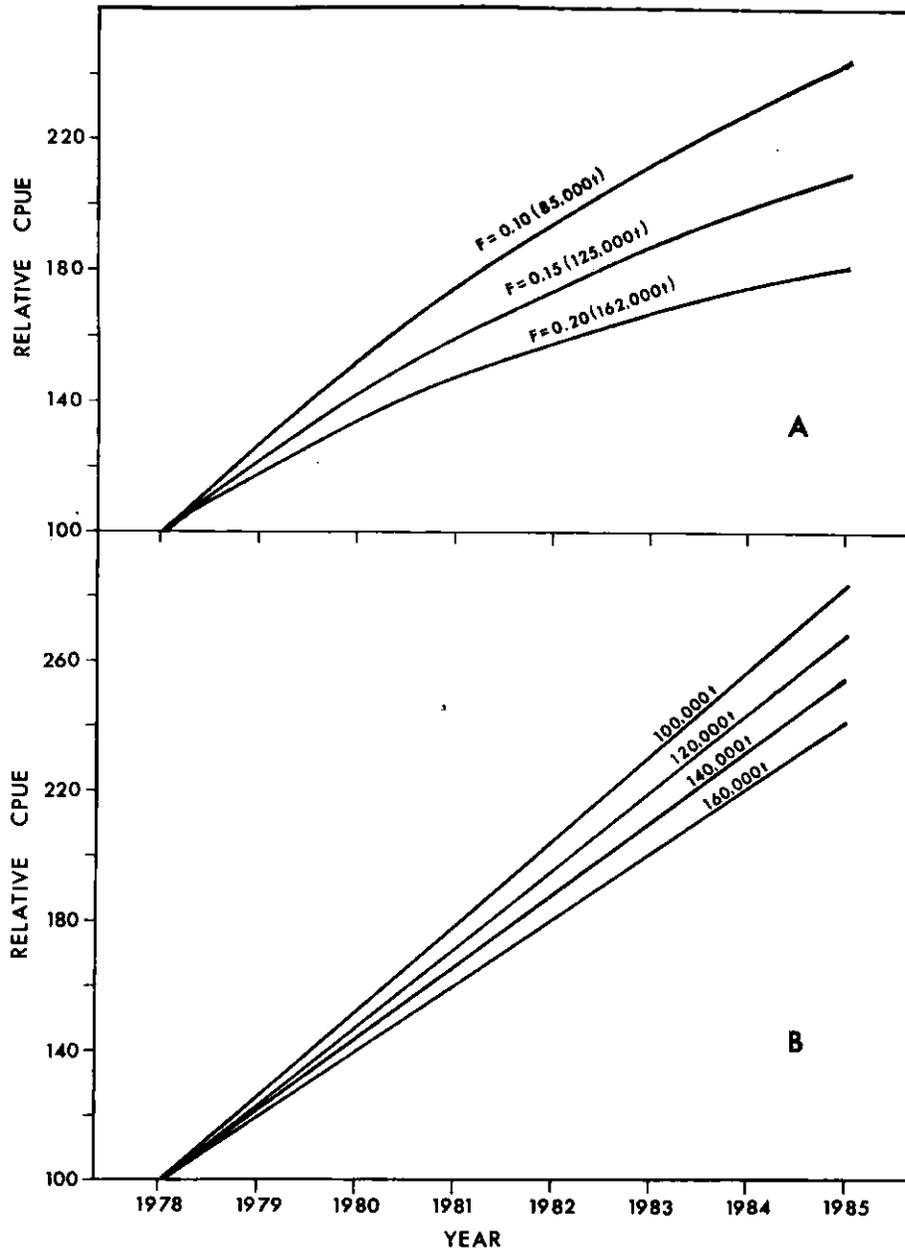


Fig. 3. Relative catch per unit effort for (A) various levels of constant F, and (B) various levels of constant catch (TAC).

If, in fact, future recruitment is greater than the average assumed in these projections, the F-values will be lower than those calculated for the years after 1978 and the biomass will recover more rapidly. If, on the other hand, future recruitment is less than that assumed in the projections, the F-values will be greater than those calculated and the biomass will recover at a slower rate and may even decline under poor recruitment conditions. STACRES expresses its concern over the possibility of the latter situation occurring, and points out that it sees no advantage in setting TACs for more than one year in advance, since the annual updating of the assessments incorporates revised recruitment estimates which result in updated estimates of the stock size. Therefore, the level of constant catch may not necessarily achieve the result originally projected, and the TAC may in any case have to be adjusted periodically.

II. STATISTICS AND SAMPLING (APP. II)

1. CWP Activities and Plans for its Ninth Session

The Secretary of the CWP (Coordinating Working Party on Atlantic Fisheries Statistics) reported that plans for its Ninth Session, to be held at ICNAF Headquarters during 17-25 August 1977, were well advanced and that representatives are expected to attend from ICNAF, ICES, ICCAT, ICSEAF, FAO, OECD and EUROSTAT. STACRES reconfirms that the ICNAF representatives will be the Assistant Executive Secretary, the Chairman of the Statistics and Sampling Subcommittee, and Mr P. Hart who has been nominated by Canada.

2. ICNAF Statistical Activities

The late reporting of data continues to affect the timely compilation of statistical reports for subcommittees and working groups and also for publication, particularly the Statistical Bulletin. STACRES noted that advance statistics for the April 1977 Meeting of the Assessments Subcommittee were incomplete and that information on discards continues to be very inadequate. STACRES again urges that member countries make every effort to improve the quality of their fisheries statistics and to adhere to the established deadlines for reporting.

Concerning the great inadequacy of discard information, STACRES agreed that these data were essential for assessment work and were required earlier in the year than the previous deadline of 31 July. STACRES accordingly

recommends (6)

that the Secretariat circulate guidelines for improved discard statistics, requesting each country to appoint a scientist to investigate and report on the discarding aspect of his (her) country's fisheries in the Northwest Atlantic and to assist in the provision of adequate discard statistics.

In the light of the recent implementation of coastal state jurisdiction and the present uncertainty about the requirements of the coastal states for detailed catch and effort statistics for assessment and management purposes, STACRES considered that the recently established ICNAF requirement for countries to report by small unit areas on STATLANT 21B might be a duplication. STACRES therefore

recommends (7)

that countries not be required to report by 30' x 30' unit areas and twice-monthly periods for 1976 and 1977 data, but that they continue to complete STATLANT 21B in accordance with past practices.

3. ICNAF Sampling Activities

STACRES was informed that serious deficiencies in the level of sampling activity continue to exist, the minimum sampling requirement in 1975 having been met for just over 50% of the stocks (52 stocks were analyzed), with cod, redfish, Greenland halibut, roundnose grenadier and capelin being the species most seriously affected. Much of the data was lacking in quality, particularly with respect to the reporting of length data by sex for some species and the complete lack of age-length keys for much of the length frequency data. It was agreed that the advance reporting of sampling data for assessment purposes should continue in accordance with recent procedures, and member countries are again urged to improve on their collection and reporting of sampling data.

STACRES noted that the *ad hoc* Working Group on the Implementation of an ICNAF Sampling Data Base met briefly and concurred with its view that planning for the establishment of a detailed data base is currently premature, considering the uncertainty about the future requirements of the coastal states. However, STACRES welcomed the work of the Secretariat in computerizing existing sampling data and providing the data to interested scientists upon request, considering that no detailed data have been published in Sampling Yearbook since that of 1972.

4. List of Vessels

It was decided that the ICNAF List of Vessels containing data for 1977 should be published, and that the data for 1976 be presented in a Summary Document as was the case for the 1975 data.

5. International Observer Program

STACRES reiterates its support for the Scientific Observer Scheme as a means of improving sampling at sea and of obtaining better information on by-catches and discards.

III. BIOLOGICAL SURVEYS (APP. III)

1. Survey Activities and Plans

Survey activity in 1976 and plans for 1977 are on about the same scale as in 1975. Groundfish and pelagic survey activity in 1976 were reviewed country by country in relation to survey objectives. Many surveys represent time series too short for validation in relation to independent sources of information, but abundance and pre-recruit indices of cod and flatfish have proved their worth.

2. Coordination of Biological Surveys

In the light of the discussion by the Subcommittee on the possibility for coordinating survey activity, STACRES further discussed the role of the Subcommittee in this regard. Although the annual reviews of surveys carried out in the preceding year and planned for the current year are valuable, it was nevertheless noted that such reviews do not by themselves lead to coordination of surveys. It was agreed that coordination could best be planned if the needs for surveys in the year following the Annual Meeting were discussed by the Subcommittee. This might enable individual laboratories to take such needs into account when planning their research activities. STACRES accordingly

recommends (8)

that the Biological Surveys Subcommittee in consultation with the Assessments Subcommittee specify future needs for surveys at each Annual Meeting, and that laboratories take proper account of such needs when planning their research activities.

STACRES further agreed that a major role of the Biological Surveys Subcommittee is to ensure that the best possible background for comparison between the various countries' surveys, for example, through the adoption of stratification schemes, standardization of survey methods, etc. (see paragraph 4 below). A further role of the Subcommittee would be to carry out analyses of survey results (see paragraph 6 below).

3. Processing Facilities for Survey Data

STACRES was informed that no data had yet been received by the Secretariat for processing in accordance with the pilot project established at the 1976 Annual Meeting. It was noted that data for Federal Republic of Germany surveys would be delivered to the Secretariat in August 1977.

4. ICNAF Manual for Groundfish Surveys

STACRES was informed that drafts of most of the sections of the Manual for Groundfish Surveys had been received and were under review by the Editorial Working Group, which met briefly at this Annual Meeting to discuss preferred survey methods and to finalize editorial policy. A draft of the Manual is expected to be available for consideration at the 1978 Annual Meeting.

5. Hydroacoustic Surveys

Combined hydroacoustic and photographic methods used in conjunction with trawl surveys by three countries were discussed. Acoustic methods for groundfish surveys are still being developed, but acoustic surveys for pelagic species, especially capelin, are resulting in abundance indices which are used in the assessments.

6. Other Matters

- a) A stratification scheme for Div. 3M (Res. Doc. 77/VI/29) was reviewed and adopted. It was noted that the Environmental Subcommittee is planning a two-year study of factors which influence the cod and redfish stocks of Flemish Cap (Div. 3M) and that this study will include stratified surveys of juvenile and adult fish (see Appendix IV, Annex 1).
- b) In considering the need for a comprehensive review of survey results in relation to abundance indices, STACRES

recommends (9)

that the Biological Surveys Subcommittee meet in advance of the 1978 Annual Meeting of STACRES for a sufficient period to review systematically the precision of survey results to date and that scientists from the member countries make available the data necessary for this purpose.

IV. ENVIRONMENTAL STUDIES (APP. IV)

1. The Flemish Cap Project

In accordance with a STACRES recommendation at the 1976 Annual Meeting (*Redbook* 1976, page 60), a group of scientists from Canada, Poland, USSR and USA met at Murmansk, USSR, during 16-19 May 1977 under the Chairmanship of Dr Konstantinov (USSR) to discuss the suitability of Flemish Cap as an area worthy of special study, and, since the outcome of this appraisal was favourable, the Working Group set up plans for a coordinated international project. STACRES noted that further planning had been discussed by the Environmental Subcommittee, and accordingly

recommends (10)

- i) that a coordinated international research project be launched on the factors determining year-class success for Flemish Cap (Div. 3M) groundfish, with emphasis on cod and redfish;*
- ii) that a planning group of national representatives be formed to plan the Flemish Cap project; and*
- iii) that the Task Force Leader of the planning group be a Canadian scientist who will be involved in the Flemish Cap Project.*

Three major problem areas were identified for investigation: (a) larval fish survival and retention, (b) juvenile fish survival, and (c) assessment of cod and redfish spawning stocks. It is suggested that initial investigations should begin in 1978 and that a comprehensive program commence in 1978. Member countries intending to support the Flemish Cap Project are urged to name their representative(s) as soon as possible.

2. ICNAF Larval Herring Surveys

Larval herring surveys in the Georges Bank-Nantucket Shoals area were conducted again in 1976, the sixth consecutive year of intensive monitoring of herring larval production in the area. Preliminary results indicate that the 1976 larval herring production on Georges Bank is the lowest observed to date. Plankton sorting, computer processing and analysis of the larval herring time series of data, as well as the processing of hydrographic, nutrient and primary production data are still in progress. Monitoring of the larval herring production on Georges Bank is expected to continue in 1977 and 1978, with participation by Federal Republic of Germany, German Democratic Republic, Poland, USSR and USA, and by two Canadian vessels in 1978.

3. Marine Environmental Data Service (MEDS)

In order to aid MEDS in its data acquisition and development role, STACRES

recommends (11)

that a form for providing an inventory of oceanographic station data (see Appendix IV, Annex 2) be adopted, completed by each country and submitted to MEDS by 31 March of each year.

The possibility of having MEDS assist in various analyses was emphasized, and MEDS is expected to prepare a unified assessment of environmental conditions in the ICNAF Area for 1977 prior to the 1978 Annual Meeting.

4. Standard Oceanographic Sections and Stations

The list of standard oceanographic sections and stations was sent to all member countries in late 1976 (Circular Letter 76/79) with the request that they be occupied whenever possible. It was noted that the list will be published in one of the ICNAF publication series for wide distribution.

5. Plankton Sorting Centre

STACRES welcomed a progress report on the activities of the Plankton Sorting and Identification Centre at Szczecin, Poland, noting that it had expanded and was devoting virtually its entire attention to the ICNAF data.

6. Weather and Ice Reporting by Fishing Vessels

The Secretariat is requested to contact the relevant meteorological and ice forecasting institutes to determine how successful the reporting of meteorological data by fishing vessels is and whether they wish the program to be extended further.

7. Environmental Conditions in 1976

A review of environmental conditions in the ICNAF Area in 1976 is given in Appendix IV, section 3. It is noted that unusual conditions occurred in some of the subareas during 1976.

V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Ageing Workshop on Cod (Summ. Doc. 77/VI/12; Res. Doc. 77/VI/13)

STACRES noted that the report of the workshop, held at Vigo, Spain, in October 1975, has been published in *Selected Papers* No. 2 which was issued in February 1977. As a follow-up to ageing problems evolving from that workshop, another workshop on the ageing of cod, convened by Mr R. Wells, was held at St. John's, Newfoundland, Canada, during 31 January-5 February 1977. The experts dealt specifically with problems of ageing cod from the stock in Div. 2J, 3K and 3L. Because the age determinations had been made through otolith and photograph exchanges prior to the workshop, the participants were able to devote their time to examining in detail the causes of the apparent discrepancies in ageing. STACRES agreed that the information now available was sufficient for the development of a set of guidelines for otolith interpretation, and Mr Wells was requested to do this in collaboration with other interested experts. STACRES indicated that the guidelines should be prepared as soon as possible, circulated to experts for comment and presented as a document for review at the 1978 Annual Meeting.

2. Ageing Workshop on Silver Hake (Summ. Doc. 77/VI/13; Res. Doc. 77/VI/25)

After several attempts to organize a meeting of experts to discuss the ageing of silver hake, a workshop, convened by Mr J. Hunt, was held at St. Andrews, New Brunswick, Canada, during 14-18 March 1977. It was noted that both sectioned and whole otoliths could be used for ageing, and that the presence of a "pelagic" zone in the otolith may have been the partial cause of past discrepancies in ageing. It was also noted that age compositions based on otolith interpretations agreed well with age compositions based on modal analysis, at least for age-groups 1 to 3. Having considered the conclusions of the workshop, STACRES

recommends (12)

- i) that another workshop on the ageing of silver hake be held during the first quarter of 1978 and that Mr J. Hunt be requested to act as convener;*
- ii) that particular attention be given to a more detailed description of otolith types, size of the first annulus, etc., with respect to geographical location, and including analysis of the variation in the size of the otolith at ages 1 and 2;*
- iii) that otolith and photograph exchanges be carried out prior to the workshop so that discussions at the workshop can be devoted to problems of interpretation based on pre-read otoliths; and*
- iv) that member countries planning to do work on the ageing of silver hake should take advantage of the workshop for training purposes.*

3. Review of Papers on Validation Studies

STACRES noted that no papers on this subject were available, except for Res. Doc. 77/VI/25. However, a paper on the age and growth of butterfish was reviewed (Res. Doc. 77/VI/27). It was pointed out that ageing by otoliths was probably the best method and that interpretation was relatively easy for ages 1 to 3. STACRES welcomed this contribution as the first involving the ageing of butterfish and hoped that such studies will be continued.

VI. GEAR AND SELECTIVITY

1. Trawl Materials and Mesh Size Sampling for 1976 (Summ. Doc. 77/VI/28)

STACRES was informed that returns for 1976 had been received from 9 member countries, of which 3 reported that no data were available. Considering the incompleteness of the data, STACRES questioned the need to continue compiling such data if they were not used by scientists. It was agreed that there was no need to continue acquiring the data for STACRES but that the possible interest of STACTIC in the data should be taken into account.

2. Need for Selectivity Studies on Silver Hake

STACRES noted the concern of the Assessments Subcommittee that firm advice about the consequences of

the silver hake mesh regulation in Div. 4VWX cannot be made without stronger experimental evidence, and accordingly

recommends (13)

that mesh selection experiments be carried out in 1977 to determine the consequences of the mesh size regulations for silver hake in Div. 4VWX

VII. TAGGING ACTIVITIES IN 1976

1. International Herring Tagging Program

STACRES noted that the Assessments Subcommittee had reviewed the progress achieved in the herring tagging program (Summ. Doc. 77/VI/16; 77/VI/19), plans for which were drawn up at the 1976 Annual Meeting (*Redbook* 1976, pages 62 and 153). It was pointed out that the tagging objectives for 1976 were in most cases achieved, but that the joint USSR-USA project to tag 60,000 fish in Subdiv. 5Zw and Div. 6A was hampered by not finding adequate concentrations of herring. However, during the first half of May 1977, about 23,000 fish were tagged in Subdiv. 5Ze near the boundary line of Subdiv. 5Ze and 5Zw. It was reported that further tagging experiments were planned for 1977. STACRES was pleased with progress to date and expressed the wish that progress reports on these activities be available before the 1978 Meeting of the Assessments Subcommittee. Concern was expressed that the "seeding" experiments, which were to be carried out on fishing vessels to assess the recovery rate of recaptures, had not been reported for the 1976 fishery. The representative of Federal Republic of Germany indicated that the fishing vessels had already left for the fishing grounds by the time that the tags became available but that the experiments would be carried out during the 1977 fishery. It was noted that some experiments were carried out on German Democratic Republic vessels and that these would be reported to the Secretariat soon. STACRES stressed the importance of the "seeding" experiments and urges that they be continued where necessary and reported as soon as possible.

2. Other Tagging Activities

STACRES noted the compilation of tagging experiments on a variety of species, as reported to the Secretariat for 1976 (Summ. Doc. 77/VI/19), and agreed that present procedures for acquiring and reporting on such information should be continued.

VIII. REVIEW OF RESEARCH PAPERS IN STACRES

1. STACRES noted that most of the research documents had been reviewed by the various subcommittees and working groups, except for the following:
 - a) Res. Doc. 77/VI/23. Further to studies reported at the 1976 Annual Meeting, this paper presents results on the biology of salmon taken during May-July 1976 near St. Pierre and Miquelon. Data on length, weight, age, sex, maturity and stomach contents are given, together with information on environmental conditions and the behaviour of salmon.
 - b) Res. Doc. 77/VI/47. Two programs for stock assessment by programable pocket calculators were presented (virtual population analysis and catch projection). STACRES appreciates the interchange of such information between scientists and would welcome other similar reports.

IX. COLLABORATION WITH OTHER ORGANIZATIONS

1. The Chairman informed the meeting that the Report of the Joint ICES/ICNAF Salmon Tagging Experiment was not yet in the final stage for publication. Considering the great delay in the preparation of this publication, STACRES urges that the editors should finalize the contributions, which have been received, for publication as soon as possible, even if not all of the planned contributions are received.
2. STACRES noted with appreciation that the contributions to the ICES/FAO/ICNAF Symposium on Acoustic Methods in Fisheries Research, held at Bergen, Norway, in June 1973, have now been published in *ICES Rapports et Procès-Verbaux* Vol. 170.
3. STACRES noted that the Ninth Session of the Coordinating Working Party on Atlantic Fisheries Statistics (CWP) will be held at ICNAF Headquarters during 17-25 August 1977, and expressed its great appreciation for the continuing interest of FAO in ICNAF activities by the active participation of the Secretary of the CWP (Mr L. P. D. Gertenbach) in the work of STACRES and its Subcommittee on Statistics and Sampling.

4. STACRES was informed that the ICES Symposium on the Biological Basis of Pelagic Fish Stock Management is planned to be held in United Kingdom in July 1978 and that ICES would welcome co-sponsorship or support by ICNAF and FAO. It was noted that a suggested list of invited papers contain examples of reactions of pelagic stocks to exploitation and management within the ICNAF Area (Northwest Atlantic mackerel, Georges Bank herring) and that general assessment and management problems to be considered are of great interest to ICNAF. STACRES accordingly

recommends (14)

that ICNAF co-sponsor the Symposium on the Biological Basis of Pelagic Fish Stock Management and that Canada be requested to nominate a scientist to represent ICNAF on the planning group for the symposium.

With reference to the interest of STACRES in co-sponsoring the symposium, the Commission may wish to consider that an appropriate amount be budgeted for co-sponsorship. Earlier ICNAF contributions to similar arrangements have generally been \$5,000.00.

5. STACRES was informed that ICES is now planning the Second International Symposium on the Early Life History of Fish. The preliminary planning undertaken by the chairmen of some of the ICES committees will be presented at the 1977 Annual Meeting of ICES. ICNAF, together with SCOR and FAO (ACMRR), is invited to cooperate with ICES on the arrangements for this symposium and to consider support. STACRES expressed a general interest in the problems to be considered and suggested that the ICNAF Secretariat cooperate with ICES in the early planning for the symposium. It was noted that no decision has yet been made on the time and place for the symposium, and it was agreed that further consideration of co-sponsorship by ICNAF could best be dealt with at a later stage but that STACRES should, in principle, support the symposium.

X. STEERING AND PUBLICATIONS

1. Status of Subcommittees and Working Groups

STACRES discussed the status of its organization and agreed that there should be no change in its present structure at this time but that the situation should be reviewed annually.

2. Scientific Problems Arising Under the New Fisheries Management Regime

At the 1976 Annual Meeting, STACRES discussed its future status and pointed out the need for continued international cooperation in regard to the reporting of fisheries statistics and biological data, and for the coordination of research activities. It was further noted that STACRES could serve as the forum for discussion on general problems of fisheries science and management in the Northwest Atlantic. Since the 1976 Annual Meeting, coastal states have extended their jurisdiction for fisheries management and one coastal state has withdrawn from the Commission. Proposals for amendment to the Convention, adopted at the Special Commission Meeting in December 1976, have resulted in the situation where the Assessments Subcommittee advised on TACs only for those stocks for which a request for advice was expressed by the coastal states and the Commission. These events seem to have influenced the amount of general scientific information presented in research documents for the present meeting. In terms of the number of documents, the amount of scientific information concerning the ICNAF Area and its stocks is less than one-half of the amount of information provided at the last Annual Meeting. Although scientific information cannot be measured strictly in terms of the number of papers presented, it nevertheless seems clear that STACRES, or its successor, could be faced with the problem of ensuring an adequate supply of scientific information. Since no fish stocks are completely biologically isolated from other stocks or organisms in the water, STACRES points out the need for good scientific coverage of all aspects of the marine life, its environment and its exploitation by man to ensure the maintenance and improvement of the scientific base for fisheries management in the Northwest Atlantic.

3. Review of Publications

The Executive Secretary reviewed the various ICNAF publications as reported in the 1976/77 Administrative Report (Comm. Doc. 76/VI/6). It was noted that only four papers have been approved for the next volume of *Research Bulletin* (No. 13), and it was agreed that the Secretariat should make another request for contributions. It was reported that the research papers on shrimp, selected from documents presented to the December 1976 Special Meeting for inclusion in *Selected Papers* No. 3, have been sent to the authors for final revision, and that Dr E. J. Sandeman (Canada) has kindly agreed to edit this volume. Authors of these papers are urged to complete their work as soon as possible in accordance with the instructions circulated by the Editor.

4. After review by members of the Steering and Publications Subcommittee and by chairmen of the other subcommittees, STACRES agreed that the following papers be considered (subject to approval of the

authors and with appropriate revision) for publication in *Selected Papers* No. 4: Res. Doc. 76/XII/134, 138, 144, 145, 159 and 164; Res. Doc. 77/VI/2, 6, 10, 14, 22, 24, 27, 32+33, 38 and 42; Summ. Doc. 77/VI/13. It was noted that the authors might wish to consider Res. Doc. 77/VI/22 and 27 for publication in the Research Bulletin. It was proposed that Summ. Doc. 77/VI/12 be published in 1978, following the incorporation of the guidelines on the ageing of cod.

XI. FUTURE SCIENTIFIC MEETINGS

1. STACRES noted that the Assessments Subcommittee had not found it possible at this meeting to advise on conservation of shrimp stocks in Subarea 1 for 1978. Assessment for such advice can only be made when data for the major part of the 1977 fisheries become available. It was thought that a period of 5 days would be sufficient, should the Commission request advice, and that the meeting could best be held in late November or early December 1977. The Commission should in this case consider whether a full meeting of STACRES is necessary or whether a meeting of Panel Advisers would be adequate.
2. STACRES noted that the Assessments Subcommittee had completed its April 1977 Meeting in 8 days. This was due partly to the limited number of stocks considered and partly to the work being carried out in concurrent meetings of two working groups. The time needed for the Assessments Subcommittee in 1978 is tentatively proposed to be not more than 8 days but this will depend upon the requests for advice and the specific topics to be considered. STACRES considered that April is the best time for the Assessments Subcommittee to meet but emphasized that overlapping with meetings of ICES working groups or committees should be avoided in so far as possible. It was agreed that the April 1978 Meeting of the Assessments Subcommittee will be held at ICNAF Headquarters.
3. A further workshop on the ageing of silver hake is planned to be held in the first quarter of 1978. Canada has kindly offered to accommodate the workshop, which is to be convened by Mr J. Hunt (Canada).
4. In accordance with a STACRES recommendation establishing a planning group for the Flemish Cap Project, it was agreed that the group should be organized as soon as possible and meet at a time and place to be decided by its members.
5. STACRES agreed to meet, together with its Subcommittees, in advance of the 1978 Annual Meeting of the Commission, with sufficient time allotted for the Biological Surveys Subcommittee to complete its planned detailed analyses of survey data.

XII. OFFICERS FOR 1977/78

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

STACRES	- Dr A. W. May, Canada (elected)
Assessments Subcommittee	- Mr A. T. Pinhorn, Canada (re-elected)
Statistics and Sampling Subcommittee	- Dr J. Messtorff, Fed. Rep. Germany (re-elected)
Biological Surveys Subcommittee	- Dr W. Doubleday, Canada (re-elected)
Environmental Subcommittee	- Mr E. J. Sandeman, Canada (re-elected)
2. Members of the Steering and Publications Subcommittee were confirmed as follows:

Canada	- Dr A. W. May
Denmark, Fed. Rep. Germany, UK	- Dr A. Schumacher (Fed. Rep. Germany)
Cuba, France, Portugal, Spain	- Mr R. H. Letaconnoux (France)
Iceland, Italy, Japan, Norway	- Dr F. Nagasaki (Japan)
Bulgaria, German Dem. Rep., Poland, Romania, USSR	- Dr V. A. Rikhter (USSR)
<i>Ex officio</i> Chairman	- Chairman of STACRES

XIII. ACKNOWLEDGEMENT

1. The Chairman of STACRES expressed appreciation to Canadian colleagues for the hospitality provided, to the Secretariat for their usual efficient work, to the Chairmen and Rapporteurs of Subcommittees and to the Rapporteur and members of STACRES for their cooperation during the course of this and earlier meetings in 1977.
2. STACRES expressed its thanks to Mr Sv. Aa. Horsted for agreeing to preside over this meeting upon very short notice and whose past experience as Chairman of STACRES contributed greatly to the efficient operation of the Committee, and also to Dr F. Nagasaki who presided over the final session of STACRES in the absence of Mr Horsted.

APPENDIX I. REPORT OF ASSESSMENTS SUBCOMMITTEE

Chairman: A. T. Pinhorn

The Subcommittee met at ICNAF Headquarters, Dartmouth, Canada, during 19-27 April 1977 to review the state of and advise on catch levels in 1978 for certain stocks in Statistical Area 0 and Subareas 1 to 4 (see Part D, this volume, for STACRES Agenda). Representatives attended from Canada, Cuba, Denmark, France, Federal Republic of Germany, German Democratic Republic, Japan, Poland, Portugal, Spain and USSR, and observers from USA. The review of catch levels was carried out in two working groups of the Subcommittee as follows: Working Group No. 1 (convened by E. C. Lopez-Veiga) reviewed the relevant stocks of cod, redfish, Greenland halibut, roundnose grenadier and shrimp; and Working Group No. 2 (convened by G. H. Winters) reviewed the relevant stocks of American plaice, witch flounder, yellowtail flounder, silver hake, argentine, capelin and squid. The results of these discussions are given in sections II and III below.

Since the 1976 catch statistics available to the Subcommittee were confined to species and stocks under present or prospective catch quota regulation, the Chairman was requested to prepare the usual summary of fishery trends from more complete catch statistics that would be available at the 1977 Annual Meeting. Section I therefore contains a summary of fishery trends in 1976, which was prepared for inclusion in this report prior to its adoption by STACRES.

I. FISHERY TRENDS

1. General Trends in the ICNAF Area

Provisional nominal catches in the Northwest Atlantic for 1976, as compiled from STATLANT 21A returns of all 18 member countries of ICNAF in 1976, were available at the 1977 Annual Meeting (Summ. Doc. 77/VI/29), and these are summarized by subarea in Table 1, together with comparable figures for 1975. It is important to note that the catch figures for 1976 used in this section of the report may differ slightly from those used in sections II and III, the latter figures having been based on preliminary advance statistics provided prior to the April 1977 Meeting of the Subcommittee.

Table 1. Nominal catches (000 tons) in 1975 and 1976¹. (The symbol + indicates less than 500 tons.)

Species	SA 0		SA 1		SA 2		SA 3		SA 4		SA 5		SA 6		Total	
	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976
Cod	+	-	48	33	89	41	314	273	154	150	33	30	1	+	639	526
Haddock	-	-	-	-	-	-	2	+	20	19	7	6	+	+	29	25
Redfish	+	+	9	14	15	16	88	82	93	55	11	11	+	+	216	178
Silver hake	-	-	-	-	-	-	4	+	116	97	87	69	27	12	234	178
Red hake	-	-	-	-	-	-	1	-	3	1	18	21	11	8	33	30
Pollock	-	-	+	+	+	1	+	1	25	24	14	13	+	+	39	39
Flounders	2	5	26	13	15	11	113	109	46	49	36	35	10	10	248	233
Roundnose grenadier	+	3	5	6	12	7	16	14	-	-	-	-	-	-	33	29
Other groundfish	+	-	13	13	3	2	13	12	41	18	15	13	11	10	96	69
Herring	-	-	+	+	1	1	23	29	241	199	178	93	5	1	448	322
Mackerel	-	-	-	-	-	-	4	5	32	28	167	102	84	106	287	242
Other pelagics	-	-	+	-	-	-	+	+	1	1	35	54	185	265	221	320
Argentine	-	-	-	-	-	-	+	+	15	7	1	+	+	-	16	7
Capelin	-	-	1	+	145	95	221	265	+	+	-	-	-	-	367	361
Other fish	-	+	3	2	7	1	20	7	43	31	40	20	37	33	150	93
Squids	-	-	-	+	-	-	4	11	14	28	17	24	35	23	70	86
Shrimp	-	+	38	50	+	+	+	+	5	5	5	1	+	1	48	57
Other invertebrates	-	-	-	-	-	-	3	4	30	40	126	152	488	426	647	622
All species ²	2	8	143	132	287	175	826	811	879	752	790	644	894	895	3821	3417

¹ Nominal catches for 1976 are based on STATLANT 21A reports compiled for the 1977 Annual Meeting.

² Except seaweeds.

The total nominal catch of all finfish and invertebrates declined from 3.8 million tons in 1975 to 3.45 million tons in 1976 (10%), after having declined from 4.0 million tons in 1974. The total groundfish catch declined from 1.6 million tons in 1975 to 1.3 million tons in 1976 (19%); within this category, significant decreases occurred in the catch of cod (18%) mainly in Subareas 1 to 3, redfish (18%) mainly in Subarea 4, silver hake (24%), and "other groundfish" (28%). The total pelagic fish catch declined from 956,000 tons in 1975 to 884,000 tons in 1976 (8%); within this category, the catch of herring declined by 28% and mackerel by 16%, although the catch of "other pelagics" increased by 44% due almost entirely to an increased catch of menhaden in Subarea 5 and Stat. Area 6. Catches in the "other fish" category declined from 532,000 tons in 1975 to 461,000 tons in 1976 (13%); within this category, declines occurred in the catch of argentine (56%) and "other fish" (38%), while the capelin catch remained at about the same level as in 1975. The total catch of invertebrates (765,000 tons) was the same as in 1975; within this category, increases occurred in the catch of squid (23%) and shrimp (19%), but these were offset by a general decline in the catches of other invertebrates (4%). It should be noted that declines in catches from 1975 to 1976 do not necessarily imply declining stocks but may in some instances be due to conservation measures.

2. Statistical Area 0

The total nominal catch of all species increased from 2,100 tons in 1975 to 7,600 tons in 1976. The 1976 catch consisted mostly of 4,900 tons of Greenland halibut and 2,600 tons of roundnose grenadier, whereas the catches of those species in 1975 were 1,600 tons and 200 tons respectively. In addition, about 300 tons of cod were reported in 1975 but none in 1976.

3. Subarea 1

The total nominal catch of all species decreased from 143,000 tons in 1975 to 132,000 tons in 1976 (8%). The catch of cod continued to decline from 48,000 tons in 1975 to 33,000 tons in 1976 (31%), flounders (mainly Greenland halibut) from 26,000 to 13,000 tons (50%), and Atlantic salmon from 2,030 to 1,175 tons (42%). Increases occurred in the catch of redfish from 9,000 to 14,000 tons (56%) and shrimp from 38,000 in 1975 to 50,000 tons in 1976 (32%). The catches of other species remained approximately the same as in 1975.

4. Subarea 2

The total nominal catch of all species decreased from 287,000 tons in 1975 to 175,000 tons in 1976 (39%). The catch of cod declined from 89,000 to 41,000 tons (54%), flounders mainly Greenland halibut) from 15,000 to 11,000 tons (27%), roundnose grenadier from 12,000 to 7,000 tons (42%) and capelin from 145,000 to 95,000 tons (34%). The catch of redfish was approximately the same in both years.

5. Subarea 3

The total nominal catch of all species declined from 826,000 tons in 1975 to 811,000 tons in 1976 (2%). The groundfish catch decreased by 11% from 551,000 to 491,000 tons; in this category, decreases occurred in the catch of cod (13%), redfish (7%), flounders (4%), roundnose grenadier (13%), while the combined catch of other groundfish declined by 35%. The total catch of pelagic fish increased from 27,000 tons in 1975 to 34,000 tons in 1976 (26%), due almost entirely to an increase in the herring catch from 23,000 to 29,000 tons. Catches in the "other fish" category increased from 241,000 tons in 1975 to 272,000 tons in 1976 (13%), with the catch of capelin having increased by 20% and the small catch of other species having decreased by 65%. The total catch of invertebrates increased from 7,000 tons in 1975 to 15,000 tons in 1976 (114%) due largely to an increase in the catch of squid (*Illex*) from 4,000 to 11,000 tons.

6. Subarea 4

The total catch of all species declined from 879,000 tons in 1975 to 752,000 tons in 1976 (14%). The total groundfish catch decreased from 498,000 to 413,000 tons (17%), most of the decline being attributable to decreasing catches of redfish (41%), silver hake (16%), and "other groundfish" (56%), with the catches of other principal groundfish being approximately the same as in 1975. The total catch of pelagic species decreased from 274,000 tons in 1975 to 228,000 tons in 1976 (17%), due almost entirely to a decline in the catch of herring (17%). The total catch of species in the "other fish" category declined from 58,000 to 38,000 tons (34%); within this group, the catch of argentine declined by 53% and other species by 28%. The total catch of invertebrates increased from 49,000 tons in 1975 to 73,000 tons in 1976 (49%), of which the squid catch increased by 100% and "other invertebrates" by 33%.

7. Subarea 5

The total catch of all species declined from 790,000 tons in 1975 to 644,000 tons in 1976 (18%).

The catch of groundfish species declined by 10% from 221,000 to 198,000 tons, due largely to a decline in the silver hake catch (21%), with the catches of other species in the group being approximately the same or slightly below those of 1975. The total catch of pelagic species declined from 380,000 tons in 1975 to 249,000 tons in 1976 (34%), with decreases in the catch of herring (48%) and mackerel (39%) although the menhaden catch increased by 51%. The total catch of "other fish" declined by 50% mainly due to decreases in the catch of dogfish, skates and unspecified finfish. The total catch of invertebrates increased from 148,000 tons in 1975 to 177,000 tons in 1976 (20%), due in part to an increase in the catch of squids (*Illex* and *Loligo*) (41%) but also to increases in the catches of some other invertebrate species (17%). The catch of shrimp declined from 5,300 tons in 1975 to about 1,000 tons in 1976.

8. Statistical Area 6

The total catch of all species was approximately the same in 1976 as in 1975. Declines in the catch of silver hake (56%), red hake (27%), squids (34%) and "other invertebrates" (13%) were offset by increases in the catches of mackerel (26%) and other pelagics (mainly menhaden) (43%).

II. SUMMARY OF RECENT CATCHES AND TACs

The Subcommittee used as the basis for discussion the Canadian request for advice on 18 stocks which lie within or partly within its 200-mile fisheries management zone in Subareas 2 to 4, and three stocks which overlap the Canadian and Danish fisheries zones in Statistical Area 0 and Subarea 1 (Comm. Doc. 77/VI/4). The Subcommittee also reviewed the cod stock in Subarea 1 at the request of Denmark, and the three stocks which lie completely outside of the national fisheries zones in Division 3M. In reviewing the state of the various stocks, the Subcommittee took account of the Canadian view on options to be considered in providing advice on the scientific basis for management in 1978 (Comm. Doc. 77/VI/12). 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 1978. Details of the stock reviews are given in the following section.

Table 2. Summary of recent catches (1972-76) and TACs (1974-77) for stocks reviewed at the April 1977 Meeting of the Assessments Subcommittee, together with advised TACs for 1978 in parentheses.

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)				
		1972	1973	1974	1975	1976 ¹	1974	1975	1976	1977	1978
Cod	1	111	63	48	48	34	107	60	45	31	() ⁶
	2GH	14	+	4	7	6	20	20	20	20	(20)
	2J+3KL	458	355	373	288	216	657	554	300	160	() ⁷
	3M	58	23	25	22	25	40	40	40	25	(40)
	3NO	103	80	73	44	25	101	88	43	30	() ⁸
Redfish	2+3K	20	39	30	26	24	30	30	30	30	(30)
	3M	42	22	35	16	16	40	16	16	16	(16)
	3LN	29	33	22	18	18	28	20	20	16	(16)
	3O	16	9	13	15	15	16	16	16	16	(20)
Silver hake	4VWX	114	299	96	116	97	100	120	100	70	(81)
A. plaice	2+3K	9	5	6	6	7	10	8	8	8	(6)
	3M	1	1	2	2	1	2	2	2	2	(4)
	3LNO	59	53	46	43	51	60	60	47	47	() ⁹
Witch	2J+3KL	17	24	16	12	11	22	17	17	17	(17)
	3NO	9	7	8	6	8	10	10	10	10	(10)
Yellowtail	3LNO	39	33	24	23	8	40	35	9	12	(15)
G. halibut	0+1	14	10	14	25	15	-	-	20	20	(25)
	2+3KL	30	29	27	29	24	40	40	30	30	(30)
R. grenadier	0+1	8	5	12	5	7	-	10	14	8	(8)
	2+3	24	18	28	27	24	32	32	32	35	(35)
Argentine	4VWX	6	1	17	15	9	25	25	25	20	(20)

Table 2. (Cont'd)

Species	Stock area	Nominal catches (000 tons)					TACs (000 tons)				
		1972	1973	1974	1975	1976 ¹	1974	1975	1976	1977	1978
Capelin	2+3K	46	136	127	199	209	110 ²	160 ²	160 ²	212.5 ²	(300)
	3LNOPs	25	132	161	167	134	148 ³	180 ³	180 ³	200 ³	(200)
Squid- <i>Illex</i>	3+4	2	10	+	18	37	-	25 ⁴	25 ⁴	25 ⁴	(25)
Shrimp	1	10	13	18	38	50	-	-	-	36 ⁵	() ¹⁰

- 1 Provisional statistics for the April 1977 Assessments Meeting.
- 2 In addition, countries without specific allocations may each take up to 10,000 tons.
- 3 In addition, countries without specific allocations may each take up to 5,000 tons.
- 4 In addition, countries without specific allocations may each take up to 3,000 tons.
- 5 TAC pertains to offshore fishing grounds in Subarea 1.
- 6 See section III(1) for TAC options.
- 7 See section III(3) for TAC options.
- 8 See section III(5) for TAC options.
- 9 See section III(13) for TAC options.
- 10 Conservation measures for 1978 depend largely on data derived from the fishery during 1977; see section III(24) for assessment advice.

III. STOCK ASSESSMENTS

1. Cod in Subarea 1 (Res. Doc. 77/VI/8)

Provisional statistics for 1976 indicate that the nominal catch of cod decreased further to 33,700 tons in 1976 from the low catch of 47,900 tons in 1975. The 1976 catch is about 75% of the TAC of 45,100 tons adopted by the Commission for that year but is slightly above the TAC of 31,000 tons adopted for 1977. The decrease in catch from 1975 to 1976 is not evenly distributed among divisions, as there was a slight increase in Div. 1E and 1F and the decrease in the northern part of the Subarea (Div. 1A to 1D) was somewhat greater than the overall decline of 14,200 tons. In Div. 1B, where a significant fishery took place in earlier years, there was practically no offshore cod fishing in 1976. About one-third of the 1976 catch was taken in Div. 1E. There was no noticeable change in the breakdown of the catches by gear categories, otter trawls accounting for about 60% of the catch in 1975 and in 1976. The overall catch-per-unit-effort of Greenland trawlers decreased only slightly (about 8%) from 1975 to 1976, and, on the basis of data from this fleet, the overall effort appears to have declined by about 25% from the 1975 level.

In terms of numbers of fish caught, the removals increased from about 16.7 million fish in 1975 to about 21 million fish in 1976, of which about 10 million fish belong to the 1973 year-class which started to recruit to the otter trawl and poundnet fisheries in 1976. The mean weight of fish in the catches decreased from about 2.9 kg in 1975 to 1.7 kg in 1976 but was as low as 1.0 kg in some samples from otter trawl and poundnet landings. The 1973 year-class dominated (up to 90%) in some commercial catches by Federal Republic of Germany trawlers in the latter part of 1976.

The small number of older age-groups in the stock and the recruitment of the relatively good 1973 year-class to the fishery seems to have led to a change in fishing pattern so far as partial recruitment is concerned. When fishing conditions were much more favourable in the 1960's, the distant water fleets of otter trawlers concentrated their activity in the first half of the year on schools of mature fish. Catch rates were relatively high and the fishery did not concentrate on newly-recruited age-groups. By 1976, however, it seems that the best catch rates were achieved when fishing took place on concentrations of the 1973 year-class. It is thus likely that a considerably greater part of the effort was directed toward the taking of smaller fish in 1976 than had been the case in former years. Consequently, the use of partial recruitment information from earlier assessments of this stock leads to quite unrealistic estimates of the number of fish in the stock. Since the Subcommittee did not have available the information required to calculate new partial recruitment factors, some likely upper and lower limits were used in the assessment. Although it was not possible to calculate the present stock size and the number of pre-recruits, the analyses clearly show the relative changes in stock size, spawning biomass and catches that will result from using various management strategies. The Subcommittee was concerned that the spawning stock is at a critically low level, and, although it is not possible at present to indicate a biological optimum level for the spawning stock (target spawning biomass), it was the general feeling that management strategy should allow for improvement in the stock size. Since a TAC of 31,000 tons has been adopted by the Commission for 1977, the analyses using various strategies assume that this quantity

will be fully taken. The likely implication of the various strategies are given in Table 3. On the basis of present estimates of stock size and forthcoming recruitment, the figures given for Strategy 1 show what would have been the implication, if the Commission had adopted a zero TAC for 1977.

In computing the spawning biomass and catch estimates of Table 3, the following assumptions were made: the 1973 year-class is exposed to the same fishing mortality as age-groups 6 and older; partial recruitment for other age-groups is 60% for age 3, 72% for age 4 and 88% for age 5; recruitment of 3-year-olds is 85 million fish for the 1973 year-class, 30 million for the 1974 year-class, 40 million for the 1975 year-class, and 20 million for the 1976 year-class.

If a zero TAC had been set for 1977 (Strategy 1), the improvement in spawning biomass by 1979-80 would have been about two-thirds of the TAC actually set for 1977 (31,000 tons). Similar, or even relatively greater improvement in spawning stock by 1980 would likely occur if a zero TAC were set for 1978 (Strategies 6-8), although it should be realized that some by-catches of cod (possibly 2,000 tons) would be taken in fisheries for species other than cod. In any case, unless fishing mortality is increased above the levels indicated in Table 3, some improvement in spawning stock biomass is expected by 1979-80, due to the recruitment of the relatively good 1973 year-class to the spawning stock by that time. However, since the present level of spawning stock is considered to be very low (about one-tenth of the level prevalent in the 1960's), the Subcommittee advises that the cod stock in Subarea 1 be managed in such a way as to allow the greatest possible improvement in the spawning stock, that is, that the 1978 catch should be kept at the lowest possible level.

Although the spawning stock is expected to improve by 1979-80, the improvement will be only of short-term duration unless good year-classes are produced after 1976 that are at least as good as the 1973 year-class is thought to be. As indicated above, there are uncertainties about the actual level of stock size and recruitment, and the figures in Table 3 can only be considered as indicative of trends. The actual prediction of catch level and stock size is greatly dependent on the estimates of the recruiting year-classes. Thus, when the 1973 year-class enters the spawning stock by 1979, it will constitute about one-third and probably even one-half of the spawning biomass in 1979 and 1980. The individuals of the 1973 year-class are likely to increase their weight by about one-third from 1978 to 1979 (and die at a rate of about 20% annually). Thus, in terms of yield-per-recruit, there would be some reason to keep fishing low in 1978, but not as strong as for keeping fishing low in 1977. However, the major concern of the Commission should be the desirability of increasing the spawning stock biomass.

Table 3. Estimated catch and spawning biomass (000 tons) for different management strategies: the figures for Strategy 1 show what the results would have been in 1978-80 for $F = 0.25$ in 1978 and 1979 if the TAC had been set at zero for 1977; Strategies 2 to 8 assume that the 1977 TAC of 31,000 tons will be taken.

Strategy No.	1	2	3	4	5	6	7	8
1978 Spawning biomass at start of year	141	119	119	119	119	119	119	119
Fishing mortality(F)	0.25	0.25	0.15	0.15	0.10	-	-	-
Projected catch	51	44	27	27	19	-	-	-
1979 Spawning biomass at start of year	163	137	151	151	159	175	175	175
Fishing mortality(F)	0.25	0.25	0.15	0.10	0.15	0.25	0.15	0.10
Projected catch	46	40	27	19	28	50	31	21
1980 Spawning biomass at start of year	151	129	156	165	164	163	180	189

2. Cod in Divisions 2G and 2H

The provisional catch of 6,300 tons in 1976 is slightly lower than the 1975 catch of 6,960 tons. The catches from this area are generally unpredictable due to variable ice conditions. Because of the small catch in 1976, there was a complete lack of biological sampling, and it was not possible to reassess the stock. Catch rates of FRG trawlers indicate little or no change in the state of the stock from 1975 to 1976. Lacking new biological information, the Subcommittee could find no reason to recommend a change in the TAC, and therefore advises that the TAC for 1978 should remain at 20,000 tons.

3. Cod in Divisions 2J, 3K and 3L (Res. Doc. 77/VI/26; Summ. Doc. 77/VI/8, 15)

a) Stock assessment

Catches in this area declined from an average of about 640,000 tons in 1966-70 to about 380,000 tons in 1971-75. Recent annual catches (1976 being provisional) and TACs are as follows:

	1973	1974	1975	1976	1977
TAC (000 tons)	666	657	554	300	160
Catch (000 tons)	355	373	288	216	

Seasonally adjusted catch rates, derived from Spanish otter trawl catch and effort data, declined about 40% in the 1967-74 period, but there appears to have been some improvement in 1975. USSR survey data indicates that the stock in 1976 was at a relatively low level due to a series of poor year-classes (especially those of 1970 and 1971) but that the biomass should improve substantially in 1977 and 1978 with the recruitment of the much stronger 1972 and 1973 year-classes. From these surveys, it was observed that the mean catch (by weight) per hour trawling in Div. 3K increased by 6.4 times and in Div. 3L by 2.4 times, with respect to the catch per hour in 1975. Sampling data indicate that the 1972 year-class was dominant in the commercial catches in 1976. Length frequencies of Polish cod catches in Div. 2J and 3K during the first quarter of 1977 show average lengths of about 40 cm, implying that the 1972 and 1973 year-classes will comprise the bulk of the catches in 1977. FRG research vessel surveys in recent years show that the 1972 year-class is very much stronger than those of adjacent years.

The fishing mortality generated on this stock in 1975, estimated from regressions of F against two standard units of effort (Spanish otter trawl, USSR otter trawl), was in the order of 0.5. The Subcommittee considered a virtual population analysis for the stock, together with projections of catch and spawning biomass based on the analysis, assuming that the 1977 TAC of 160,000 tons would be taken and using recruitment values of 350, 550 and 400 (millions of fish) derived from USSR young fish surveys for the 1972, 1973 and 1974 year-classes respectively. In making the projections, recruitment for 1975 year-classes and onwards was taken at the average value as no stock-recruitment relationship incorporating biotic and abiotic environmental factors has been determined. The Subcommittee stresses that the long-term forecasts should be considered as indicating trends, as the actual recruitment in future years may be much better or worse than the average. While not advising a specific TAC for 1978, the Subcommittee indicates that catches and spawning biomass (000 tons) for 1978-80 at $F_{0.1}$ and at two lower levels of F are projected as follows:

Year	$F_{0.1} = 0.20$		F = 0.15		F = 0.10	
	Catch	Spawning biomass	Catch	Spawning biomass	Catch	Spawning biomass
1978	162	392	125	392	85	392
1979	199	481	159	506	112	533
1980	233	695	192	768	140	850

The Subcommittee considered the relationship between spawning biomass as derived from virtual population analysis and recruitment as indicated from young fish surveys, and advises that an adequate spawning biomass for this stock might be in the range of 1.2-1.8 million tons, with 1.5 million tons as the reference point. It was further noted that stock-recruit relationships generally show a great deal of variation. Poor recruitment may result from a large spawning stock and very good recruitment from a small spawning stock. Assuming average recruitment, catches and biomasses were estimated in 1985 for three levels of F. In view of the uncertainty in predicting recruitment, these estimates may be considered only as indicative of trends. Comparing the projected catches in 1985 at the various levels of F with the TAC of 160,000 tons in 1977 and comparing the corresponding projected biomasses in 1985 with the target spawning biomass of 1.5 million tons (under average conditions), the percentage changes are indicated as follows:

	F = 0.20	F = 0.15	F = 0.10
Percentage change in 1985 catch relative to 1977 TAC	198	177	142
Percentage of target spawning biomass reached in 1985	78	98	123

The USSR scientists felt that the management strategy for stocks subject to large natural fluctuations cannot be exercised on a long-term basis, and the aim of continually increasing the spawning biomass has no substantial biological evidence. Such action could only be justified when the spawning stock fails to generate strong year-classes. With respect to cod in Div. 2J+3KL, two strong year-classes of 1972 and 1973 are evident and the stock itself will tend to increase by fishing at $F_{0.1} = 0.2$. Consequently, it is the view of USSR scientists that the 1977 TAC of 160,000 tons can be maintained for 1978.

b) Inter-relationships of cod stocks in Divisions 2J, 3K and 3L

The Subcommittee reviewed the information presented to its 1974 Meeting and reiterates the advice given at that time (*Redbook* 1974, page 80). Returns from cod tagged offshore in Div. 2J, 3K and 3L indicate that large numbers of cod seasonally migrate inshore where they are exploited by the inshore fishery. Templeman (J. Fish. Res. Bd. Canada 1974, Vol. 31, pages 1073-1092) showed that returns from the offshore fishery of cod tagged in inshore areas were substantial. The Subcommittee considered it very unlikely, due to topographic and hydrographic conditions, that large concentrations of cod could successfully overwinter inshore, except in the deepwater bays in Div. 3L. This is in contrast to the situation at West Greenland where local cod stocks may be found in certain fjords. The Subcommittee therefore concluded that the cod being exploited by the inshore and offshore fisheries comprise one stock, this being in accord with the conclusion of the Subcommittee at its 1974 Meeting. The relationship between the inshore and offshore fisheries is, therefore, one of competition between components of the fishery. It was noted that hydrographic conditions would tend to affect availability of cod to the inshore gears more than to the mobile offshore fleet.

The Subcommittee advises that it is not possible at present to project in a precise way the effects upon the inshore fishery of fishing at $F_{0.1}$ or at other levels of F. Nevertheless, it is clear that, if fishing is conducted at levels of F which result in increased stock biomass, catch rates for both the inshore and the offshore fisheries would improve. The faster the rate of recovery of the biomass, the faster the catch rates will improve.

4. Cod in Division 3M (Res. Doc. 77/VI/15, 28; Summ. Doc. 77/VI/15)

The cod catch in this area declined from an average of 42,000 tons during 1965-69 to about 25,000 tons annually since 1973. An assessment presented in 1973 indicated that the average long-term yield is about 40,000 tons annually, an estimate which was confirmed by a general production model assessment presented at the 1976 Meeting of the Subcommittee and updated at the present Meeting (Res. Doc. 77/VI/28). In 1976, the Subcommittee considered that the stock was not in a condition to support catches at the MSY level and consequently recommended a reduction in TAC to 25,000 tons for 1977. However, some evidence presented at the present meeting indicates an improvement in the stock. Catch rates for the Portuguese fleet were somewhat higher in 1976 than in 1975, and USSR young fish surveys indicate that an exceptionally strong 1973 year-class will likely enter the fishery by 1978. Although it was felt that the TAC for 1978 could be set above the level of the long-term MSY, due to the recruitment of the 1973 year-class, the Subcommittee considered it unwise to do so. By setting the TAC at the MSY level, the benefits of the strong 1973 year-class would be expected to extend over a period of 3-4 years, stabilizing the catches and making a significant contribution to a complete recovery of the spawning biomass. The Subcommittee therefore advises that the TAC for 1978 should be set at 40,000 tons.

5. Cod in Divisions 3N and 3O (Res. Doc. 76/VI/108, 77/VI/17; Summ. Doc. 77/VI/8, 15)

Cod catches in this area declined from a high level of 227,000 tons in 1967 to 44,000 tons in 1975. The provisional catch in 1976 was about 25,000 tons. Catches and shortfalls (000 tons) in relation to TACs since 1973 have been as follows:

	1973	1974	1975	1976
TAC	103	101	88	43
Catch	80	73	45	25
Shortfall	23	28	43	18

Sampling data for 1975 and 1976 were insufficient to produce satisfactory age compositions of the catches for these years, and, consequently, it was not possible to complete a reliable analytical assessment of the stock.

Seasonally adjusted catch rates of Spanish pair trawlers showed a marked decline from 1.5 tons per hour in 1971 to 0.4 tons per hour in 1975, implying continued high effort and a low level of stock size. Effort data in terms of catch-per-hour were not available for 1976, but an estimate of the catch-per-day-fished in Div. 3LNO was derived for 1976 and compared with values calculated for previous years. These values indicated that fishing effort in 1976 for Div. 3LNO (and possibly for Div. 3NO) was below that in 1975. A general production analysis, using catch-per-unit-effort data for Spanish pair trawlers during 1960-75, indicates that the stock in 1975 was at a relatively low level. Canadian survey data show the stock in 1973-76 to be considerably below the level in 1971-72. USSR young fish surveys indicate that the incoming 1973 and 1974 year-classes are somewhat better than average. The lack of adequate sampling data makes the assessment of this stock difficult, but there was general agreement in the Subcommittee that the present stock size is at a lower level than in the 1960's. Assuming that the effective fishing effort in 1976 and 1977 is at about the same level as in 1975, the Subcommittee advises that catches of 30,000 tons and 20,000 tons in 1978 would correspond approximately to fishing at F_{MSY} and $2/3 F_{MSY}$ respectively.

USSR scientists consider that a catch of 30,000 tons in 1978 would be conservative.

6. Redfish in Subarea 2 and Division 3K (Res. Doc. 77/VI/18)

General production model analysis indicates that this stock can sustain catches of 40,000-45,000 tons per year under equilibrium conditions. The catch increased from about 20,000 tons in 1972 to 39,000 tons in 1973 but declined to 30,000 tons in 1974 due to the implementation of a TAC of 30,000 tons in that year. Even though the TAC has remained at 30,000 tons, the catch further declined to 26,000 tons in 1975 and to 24,000 tons in 1976. Catches in relation to fishing effort during 1966-74 were below the equilibrium curve, and both the effort and catch-per-unit-effort have remained relatively stable over the last decade. Statistics reported for 1975 indicate that much of the redfish may have been taken as by-catch in fisheries for other species. There was insufficient catch and effort data for cases where redfish could be designated as the main species sought, and consequently it was not possible to determine realistic effort and catch-per-unit-effort values for 1975 that correspond with the standardized method used for earlier years.

Commercial bottom trawl sampling data for recent years show a broad range of length and age groups, and midwater trawl samples for 1976 were similar. Recent research vessel sampling data also confirm the existence of a wide range of sizes and ages in the stock with the 1960-64 year-classes dominant and those of the late 1950's and early 1960's proportionately more abundant at greater depths. The TAC for 1974 to 1977 was set at 30,000 tons in order to allow the stock to rebuild from the relatively low levels prevalent from the late 1960's to 1975. In order that stock rebuilding may continue, the Subcommittee advises that the TAC for 1978 should remain at 30,000 tons.

7. Redfish in Division 3M (Res. Doc. 77/VI/7, 18)

General production model analysis indicates that an MSY in the range of 13,000-17,000 tons can be sustained for this stock. Yield-per-recruit analysis indicates that $F_{0.1}$ is in the range of 0.2-0.3 and that, during 1963-73, when catches averaged 13,600 tons, the fishing mortality may have been at or in excess of $F_{0.1}$ under average recruitment conditions. Updating of the yield-per-recruit assessment has not been possible due to the lack of age composition data for 1974-76. Catches averaged 8,500 tons during 1966-71, increased to 42,000 tons in 1972 with an increase in effort, declined to 22,000 tons in 1973, and increased to 35,000 tons in 1974 under a TAC regulation of 40,000 tons for that year. The TAC was substantially reduced to the MSY level of 16,000 tons in 1975 and remained at that level for 1976 and 1977. Catches in 1975 and 1976 were at the TAC level of 16,000 tons.

Effort and catch-per-unit-effort data presented in Res. Doc. 77/VI/7 and 77/VI/18 show similar trends although slightly different standards were used. The catch-per-standard-day fished (Res. Doc. 77/VI/18) increased from 3.4 tons in 1969 to 7.8 tons in 1972 but decreased to 5.5 tons in 1974 and 5.4 tons in 1975. Both catch and effort declined substantially from 1974 to 1975 due to the reduction in TAC from 40,000 to 16,000 tons. Commercial length frequency data indicate that the 1963 year-class comprised a relatively high proportion of catches during 1973-76. Both research and commercial sampling data indicate that the 1972 year-class is better than average. Therefore, based on the evidence of stabilizing catch-per-unit-effort and the recruitment of a better-than-average year-class to the fishery, the Subcommittee advises that the TAC should remain at 16,000 tons, approximately the level of the estimated MSY.

8. Redfish in Division 3LN (Res. Doc. 77/VI/18)

Catches in this area have increased from about 10,000 tons in 1964 to 34,000 tons in 1971, declined

to 29,000 tons in 1972 and increased again to 33,000 tons in 1973. These latter catches were in excess of the estimated MSY level of 20,000 tons derived previously from a general production model analysis of catch and effort data. From 1974 the fishery has been regulated with TACs of 28,000, 20,000 and 20,000 tons in 1974-76 respectively. Consequently the annual catch declined to 22,000 tons in 1974 and to 18,000 tons in 1975 and 1976. The TAC was reduced to 16,000 tons for 1977. In 1974 there was a significant shift from fishing with bottom trawl when 80% of the catch was taken with midwater trawl, but the pattern was reversed in 1975 when 89% of the catch was taken with bottom trawls mainly in Div. 3N. The previous general production model analysis was updated with data for 1974 and 1975. The catch of 17,870 tons in 1975 was slightly less than the MSY, and the fishing effort of 15,370 hours was close to the level of effort required to take the catch equivalent to the MSY. With the decline in both catch and effort after the introduction of TAC regulation, the catch rate has increased slightly from 1.3 tons per hour in 1973 to 1.5 tons per hour in 1975.

Despite the high level of catches in 1971-73, no length or age composition data were collected from the commercial catches. From midwater trawl samples in 1975, most of the males were in the range of 36-40 cm and the length distribution of females was bimodal at 30-34 cm and 40-46 cm. Canadian length composition data taken in Div. 3L during May-July of 1976 with midwater trawl were similar to those for 1975, but later in the year smaller males in the 29-33 cm range appeared in both the midwater and bottom trawl catches. Bottom trawl samples from Div. 3N contained smaller redfish in the range of 22-25 cm for males and 25-28 cm for females. Since the catches, catch rates and length composition data for 1976 do not indicate any significant change in the state of the stock from 1975 to 1976, the Subcommittee advises that the TAC should remain at 16,000 tons for 1978 so that the effort will be less than the F_{MSY} level in order to compensate for the high fishing effort in excess of the F_{MSY} level during 1971-73.

9. Redfish in Division 30 (Res. Doc. 77/VI/18)

Catches in this area declined from 20,000 tons in 1971 to 9,000 tons in 1973, but increased to 13,000 tons in 1974 and to 15,000 tons in 1975 and 1976. The fishery has been regulated by a TAC of 16,000 tons since 1974. The catch-per-standard-hour-fished has stabilized at 1.1-1.2 tons in 1973-75 from a much lower level of 0.4 tons in 1965. USSR catch/effort data for 1976 indicate the same catch rate as for 1975. The significant upward trend in the catch rate from the low level of the mid-1960's indicates that an increase in abundance or availability has occurred in recent years. Canadian length composition data from commercial catches in 1976 indicate a high proportion of newly recruited young fish.

Although the general production model for this stock has no built-in time lag, the data points fit the curve reasonably well. In view of the favourable catch rate, good recruiting year-classes and improved condition of the stock as reflected in the general production model, the Subcommittee advises that the TAC for 1978 should be increased to 20,000 tons, which is the estimated MSY level from the simplified application of the general production model.

10. Silver hake in Divisions 4V, 4W and 4X (Summ. Doc. 77/VI/13; Res. Doc. 77/VI/6, 25, 34, 44)

a) Review of ageing problems

The Subcommittee reviewed the report of the Silver Hake Ageing Workshop held at St. Andrews, Canada, during 14-18 March 1977 and attended by ageing experts from Canada, USSR and USA (Summ. Doc. 77/VI/13). There was general agreement that both whole otoliths stored in glycerine and sections from dry-stored otoliths were acceptable for ageing silver hake and that age readers should be familiar with both methods. Age validation studies using length frequencies or other potential ageing structures were recommended. It was noted that past discrepancies on the estimation of the age composition of commercial catches could be due to the presence of a pelagic zone laid down during the first year of life. The Subcommittee

recommends (12)

that further otolith exchanges should take place to establish whether a need exists for a silver hake ageing workshop in 1978.

Following the ageing workshop at St. Andrews, the newly agreed techniques were applied to otoliths collected on a Canadian research cruise in Div. 4W in July 1976 (Res. Doc. 77/VI/25). Age compositions of the catches from the entire survey were obtained by using age-length keys from otolith ageing and by using corresponding age-length keys constructed from the modal analysis technique used in Canadian assessments. Excellent agreement was observed between the two methods for age-groups 1 to 3.

b) Stock assessments

The provisional nominal catch in 1976 was 97,100 tons, slightly less than the TAC of 100,000 tons. A total of 81,200 tons was reported by USSR, 12,600 tons by Cuba, 3,100 tons by Bulgaria and small quantities by five other countries. Cuban scientists presented a preliminary estimate of the natural mortality rate for silver hake (Res. Doc. 77/VI/6). On the basis of this study, the Subcommittee agreed that the natural mortality was likely to be less than 0.5 and that $M = 0.4$ would be the best value for assessing the 1978 TAC.

Assessments of the silver hake stock were presented by USSR (Res. Doc. 77/VI/34) and Canadian (Res. Doc. 77/VI/44 + Corrigendum) scientists. When the USSR catch projection was recalculated to allow for a total reported catch of 97,100 tons in 1976, the projected 1978 catch at $F_{0.1} = 0.50$ under the historical pattern of fishing was 70,000 tons, compared with 81,000 tons in the Canadian assessment. The Subcommittee noted that the difference in projected catches was slight and accepted the Canadian estimates of the age composition of the commercial catch and of the natural mortality rate as the basis for calculating options for 1978.

The Canadian assessment included a theoretical analysis of the possible effects of limiting the otter trawl minimum mesh size to 60 mm manila equivalent (effective 1 April 1977) based on mesh selection experiments carried out by USA in Subarea 5. The Subcommittee noted that firm predictions about the consequences of the mesh size regulation could not be made without stronger experimental evidence, and accordingly

recommends (13)

that mesh selection experiments be carried out in 1977 to determine the consequences of the silver hake mesh size regulation in Div. 4VWX.

The Subcommittee noted the results of Canadian calculations on the possible effects of the 60 mm manila equivalent mesh regulation. By changing the partial recruitment at age, fishing at $F_{0.1} = 0.65$ in 1978 might correspond to a catch of as little as 61,000 tons. However, even if this is the true selection pattern in 1978 and a catch of 81,000 tons is taken (rather than 61,000 tons), the biomass of all age-groups (age 1 and older) will still increase to 265,000 tons at the beginning of 1979. This increase will be at least as great as the increase in biomass at this catch level, if the mesh regulation does not modify the partial recruitment at age from that observed historically. This is due to the projected release of more fast-growing young fish under the assumption of a modified selection pattern than under the historical pattern, even though the exploitation of older age-groups will be at an F greater than $F_{0.1} = 0.65$. The Subcommittee therefore advises that the 1978 TAC should be 81,000 tons, recognizing that the stock biomass will likely increase to 255,000-265,000 tons in 1979. Although an analytical assessment of this stock is available, the Subcommittee considered that the projection of catch and biomass beyond 1978 would be unrealistic because of the large fluctuations in recruitment observed in this stock.

11. American Plaice in Subarea 2 and Division 3K (Res. Doc. 77/VI/9)

Nominal catches since 1973 have averaged about 6,000 tons. A TAC of 8,000 tons, aimed at management at the $F_{0.1}$ level, has been in effect since 1974. This fishery has been to a certain extent a by-catch fishery, at least for the offshore otter trawl component. The Canadian inshore gillnet fishermen have, in the past few years, experienced declines in catch rates. USSR survey data also indicate a reduction in abundance. An assessment presented at this meeting indicates that the fishing mortality was approximately at $F_{0.1}$ during 1966-76 when catches averaged 6,300 tons. The Subcommittee therefore advises that the TAC for 1978 should be reduced to 6,000 tons.

12. American plaice in Division 3M

Nominal catches from this stock were as high as 5,300 tons in 1965 and 4,100 tons in 1966. Recent catches (1974-76) have averaged 1,500 tons. The TAC, based on catch statistics only, has been 2,000 tons since 1974. USSR survey data indicate a continuing increase in abundance indices during the 1971-76 period. Therefore, the Subcommittee advises that the TAC for 1978 should be increased to 4,000 tons.

13. American Plaice in Divisions 3L, 3N and 3O (Res. Doc. 77/VI/20)

Nominal catches from this stock have declined from a peak of 94,000 tons in 1967 to 68,000 tons in 1971 and subsequently to 43,000 tons in 1975. Provisional statistics for 1976 indicate that the catch is about 51,000 tons. Since 1976 the TAC has been aimed at managing the fishery at the $F_{0.1}$ level. Recent TACs and catches are as follows:

	1973	1974	1975	1976	1977
TAC (000 tons)	60.5	60	60	47	47
Catch (000 tons)	53.5	46	43	51	

The assessment of this stock has been based on a virtual population analysis for Div. 3LN with allowance made for the part of the stock in Div. 30 based on historical catches. The present assessment includes virtual population analyses for Div. 3LN and Div. 30, indicating a somewhat lower value for Div. 30 than previously allowed for. Stock size and catch predictions were carried out based on fishing at the $F_{0.1}$ (0.43) level of fishing mortality and also at a level lower than $F_{0.1}$, namely $F = 0.33$. In addition, the projections were extended to 1985 using both management options. Recruitment values used in the projections to 1985 are averages of 1971-73 recruits at age 6 for males (64 million fish) and age 7 for females (125 million fish). The projections are listed in the following table, together with data for 1962-64, 1965-70 and 1976:

	1962-64	1965-70	1976	1978	1982	1985
A. Fishing mortality	0.23	0.50	0.57	0.43	0.43	0.43
Biomass (000 tons)	560	425	430	453	488	495
Catch (000 tons)	27	72	52	47	56	56
B. Fishing mortality				0.33	0.33	0.33
Biomass (000 tons)				453	528	542
Catch (000 tons)				32	48	52

Estimates of the biomass for the 1962-70 periods were based on virtual population analysis for Div. 3LN, and biomass estimates for Div. 30 were added, using the ratio of biomass in Div. 3LN to that calculated for Div. 30 in 1973.

The Subcommittee points out that the projections to 1985 are only intended to indicate relative trends in recovery of the stock at two different levels of fishing mortality, as the actual biomass that will result from fishing at these levels of F is subject to environmental fluctuations which are unpredictable. However, Option A indicates that management at $F_{0.1}$ (= 0.43) would increase the potential catch to 56,000 tons by 1985, which is close to the 60,000-ton TAC of 1973-75. Under Option B, on the other hand, while the biomass would increase more rapidly, the catch would remain somewhat lower and not reach the pre-1976 level until sometime after 1985.

14. Witch Flounder in Divisions 2J, 3K and 3L (Res. Doc. 77/VI/10)

The nominal catch from this stock increased from 4,400 tons in 1961 to 24,000 tons in 1973, and then declined to about 11,000 tons in 1976, with Canada, Poland and USSR accounting for most of the catches. The TAC was initially set at 22,000 tons in 1974, but, on the basis of an assessment in 1974, it was set at 17,000 tons for 1975 and remained at the level for 1976 and 1977 based on management at $F_{0.1}$ (0.30 for males and 0.25 for females). While catches from this stock are, to a certain extent, by-catches in fishing for other species, the fishery is of considerable importance to Canadian gillnet fishermen and a Canadian otter-trawl fishery in the offshore part of the area has developed in 1977. An update of the yield-per-recruit assessment at this meeting indicates that fishing at the $F_{0.1}$ level has been achieved. The Subcommittee therefore advises that the TAC for 1978 should remain at 17,000 tons.

15. Witch Flounder in Div. 3N and 30 (Res. Doc. 77/VI/12)

Recent nominal catches have ranged from 15,000 tons in 1971 to 6,200 tons in 1975 and 7,800 tons in 1976. The TAC has been constant at 10,000 tons since 1974. Removals from this stock are primarily as by-catch of other fisheries, although Canada began developing a directed fishery in 1976. The level of fishing mortality (F) during 1966-76 has been relatively close to $F_{0.1}$ (0.45 for males and 0.40 for females), with removals averaging about 8,500 tons. The Subcommittee advises that the TAC should remain at 10,000 tons for 1978.

16. Yellowtail Flounder in Divisions 3L, 3N and 30 (Res. Doc. 77/VI/19)

This stock has been subject to TAC regulation since 1973 as indicated in the following table together with the nominal catches (1976 catch is provisional):

	1973	1974	1975	1976	1977
TAC (000 tons)	50.0	40.0	35.0	9.0	12.0
Catch (000 tons)	32.8	24.2	22.9	7.8	

The assessment presented in 1975 pointed to a drastic reduction in stock abundance and indicated that very high fishing mortality (F in the range of 1.0-2.0) was required to take the catches in 1973-75. Abundance indices from both the Canadian and USSR surveys and from catch-per-unit effort of Canadian trawlers indicate that the stock has at least stabilized and may in fact have increased in abundance.

The major difficulty in assessing this stock is the problem of obtaining estimates of fishing mortality and recruitment for the most recent year of fishing (i.e. for 1976 in the present assessment). Abundance indices (average number per haul) from research vessel surveys gave excellent correlations for ages 6 to 8 with estimates of population size-at-age from cohort analysis for 1971-75. However, abundance indices of age 5 fish from survey data are of little use in determining the size of the incoming year-class. In view of this problem, the catch projections for 1977 and 1978 were made for a range of recruitment of 5-year-old fish in 1976 to 1978, using F = 0.5 in 1977 and 1978:

Recruitment at age 5 (10 ⁶ fish)	Catch in 1977 at F = 0.5 (000 tons)	Catch in 1978 at F = 0.5 (000 tons)
80	12.7 (15.5)	16.6
70	12.1 (13.7)	15.2
60	11.4 (12.0)	13.8
50	10.7 (10.3)	12.4

The figures in parentheses for 1977 are the catches predicted for the indicated levels of recruitment in the assessment presented to the 1976 Meeting of the Subcommittee (*Redbook* 1976, page 81).

As an additional exercise, the stock size (numbers at age) in 1976 was determined directly from the regression of population size on abundance indices of ages 6 to 9 from research vessel surveys (Res. Doc. 77/VI/19), and the stock size was projected to 1978. Using the same series of recruitment values as above, the catches in 1977 and 1978 were projected as follows:

Recruitment at age 5 (10 ⁶ fish)	Catch in 1977 at F = 0.4 (000 tons)	Catch in 1978 at F = 0.5 (000 tons)
80	12.1	17.3
70	11.9	16.7
60	11.8	16.0
50	11.7	15.4

Based on an assumed annual recruitment of 60 million fish (age 5) in 1976 to 1978, the Subcommittee advises that the TAC for 1978 should be 15,000 tons.

17. Greenland Halibut in Statistical Area 0 and Subarea 1 (Res. Doc. 76/VI/109)

The nominal catch increased from less than 5,000 tons prior to 1972 to 14,000 tons in that year. There was a decline to 10,000 tons in 1973, but the catch increased rapidly to 25,000 tons in 1975. A precautionary TAC of 20,000 tons was introduced in 1976, and the provisional catch for that year is reported at 15,000 tons. Lacking adequate data for assessment, the precautionary TAC of 20,000 tons was continued for 1977.

At the 1976 Annual Meeting, the Scientific Advisers to Panel 1 reviewed a paper (Res. Doc. 76/VI/109) which gave estimates of stock size based on observations from USSR scouting and commercial vessels. This paper was again reviewed by the Subcommittee at the present meeting. On the basis of a number of observations (catch per hour fishing) in a trawl survey at depths greater than 500 m between Greenland and Baffin Island-Labrador, USSR scientists concluded that the stock size in this area could support a catch of 50,000 tons. One of the determining factors in the basic calculation of the stock size is the efficiency of the trawls used, which was set as low as 10% (i.e. only 10% of the fish in front of the trawl would be caught and retained by the trawl). The Subcommittee welcomed the new information, but, noting the lack of detailed background data and pointing out the impli-

cations of small changes in the efficiency factor, considered that further data would be required in order to justify a significant increase in the TAC. Pending the provision of further information and taking account of the by-catch of immature Greenland halibut in the recently established shrimp fisheries in Subarea 1, the Subcommittee considered the possibility of increasing the precautionary TAC to 25,000 tons, corresponding to the highest catch in the history of the fishery in this area (in 1975). USSR scientists thought that a TAC of 35,000 tons would still be on a precautionary level, but other members of the Subcommittee considered it necessary to have more information before a TAC higher than 25,000 tons could be advised. The Subcommittee accordingly advises that a precautionary TAC of 25,000 tons should be set for 1978.

It was pointed out that, although the biological population may cover a wide area, a significant increase in the TAC would raise the question of a breakdown of the TAC by smaller areas in order to avoid local overfishing. It was noted that additional information might be available at the forthcoming Annual Meeting in June 1977, and the Subcommittee stressed the need for information on the magnitude and composition of the by-catch of Greenland halibut in the shrimp fisheries.

18. Greenland Halibut in Subarea 2 and Divisions 3K and 3L (Res. Doc. 77/VI/11)

Nominal catches averaged about 29,000 tons annually in 1972-75. The provisional catch for 1976 is somewhat below this level at 24,000 tons. The TAC for this stock was set at 40,000 tons for 1974-75 and reduced to 30,000 tons for 1976-77.

Biological studies indicate that most of the mature fish in this area are concentrated in deep water to the north of Div. 3K. A considerable part of the fishery for this species has therefore been directed at immature fish in shallower depths. This is especially the case for the Canadian gillnet fishery which is concentrated in the Canadian coastal waters of Div. 3K and 3L. Since proper assessment of this stock is impossible without adequate sampling from all components of the fishery, the Subcommittee

recommends (5)

that scientific investigation of the probable segregation of mature and immature fish be continued and expanded, together with intensive sampling of the commercial catches.

Although USSR survey data indicate a substantial population of Greenland halibut in the northern part of this stock area, the only evidence available on exploitation rates indicates that the stock is presently being exploited at the $F_{0.1}$ level of fishing mortality. The Subcommittee accordingly advises that the TAC for 1978 should remain at 30,000 tons.

19. Roundnose Grenadier in Statistical Area 0 and Subarea 1 (Res. Doc. 77/VI/30)

Nominal catches in 1972-75 were in the range of 4,900-12,300 tons. Provisional statistics for 1976 indicate a catch of 7,400 tons, compared with 5,000 tons in 1975. The TAC was initially set at 10,000 tons for 1975, increased to 14,000 tons for 1976, and reduced to 8,000 tons for 1977, based on an assessment presented at the 1976 Annual Meeting, which determined that fishing at the level of $F_{0.1}$ should give a sustainable yield in the range of 7,400-9,800 tons. Lacking any evidence to warrant revising the TAC, the Subcommittee advises that the TAC for 1978 should remain at the 1977 level of 8,000 tons.

20. Roundnose Grenadier in Subareas 2 and 3 (Res. Doc. 77/VI/30)

Nominal catches in 1972-75 were in the range of 17,600-28,400 tons. Provisional statistics for 1976 indicate a catch of 23,600 tons, a decrease from the 1975 catch of 27,400 tons. The decline was mainly due to decreases in catch by German Democratic Republic (2700 to 500 tons) and by Poland (1500 to 100 tons).

The fishery, conducted in the most recent years, has had no noticeable effect on the age and size composition of the population. Lacking any evidence to warrant revising the TAC, as determined from an assessment at its 1976 Meeting, the Subcommittee advises that the TAC for 1978 should remain at the 1977 level of 35,000 tons.

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

Provisional statistics for 1976 indicate a catch of 8,800 tons, which is approximately one-half of the catches in 1974 and 1975. The TAC, which was initially set at 25,000 tons in 1974, remained at that level in 1975 and 1976 but was reduced to the estimated MSY level of 20,000 tons for 1977. The Subcommittee noted the comment in its report to the 1976 Annual Meeting that, despite regulation of the fishery with a precautionary TAC since 1974, very few data have become available with which to determine the effect of fishing on the stock. Again, no data were available at the present meeting

to determine the status of the stock, and the Subcommittee hence advises that the TAC should remain at 20,000 tons for 1978.

22. Capelin Stocks in Subarea 2 and Division 3K and in Divisions 3L, 3N, 3O and 3Ps (Res. Doc. 77/VI/5, 14, 16, 22, 32, 33)

Nominal catches from these stocks increased from 71,000 tons in 1972 to 288,000 tons in 1974, 366,000 tons in 1975 and to 343,000 tons in 1976. From survey and commercial sampling data, the 1973 year-class of capelin was identified as being relatively strong both with regard to the mature components spawning offshore in Div. 3N and inshore in Div. 3L and 3P as well as in the autumn fishery in Div. 2J and 3K. Despite the observed relative strength of this year-class, the spawning biomass of capelin on the Southeast Shoal (Div. 3N) in 1976 was lower than in 1975, although the abundance (in numbers) was higher. The lower spawning biomass in 1976 compared with 1975 was probably due to slow growth and lower maturation rate of the 1973 year-class. Consequently, the reduction in biomass does not appear to be related to the capelin fishery. The presence of the relatively strong 1973 year-class in samples taken in the autumn of 1976 indicates that capelin will likely be abundant in 1977 and that this year-class may also contribute to the spawning biomass in 1978. This latter conclusion is based on the observation that the relatively strong 1969 year-class contributed to the spawning biomass in 1972, 1973 and 1974. There is some uncertainty about the size of the 1974 year-class, but it is considered to be of average strength and not as strong as the 1973 year-class. Estimates of consumption of capelin by cod were similar to those presented at the 1975 Annual Meeting. No new data were available to assess the effect of the capelin fishery on the capelin stock or on its predators. Consequently, the Subcommittee advises that the present management strategy should be continued for 1978, the overall TAC being 500,000 tons for both stock areas with 300,000 tons allocated to Subarea 2 and Div. 3K and 200,000 tons to Div. 3LNOPs.

The Subcommittee recognizes that priority should be given to estimating the strength of the incoming year-class(es) as close as possible to the year for which TACs are to be set. This could be achieved from autumn surveys in Div. 2J and 3K and the data used for advising on the TAC for the following calendar year. The Subcommittee suggested that pre-recruit surveys (cooperative surveys involving countries with an interest in the capelin fishery) be initiated in Div. 3K and 3L. USSR scientists were requested to collect data on the influence of the capelin fishery on major predators of capelin and present a report to the 1978 Meeting of the Subcommittee. All countries participating in the capelin fishery were requested to conduct studies to delineate the capelin stocks and describe the migratory patterns.

23. Illex in Subareas 3 and 4 (Res. Doc. 77/VI/4)

The nominal catches of *Illex* fluctuated greatly during 1972-75 in the range of 400-17,800 tons. The provisional catch of 37,400 tons in 1976 was more than twice the level of the 1975 catch of 17,800 tons. The sharp increase in catch apparently reflected high abundance of *Illex* over a broad area not only in Subareas 3 and 4 but also on Georges Bank and further southward.

Little information is available on the basic biology of *Illex* in Subareas 3 and 4. Some studies of age and growth have been made based on monthly length (mantle) frequencies. The Subcommittee discussed the two different hypotheses regarding the life span of this species, namely, a one-year cycle and a 1.5-year cycle, but could not reach a definite conclusion on the problem. It was noted that further study on the biology of *Illex* based on more extensive data is urgently needed in view of the increasing commercial interest in this species.

Estimates of stock biomass of *Illex* are not available for Subareas 3 and 4. However, French scientists estimated by the areal expansion method, using research vessel survey data, that the minimum stock biomass in Subareas 5 and 6 (excluding the Georges Bank area) in October-December 1976 was 95,000 tons. USSR surveys indicated a minimum biomass in the Georges Bank area in September-October 1976 was 258,000 tons. Due to the short life-span of this species and the large fluctuations in abundance, the Subcommittee considers it extremely difficult to predict TACs well in advance of the fishing season and indicates that the effectiveness of effort regulation should be evaluated for management against that of catch limitation as currently applied. The scientists of countries involved in fishing for squid are requested to provide catch and effort data for *Illex* in Subareas 3 and 4 for preliminary examination by STACRES at the 1977 Annual Meeting. Lacking any firm evidence to warrant changing the present pre-emptive TAC, the Subcommittee advises that the TAC of 25,000 tons should remain in effect for 1978.

24. Shrimp (*Pandalus borealis*) in Subarea 1

Nominal catches of shrimp (northern deepwater prawn) have increased rapidly from less than 10,000 tons prior to 1973 to 38,000 tons in 1975. Provisional statistics for 1976 indicate a total catch of about 50,000 tons, of which nearly 42,000 tons were taken offshore. The 1976 catches listed in the following table reflect more up-to-date statistics than those available at the Ninth Special Meeting in December 1976:

Country	1976 catch (000 tons)
Denmark (F)	11,179
Denmark (G)	9,771
Denmark (M)	2,717
France	1,100
Japan	146
Norway	11,605
Spain	6,931
USSR	6,468

Total catch	49,917
Total offshore catch	41,871

All available biological information related to the fishery in 1976 and earlier years was presented at the Ninth Special Meeting in December 1976. Lacking additional data, the Subcommittee is unable to advise on conservation measures for 1978. The major problems associated with assessing this stock are (a) the great lack of experience in this fishery due to its rapid development, (b) the lack of adequate models for assessment, and (c) difficulty in predicting recruitment to the fishery. The conservation measures adopted for 1977 were based on events that occurred during the 1976 fishing season, and the Subcommittee considered it too risky to use these events to extrapolate conservation measures for 1978. It is considered much more appropriate to assess the stock and advise on conservation measures for 1978 at a meeting near the end of 1977 when data for the 1977 fishing season would be available. The Subcommittee stresses the need for conducting stratified random surveys on the offshore shrimp fishing grounds, for an intensive sampling program, and for the development of a method to enable a proper assessment of the species.

IV. OTHER MATTERS

In addition to the stock assessments, the Subcommittee preliminarily reviewed several items which will be discussed in greater detail by STACRES at its 1977 Annual Meeting.

1. Progress Report on International Herring Tagging Program

The Subcommittee was informed that the herring tagging program planned for 1976/77 (*Redbook* 1976, pages 153-156) was progressing favourably with several projects completed and one in progress. The following is a synopsis of work to date:

- a) Gulf of St. Lawrence (Div. 4RST) - About 55,000 herring were tagged during April-December 1976 by Canadian scientists from the St. Andrews, New Brunswick, and St. John's, Newfoundland, laboratories.
- b) Chedabucto Bay area (Div. 4W(a)) - Scientists from the St. Andrews laboratory tagged about 20,000 herring in January 1976, but only about 1,000 fish were tagged in January 1977 due to poor weather conditions.
- c) Gulf of Maine (Div. 5Y) - USA scientists from the Woods Hole laboratory tagged 10,700 herring on Jeffreys Ledge in October 1976, and about 23,000 juvenile fish were tagged in coastal waters by State of Maine scientists from the Boothbay Harbour laboratory.
- d) Georges Bank (Subdiv. 5Ze) - Canadian, USA and USSR scientists, utilizing a research vessel and purse seiner supplied by USSR, tagged 29,400 herring during September 1976.
- e) South of Cape Cod (Subdiv. 5Zw) - USA scientists tagged a few herring (32 fish) near Rhode Island in November 1976, and a cooperative USSR-USA project to tag about 60,000 herring is currently in progress in Subdiv. 5Zw and Div. 6A.

The Subcommittee noted that "seeding" experiments (for estimating recovery rates on fishing vessels) were to have been carried out during the 1976 autumn fishery, and that tags had been supplied to certain countries for that purpose. No reports of such experiments have been received to date, and the countries involved are urged to submit their reports for the STACRES Meeting in May 1977, when the herring tagging program will be reviewed in detail.

2. Progress Report on International Larval Herring Surveys

The Subcommittee was informed that the larval herring surveys of the Georges Bank area were conducted again in 1976, continuing a series which began in 1971. Seven cruises were undertaken between October 1976 and March 1977 by research vessels of Federal Republic of Germany (November, March), Poland (October-November), USSR (October), and USA (October, November-December, February). Standard sampling procedures were used. Preliminary results indicate that the 1976 larval herring production on Georges Bank was the lowest observed during the 6-year history of the surveys.

The Subcommittee was informed that plankton sorting and analysis of the time series (1971-76) of larval herring data, as well as the processing of all available hydrographic and phytoplankton data, was continuing. It is expected that sorting of all fish larvae in the 0.333 mesh samples will be completed in June 1977, at which time a workshop will be held at Szczecin, Poland, to review the results of analyses carried out to date, including the first complete analysis of the 0.505 mesh larval herring data to compare production, growth, mortality and dispersal of larvae. It is also expected that analysis of larval gut contents and associated fine-mesh zooplankton samples for several winters will be completed, to evaluate whether larval growth and mortality are related to average density of food organisms during the over-wintering period.

The Subcommittee noted that the reports of the 1976/77 surveys and any available analyses of the 1971-76 data would be of great interest to the Environmental and Biological Surveys Subcommittee.

3. Progress Reports on Cod and Silver Hake Ageing Workshops

The Subcommittee noted, in accordance with a request by STACRES at its 1976 Annual Meeting, that an ageing workshop on cod was convened by Mr R. Wells at St. John's, Newfoundland, Canada, during 31 January-5 February 1977 (Summ. Doc. 77/VI/12). The experts dealt specifically with problems in ageing cod from the stock in Div. 2J, 3K and 3L and, on the basis of the material examined and the discussions at the workshop, expressed the desirability that a set of guidelines for ageing cod in this area be published. Mr R. Wells was designated to prepare a draft of the guidelines which will be discussed at a later stage and prepared for publication.

The Subcommittee also noted that a workshop on the ageing of silver hake was held at St. Andrews, New Brunswick, Canada, during 14-18 March 1977. This workshop was convened by Mr J. Hunt, with representatives from Canada, USSR and USA, and its report is given in Summ. Doc. 77/VI/13.

4. Study on Proposed Implementation of ICNAF Sampling Data Base

The Subcommittee noted the STACRES recommendation from the 1976 Annual Meeting (*Redbook* 1976, pages 59 and 131) that a small group of experts (one from Canada, USA and USSR) should meet with the Secretariat before the 1977 Annual Meeting to explore the problems associated with the implementation of an adequate base of sampling data. The Subcommittee was informed that a small group of scientists met on 25 April 1977, and a report of that meeting will be presented to STACRES at its May 1977 Meeting.

5. General Production Studies

There were no papers for consideration under this agenda item, but some general comments were noted. Canadian studies include the effect of the Labrador Current on food productivity in the Flemish Cap area, as well as plans for studying the Labrador Current in Davis Strait and southward along the continental shelf in relation to its effect on plankton and fish production. The USA observer noted that physical oceanographers are beginning to take a more active interest in the environment of the continental shelf areas, thus indicating the emergence of closer ties with biologists.

APPENDIX II. REPORT OF STATISTICS AND SAMPLING SUBCOMMITTEE

Chairman: J. Messtorff

Rapporteur: L. P. D. Gertenbach

The Subcommittee met during 25-26 May 1977 to consider and report on matters referred to it by STACRES (see Part D of this volume for Agenda). Representatives attended from all member countries except Iceland, Italy, Norway, Romania and Spain, and observers were present from FAO, ICSEAF and USA.

1. CWP Activities and Plans for its Ninth Session

The Secretary of the CWP (Mr L. P. D. Gertenbach) informed the Subcommittee that the ninth session will be held during 17-25 August 1977 at ICNAF Headquarters, Dartmouth, Canada. He outlined the proposed draft agenda which covers the following items: (a) review of the statistical programs of ICNAF, ICES, ICCAT, ICSEAF, FAO, OECD and EUROSTAT; (b) fishing areas; (c) species items; (d) fishing gears; (e) fishing fleet statistics; (f) fishing effort; (g) basic definitions and concepts; (h) conversion factors; (i) discards; (j) reporting systems and forms; and (k) processing procedures.

The Chairman confirmed that STACRES, at its June 1977 Annual Meeting, nominated Canada to represent ICNAF at the ninth session of the CWP in addition to the Assistant Executive Secretary and the Chairman of the Statistics and Sampling Subcommittee. It was reported that Mr P. Hart had been nominated by Canada to represent ICNAF at the ninth session of the CWP.

2. ICNAF Statistical Activities

The Assistant Executive Secretary reviewed the research and statistical activities of the Secretariat during 1976/77, referring the Subcommittee to Comm. Doc. 77/VI/6 (section 6) which provides a summary of these activities. Relevant discussion on various items follows.

a) ICNAF Statistical Bulletin

The Subcommittee noted that Vol. 25 for 1975 was published in January 1977. Much of the delay was due to the late submission of the basic data on STATLANT 21B forms by a few countries. The tabular arrangement of 1975 data remained essentially the same as that used after the significant reorganization of the tables in Vol. 22 (1972 data). Although some Irish catch statistics were compiled in the tables of Vol. 25, these are superceded by more detailed catch and effort data presented in Summ. Doc. 77/VI/3, as a supplement to Vol. 25. These amendments will be included in Part IV of Vol. 26 to be issued later this year.

The Assistant Executive Secretary pointed out that the Statistical Bulletin tables are generally based on catch and effort data submitted on STATLANT 21B forms. However, in one or two cases STATLANT 21B data were not received, and it was necessary to use provisional data reported on STATLANT 21A forms. The Secretary of the CWP noted that the FAO codes given for species items on pages 9-11 of Vol. 25 are no longer used by FAO and have been replaced by taxonomic codes. The Subcommittee agreed that these be included in the next issue of the Bulletin.

b) STATLANT 21A Statistics for Annual Meeting

Provisional nominal catches for 1976, as received on STATLANT 21A from 18 countries fishing in the Northwest Atlantic and arranged as in Tables 1, 2 and 3 of the Statistical Bulletin, are given in Summ. Doc. 77/VI/29 and sealing statistics for 1976 are listed in Summ. Doc. 77/VI/17. The Assistant Executive Secretary noted that a revision of Summ. Doc. 77/VI/29 will be issued in July 1977, representing the advance release of Northwest Atlantic catch statistics for 1976 pending the publication of more detailed data in Vol. 26 of the Statistical Bulletin.

c) Advance Monthly Statistics for Selected Species

These data were required for the April 1977 Meeting of the Assessments Subcommittee and were tabulated in working papers for that meeting. The Subcommittee was informed that only half of the reporting countries submitted data in accordance with requirement for a breakdown of catches by division and gear while the remainder reported the data by stock areas, whereas related sampling data are obtained on a divisional basis. To facilitate the analyses required for stock assessments, the Subcommittee reiterates the need for all countries to provide well in advance of future meetings of the Assessments Subcommittee the advance monthly catch statistics for selected species (i) by ICNAF divisions or subdivisions (not stock areas), and (ii) by gear categories.

d) Statistics on Discards

The Subcommittee noted the scarcity of information on discards for 1975 (Summ. Doc. 77/VI/18), particularly in regard to the absence of data from some countries with significant fisheries in the ICNAF Area. It was pointed out that ICNAF has tried for several years to collect information on discarded catches. At the 1976 Annual Meeting, the Subcommittee had expressed the hope that, considering the Commission's requirement that discard information be recorded in logbooks (1974 Annu. Meet. Proc. No. 20, App. III, page 242), a considerable improvement in discard statistics would occur. However, this improvement has not materialized for 1975 data.

The Subcommittee, noting the failure to obtain information on discards and taking into account the difficulties, discussed the usefulness of such data and agreed that discard data were essential for assessment work. It was therefore decided that discard data should be reported early in the year, together with the advance monthly nominal catches for selected species. It was stressed that countries should also attempt to obtain length and age compositions of fish intended for discarding. In this regard, it was observed that the use of "observers" on commercial vessels might help countries to improve the collection of discard data and that improved procedures to complete the fishing logbooks would assist to overcome these difficulties.

The Subcommittee, in urging countries to make all efforts to provide adequate statistical information on discards,

recommends (6)

that the Secretariat circulate guidelines for improved discard statistics, requesting each country to appoint a scientist to investigate and report on the aspect of discarding in its fisheries in the Northwest Atlantic and to assist in the provision of adequate statistics on discards.

The Subcommittee noted with satisfaction that problems associated with discards will be discussed at the ninth session of the CWP in August 1977. It was therefore agreed that the Secretariat circulate the guidelines following the CWP session.

e) Adequacy of National Reporting of Fishery Statistics

The Assistant Executive Secretary reiterated the many deficiencies in statistical reporting, particularly the significant delays on the part of countries in submitting their reports to the Secretariat. This adversely affects the efforts of the Secretariat in its attempt to publish the data expeditiously. The Subcommittee appreciates the many difficulties that arise in national statistical offices and which often delay the submission of completed STATLANT 21A and 21B forms. Nevertheless, all representatives of the Subcommittee are urged to remind their national statistical offices to do their utmost to provide the required data before the indicated deadlines (e.g. 15 April for STATLANT 21A and 30 June for STATLANT 21B forms).

f) Review of STATLANT Forms and Deadlines for their Submission

The Assistant Executive Secretary noted that the new STATLANT 21B form was designed to facilitate the reporting of detailed catch and effort data by twice-monthly time periods and by 30' x 30' unit areas and that supplies of these forms with instructions for their completion were dispatched to national offices by the Secretary of the CWP early in 1977 for reporting 1976 data. In the light of the recent implementation of coastal state jurisdiction and the possibility of different requirements of the coastal states for detailed statistics for assessment and management purposes, it was considered that ICNAF's requirement for reporting by 30' x 30' unit areas in a standard way on STATLANT 21B forms might be a duplication. It was observed that the Commission's resolution regarding detailed statistical reporting for 1976 contained the words "if possible", implying that all countries may not be able to provide the data in the detail required. It was reported that the Secretariat had already received STATLANT 21B reports from four countries and that none were able to provide the data by 30' x 30' unit areas.

Since one of the primary purposes of the STATLANT 21B system is to facilitate the acquisition of final national statistics in a standardized form for publication in the Statistical Bulletin, the Subcommittee stressed the importance of continuing this series. Since detailed catch and effort data for assessment and management purposes are now being acquired by the coastal states, the Subcommittee

recommends (7)

that countries not be required to report by 30' x 30' unit areas and twice-monthly time periods for 1976 and 1977 data, but that they continue to complete STATLANT 21B in accordance with past practices.

The Secretariat was requested to notify national statistical offices as soon as possible of this change in the requirements for reporting 1976 data, and to modify the instructions for completing the 21B forms when the request for 1977 data is made early in 1978. However, the Subcommittee noted that the matter should be kept under annual review.

3. Review of ICNAF Sampling Program

a) Sampling Yearbook Vol. 20 for 1975

The Assistant Executive Secretary reported that this volume has not yet been published due to delays on the part of some countries to update advance data submitted for assessment purposes or to provide their sampling data in the prescribed format. Because of the delay in issuing Vol. 20, the Secretariat has provided provisional listings of 1975 data in Summ. Doc. 77/VI/5. The format of the tables in this document corresponds with that in Vol. 18 and 19 of the Yearbook, after STACRES decided to discontinue the publication of detailed data following the issue of Vol. 17. It was noted that the 1975 data listed in Summ. Doc. 77/VI/5 are in some cases incomplete, and countries were informed that additional data could be incorporated if received at the Secretariat by July 1977.

The Subcommittee noted that the Secretariat has computerized the data for 1973 to 1975 and could provide computer printouts of such data in response to requests. With respect to data for 1976, lists are now being compiled of sampling data submitted earlier for assessments in April 1977 and these will be circulated to countries for checking and updating. The Subcommittee stressed the importance of the Secretariat maintaining as complete a file as possible of current sampling data, and accordingly

recommends (15)

that individual scientists should carefully check the list of 1976 sampling data to be provided by the Secretariat against data available in their files and promptly inform the Secretariat of any corrections, revisions and additions.

b) Adequacy of Sampling Data

The Assistant Executive Secretary presented Summ. Doc. 77/VI/31 which, in response to a request by STACRES, provides information on the sampling efficiency for some of the major fisheries in the Northwest Atlantic for 1975. A distinction was drawn between (i) sampling of commercial vessels, and (ii) sampling by research vessels, and it was indicated that data for the latter case were not generally included in the analyses.

The Subcommittee observed that, of the 52 stocks analyzed, only about one-half were adequately sampled for length in 1975 in contrast to about 60% in 1974, with cod, redfish, Greenland halibut, roundnose grenadier and capelin being the species most seriously affected. It was noted that much of the data were lacking in quality; in particular, the length composition data for the flatfish species and some others were not reported by sex as required, and, in many cases where length sampling was quite adequate, no age-length keys were provided to enable the calculation of age compositions. Also, it was noted that sampling effort was not always directly related to the months or quarters when catches were significant.

The Subcommittee considered that it should be possible to include research vessel sampling data with those for commercial catches, where research vessels use commercial-type gears whose selection is not restricted by small-meshed liners. The Subcommittee therefore requests that, when research samples are reported on the sampling forms, a note should be included indicating whether the data could or could not be considered as applicable to commercial fisheries.

c) Early Requirement for Sampling Data

The Subcommittee was informed that very early in each year the Secretariat, in consultation with the Chairman of the Assessments Subcommittee, requests through circular letters that countries submit all available sampling data for selected species for consideration in stock assessments. The Subcommittee agreed that the Secretariat should continue the recent procedures in acquiring advance sampling data for assessment purposes.

d) Implementation of Sampling Data Base

At the 1976 Annual Meeting, STACRES endorsed the recommendation of the Subcommittee that a small group of experts be nominated, together with the Secretariat, to specify the requirements and probably cost of implementing a detailed sampling data base, including methods of processing, in order that subcommittees and working groups may be provided with the tabulations required to carry out their tasks (*Redbook* 1976, pages 59 and 131). It was suggested that a representative from each of Canada, USSR and USA might form the nucleus of this group, which should meet for about a week at the Secretariat offices in advance of the 1977 Annual Meeting.

With the recent implementation of coastal state jurisdiction over fisheries with the 200-mile zone and the uncertainty about the future requirements of the coastal states with respect to the collection of biological data, the Secretariat considered that the proposed meeting for a period of several days was probably premature but was able to arrange a brief meeting of scientists from Canada, USSR and USA on 25 April 1977 (in conjunction with the Meeting of the Assessments Subcommittee) to explore what might be possible concerning the processing of detailed sampling data. The Canadian representative indicated that the future requirements for biological data under the regime of extended coastal state jurisdiction were being planned, but that, in any case, countries fishing in the Canadian zone were expected to collect and submit biological data for 1977 to the ICNAF Secretariat in accordance with the requirements of STACRES.

The Assistant Executive Secretary reviewed the progress that had been made to date in organizing for computer processing the large volume of sampling data on file at the Secretariat for the years 1973, 1974 and 1975, noting that the publication of sampling data in the *Sampling Yearbook* was discontinued following the issue of Vol. 17, containing length and age composition data for 1972. As a pilot project, in an attempt to evaluate the possible costs of operating an efficient retrieval system utilizing the computer facilities at the Secretariat, a contract was arranged with a computer analyst to investigate the feasibility of using a DRS (data retrieval system) package available to users of the IBM 370, to which the Secretariat's computer terminal is connected. While full documentation of the experimental study is not yet available, projected costs, based on a limited amount of 1975 data, were not considered to be unusually high for on-line operation, but the cost could be substantially reduced (perhaps by 50% or more) if the data were stored on magnetic tapes when not in use. It was noted that updating and retrieval could be planned to minimize the costs.

The Assistant Executive Secretary indicated that all of the 1975 data and most of the 1973 and 1974 data have been key-punched on cards and edited preparatory to input to magnetic tape. Annex 1 is a sample copy of output representing an age-length table giving the monthly length frequencies for a quarter, the age-length key, the computed monthly age frequencies and the computed mean length-at-age values for the age frequencies. Programs are being prepared for some other types of output.

While the main purpose of the meeting of the small group of experts was to provide guidelines for the implementation of a detailed sampling data base, the Subcommittee considered it rather premature to proceed without a knowledge of the future requirements of the coastal states. However, there was general consensus that the Secretariat could serve as the depository for sampling data collected in accordance with the requirements of the coastal states. In the meantime, it was agreed that the Secretariat should proceed with the establishment of a computerized depository for sampling data currently being submitted in accordance with standard reporting procedures.

4. Lists of Fishing Vessels for 1976 and 1977

The Subcommittee noted that the list of vessels 50 GRT and over for 1975 was presented in *Summ. Doc. 77/VI/4*, in accordance with the requirements of STACRES. It was pointed out that the list is revised and published in a bound volume every third year, the next issue being for 1977. The current procedure, using computer printouts, is to submit the current list to the various countries with the request that it be updated annually.

It was observed that the need to acquire and publish these lists of vessels every third year might eventually disappear and be replaced by lists kept by the coastal states. However, it was pointed out that the latter might include, in addition to their own fleets, only those foreign units fishing within the 200-mile zone. These records would therefore not cover vessels fishing outside the 200-mile zone. It was noted that the historical record of fleet statistics was useful in tracing long-term trends in development and changes in the structure of the fleets. Although the Subcommittee wishes to avoid duplication and overlapping, it was agreed that ICNAF should at least for a temporary period continue with its existing program of maintaining statistics on fishing fleets. The Subcommittee therefore

recommends (16)

- i) *that the Secretariat continue to obtain through established procedures from national statistical offices their updated lists of vessels for 1976 and 1977; and*
- ii) *that the updated list for 1976 be issued as a summary document and the list for 1977 be published in a bound volume together with relevant summary tables.*

5. International Scientific Observer Program

The Subcommittee noted its review of this program at the 1976 Annual Meeting (*Redbook* 1976, page 131). Oral reports on implementing the program on a national basis were presented by representatives of Canada, Denmark, Federal Republic of Germany and USA. The Subcommittee reiterated its support for the program which should contribute significantly to developing and improving sampling carried out at sea, particularly on factory ships.

6. Review of Pertinent Papers

The Subcommittee reviewed two research documents which were considered relevant to its work:

- a) Res. Doc. 77/VI/1 compares the lengths of haddock measured at sea and on shore and also in the round and gutted conditions. In the first instance the average loss in length from sea to shore was 0.6% and in the second case the average gain in length from round to gutted condition was 0.4%.
- b) Res. Doc. 77/VI/46 presents data on length conversion factors for four species of flatfish (American plaice, witch flounder, yellowtail flounder and Greenland halibut). Recent incentives to improve the quality of the landed product have resulted in the removal of the caudal fin at sea to allow bleeding. Sampling of such specimens on shore thus necessitated the collection of data to obtain appropriate conversion factors to determine the total length from the "anal length" (i.e. length from the snout to the posterior end of the anal fin).

7. Other Matters

The Assistant Executive Secretary noted that there is a long-standing practice whereby relevant information in the statistical reports of ICES is brought to the attention of the Subcommittee on Statistics and Sampling. In this regard, the Subcommittee reviewed Summ. Doc. 77/VI/20, containing extracts from resolutions passed at the 1976 ICES Meeting, and Summ. Doc. 77/VI/22, containing the report of the 1976 Meeting of the ICES Statistical Committee. It was noted that ICES is working toward the use of small unit areas (30' x 60') for reporting data required for assessments.

8. Acknowledgment

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

APPENDIX III. REPORT OF BIOLOGICAL SURVEYS SUBCOMMITTEE

Chairman: W. G. Doubleday

Rapporteur: J. P. Minet

The Subcommittee met during 24-25 May 1977 to consider and report on matters referred to it by STACRES (see Part D of this volume for Agenda). The first session was devoted to a review of survey activity in the ICNAF Area during 1976 and plans for 1977. The second session covered such items as the processing of survey data by the Secretariat, review of developments in hydroacoustic surveys, progress on a manual for groundfish surveys, relevant matters arising from the May 1977 meeting of the Environmental Working Group at Murmansk, USSR, and other business.

1. Review of Survey Activity in 1976

The Subcommittee noted that survey results were presented in research and summary documents as follows: Res. Doc. 76/XII/137, 138, 148, 149, 150, 153, 155, 156, 160, 163, 164, 165, 169, 170; Res. Doc. 77/VI/4, 11, 14, 17, 18, 19, 21, 22, 24, 25, 26, 29, 32, 33, 34, 40, 42; and Summ. Doc. 77/VI/9, 10, 11, 14, 15, 25, 26, 27. In view of the large number of documents, most of which were primarily concerned with assessments, the Subcommittee reviewed survey activity in 1976 (see Table 1 for summary) on a country by country basis.

- a) Canada. The main objectives of Canadian groundfish surveys were to obtain abundance indices of fully-recruited and recruiting age-groups as well as pre-recruits. Data on biological characteristics were also collected. Special surveys were carried out to develop echo-counting and integration methods and for other studies. The main difficulty with abundance indices is in obtaining a sufficient time series to correlate survey results with cohort analysis estimates of abundance. The surveys have been clearly successful for flatfish in the Newfoundland area and for cod stocks in the Newfoundland and Nova Scotian areas.
- b) Cuba. A survey of the Scotian Shelf, aimed at hydrographic, hydroacoustic and exploratory fishing studies, was carried out in 1976. An overall index of fish density was obtained, together with useful hydrographic and biological data.
- c) Denmark. Danish surveys were directed at obtaining abundance indices for ichthyoplankton (especially cod larvae), juvenile cod and shrimp (*Pandalus borealis*). Fixed stations were used, supplemented by a stratified survey by a commercial trawler for shrimp. Plankton survey results correlate well with juvenile cod abundance indices. The estimates of abundance for shrimp have been used for assessment. Information on by-catch was also obtained.
- d) Federal Republic of Germany. Groundfish surveys aimed at estimating abundance indices were carried out in Subarea 1 and surveys in cooperation with Canadian scientists were undertaken in Subareas 2 and 3. Pre-recruit indices of cod abundance correlate well with other estimates of year-class size. Analyses leading to adult stock composition and abundance estimates for cod and redfish are in progress. A juvenile herring survey was curtailed due to vessel difficulties, but a larval herring survey was carried out in the autumn.
- e) France. Groundfish surveys were directed at estimating abundance and age composition of cod stocks. A pelagic survey studied the biological characteristics of herring and a stratified random trawl survey studied the abundance of squid. Abundance indices were used in stock assessments.
- f) German Democratic Republic. A groundfish survey was carried out in Subareas 2 and 3 to obtain length and age compositions (especially for cod) corresponding to commercial catches. There was participation in the cooperative juvenile herring program in the spring for studying the relative abundance of young herring.
- g) Japan. A squid jigging survey was conducted to study the catch composition from jigging and trawling. Preliminary analysis of data indicates that the size and age composition of catches were different for the two methods of fishing.
- h) Poland. A cooperative larval herring survey was carried out in the autumn. The time series of four years of data is too short for correlation with recruitment indices.
- i) USSR. Groundfish surveys, aimed at estimating abundance indices for Greenland halibut in Stat. Area 0 and Subareas 2 and 3 and also abundance and recruitment of the main groundfish species in Subareas 2 and 3, were carried out. Scouting vessels collected biological data, especially on roundnose grenadier. A pre-recruit survey for silver hake in Emerald Basin has been conducted for many years, and a groundfish survey was carried out in Div. 5Z. In addition, acoustic studies on capelin in Subareas 2 and 3 and a larval herring survey in Subarea 5 were

undertaken, and shrimp were studies in Subarea 1.

- j) USA. The long-term series of bottom trawl surveys, aimed at multi-species abundance indices and distribution, was continued. Secondary objectives of these surveys are the collection of general biological data. The pre-recruit indices have been useful, particularly for groundfish species such as yellowtail flounder, haddock, red hake and silver hake, but less so for mackerel, herring and cod. The need for improved abundance estimates from surveys has been recognized and analyses of sources of error are in progress. Prospects for improvement include post-stratification based on time of day and reduction in variation of speed and distance hauled in standard survey tows. The surveys are being extended to inshore areas and the addition of midwater trawling is being considered. A paper concerning comparative fishing and diel effects is being prepared for presentation at the 1977 Annual Meeting of ICES.

Table 1. Inventory of biological surveys conducted in the ICNAF Area during 1976.

Sub-area	Groundfish surveys using ICNAF stratification scheme				Coordinated larval and juvenile herring surveys				Other surveys					
	Div.	Country	Months	Sets	Div.	Country	Months	Sets	Plank.	Div.	Type	Country	Months	Sets
0	No stratification scheme										Groundfish	USSR	1,12	?
1	A	DEN	7	2						A	Shrimp (photo)	DEN	5	20
	B	DEN	7	41						AB	Shrimp	DEN	5-7,10	58
	C	DEN	7	1						C-F	"	USSR	10	?
										C	"	DEN	1,4,6,11	9
										C	Groundfish	DEN		
											"	GDR	1	?
										D	"	DEN	1,4,6,9-12	9
										E	"	DEN	2,5-6,9,11	14
										C-F	"	FRG	11-12	37
											"	USSR	1,12	?
									A-D	Plankton	DEN	3,6-7,9-12	36	
2	J	CAN	11-12	77						GH	Groundfish	FRG	12	11
		FRG	10-11	62						J	"	CAN	10-11	54
										"	FRA	1-3	14	
										"	GDR	2 (inc. KL)	41	
										"	USSR	?	?	
									J	Acoustic (cap.)	USSR	10-11	?	
3	K	FRG	10-11	25						K	RNG, G Hal.	USSR	10-11	?
	KL	FRA	1-3	60						KL	Groundfish	CAN	9-11	51
	L	CAN	4-5,10	96							"	GDR	2 (inc. J)	41
	NO	CAN	4	81						KLNO	"	USSR	3-10	?
	Pn	CAN	5-6	10						Pn	"	CAN	2,6	4
	Ps	CAN	5-6	117						K	Capelin	USSR	10-11	?
	P	FRA	1-3	20						L	"	CAN	3	11
									N	Acoustic (cap.)	USSR	6	?	
									Ps	Shellfish	FRA	12	200	
4	R	FRA	1-3	36	X	GDR	3	2	3	R	Tagging cod	FRA	1-3	?
	RS	CAN	5-6	90						R	Groundfish	CAN	1-2,9-12	54
	T	CAN	9	66						S	"	CAN	9-10	77
	VW	CAN	7-8	77						W	Haddock	CAN	4-5,10	43
	WX	CAN	2,7	100						W	Silver hake	USSR	11	20
	X	USA	4-5,11	91						VWX	"	CAN	10	18
										VW	Herring	FRA	3	16
										VWX	Acoustic	CUBA	7-8	?
										W	"	CAN	7	20
										T	Eggs and larvae	CAN	6	78
									VWX	"	CAN	8	76	
									X	"	CAN	3,11	266	
									S	Shrimp	CAN	4	66	
5	YZ	USA	3-5	153	YZ	GDR	3	46	20	Z	Groundfish	USSR	9-10	67
		USA	10-11	178		POL	10-11	-	100		Squid	FRA	10-11	23
	Z	POL	5	99		USA	10-12	-	188		Mackerel	POL	11	34
	Z	USSR	10	87	Z	USA	2	-	116					
						FRG	3	40	32					
						POL	4-5	6	113					
						USSR	10	-	77					
					FRG	11	-	137						
6		USA	3	88							Groundfish	USSR	9	24
											Pelagics	POL	11	12
											Shellfish	USA	4-5	217
											Squids	FRA	11-12	83
											Clams	USA	8-10	97
											Scallops	USA	10-11	76
											Anoxia	USA	7-8,12	131

There was a general discussion on the value of stratified random trawl surveys for groundfish. In most cases, the time series of data is too short for definitive comparison with indices from cohort analysis, but, for cod and haddock in Div. 4X, the indices have been validated and used in the assessments. The availability of valid variance estimates for survey optimization and comparisons is the main feature of the method. The Subcommittee agreed that stratified random surveys were less sensitive to changes in pattern of distribution both between years and within years than alternative designs. It was noted that studies on sources of variance (such as availability, rigging of the trawl and stratum boundaries) might substantially improve the precision of abundance estimates.

2. Proposed Survey Activity in 1977

Surveys carried out to date in 1977 and planned for the remainder of 1977 are listed in Table 2. In a few cases, surveys planned for the early part of 1978 are also indicated.

Table 2. Biological surveys planned for the ICNAF Area in 1977 and 1978.

Country	Type of survey	Areas	Dates	Year		
Canada, Newfoundland	Groundfish	2J,3K	Sep 12-28	1977		
	"	2J,3K	Oct 26-Nov 16			
	"	2J,3K	Nov 22-Dec 13			
	"	3L	May			
	"	3M	Feb			
	"	3Pn	Jan			
	"	3Ps	Apr			
	"	3LNOP	Apr 13-28			
	"	3LNOP	May 4-19			
	"	3LNOP	May 25-Jun 8			
	"	4RST	Sep 6-27			
	Capelin	3L	Feb-Mar			
	"	3NO	Jun 14-30			
	Salmon, shrimp, G. halibut	0+1	Aug 16-Sep 21			
	" Maritmes	Groundfish	2J,3K		Jan 10-25	1978
"		2J,3K	Jan 31-Feb 24			
"		3M	Mar 2-22			
"		3Ps	Feb 21-Mar 8			
"		4RS	Jan 10-26			
Capelin		3L	Jan 10-25			
Acoustic trials		3Pn	Jan 31-Feb 15			
" Quebec		Groundfish	4T	Sep 6-30	1977	
		"	4VWX	Apr 18-29		
		"	4VWX	Jul 3-30		
	"	4VWX	Oct 3-14			
	Eggs and larvae (mackerel)	4T	Jun 20-30			
	Eggs and larvae	4T	May 24-Jun 3			
	" " "	4VWX	May 2-20			
	" " "	4VWX	Jul 25-Aug 20			
	" " "	4VWX	Oct 17-Nov 10			
	Larval herring	4T	Jun 6-17			
	" "	4X,5Z	Nov 14-25			
	Herring and plankton	4X(Fundy)	Aug 8-26			
	" " "	4X(Fundy)	Oct 17-Nov 4			
	Pelagic (silver hake)	4VWX	Oct 3-14			
	Pelagic (mackerel)	4VWX	Nov 28-Dec 20			
Acoustics	4X(Fundy)	Jul 25-29				
Scallops	4X,5Z	Jul 4-22				
" Quebec	Groundfish	4VWX	Mar 13-31	1978		
	Pelagic (mackerel)	4VWX	Jan 30-Feb 21			
	Herring and plankton	4X	Mar 13-31			
" Quebec	Groundfish	3Pn,4RS	May 19-Jun 25	1977		
	"	3Pn,4Rs	Sep 5-Oct 19			
	Shrimp	4S	Apr 11-24			
	"	4S	Oct 25-Nov 15			

Table 2. (Continued)

Country	Type of Survey	Areas	Dates	Year
Cuba	Trawl & acoustic (capelin)	3LNO	Jun 5-Jul 5	1977
	" " (s. hake, etc.)	4VWX	Jul 12-Aug 10	
Denmark	Shrimp	1AB	Apr-Jun, Aug, Oct	1977
	Shrimp (photographic)	1B	Jul	
	Shrimp and groundfish	1C	Feb, Jun	
	" " "	1D	Feb-Jun, Oct	
	" " "	1E	Feb-Mar, Oct-Nov	
	" " "	1F	Nov	
	Plankton	1BCD	Jul	
	"	1D	Feb-Jul, Oct-Nov	
Fed. Rep. Germany	Groundfish	1, 2, 3K	Nov 19-Dec 22	1977
	Juv. herring, ichthyoplankton	5Z	Feb 26-Apr 6	
	Herring, mackerel, squid	5Z	Sep 22-Oct 24	
	Larval herring	5Z	Oct 29-Nov 19	
France	Cod	2J, 3KLP, 4RS	Jan 10-Feb 18	1977
	Groundfish (strat. survey)	0, 2GH	Sep 15-Oct 24	
	" " "	3Ps	Mar 15-31	
	" " "	3Ps	Oct 28-Nov 16	
German Dem. Rep.	Juvenile herring	5	Mar-Apr	1977
Poland	Groundfish	5Z, 6	Feb-Apr	1977
	Larval herring	5Z	Sep-Oct	
	Environmental project	3M	Feb or Apr	
USSR	Groundfish stocks (trawling)	3	May-Aug	1977
	" "	4W	Nov	
	Capelin biomass assessment	2J, 3K	Oct-Nov	
	" " "	3N	Jun	
	Ichthyoplankton (hydrology)	2+3	Jun-Aug	
	"	4W	Aug-Oct	
	"	5Z	May-Aug, Oct	
	Silver hake (yearlings)	5Z	Sep	
	Groundfish stocks (trawling)	0, 1, 2	Oct-Feb	1977/78
USA	Groundfish (trawling)	4X, 5, 6	Mar 19-May 20	1977
	" "	4X, 5, 6	Aug 1-Sep 1	
	" "	4X, 5, 6	Sep 25-Nov 22	
	Larval herring	5YZe	Nov 28-Dec 17	
	Ichthyoplankton	5Z, 6	Apr 12-May 27	
	"	5Z, 6	Jun 8-30	
	"	5, 6	Nov 14-Dec 22	
	Shellfish	5Zw, 6	Feb 3-Mar 16	
	"	5Ze	May 24-Jun 3	
	"	5Z	Sep 6-16	
	Gear development	6	Aug 15-25	
	" "	5Z	Sep 6-28	
	Hydroacoustics	5	Aug 1-8	
	Environmental	5Z	Jan 3-11	
	"	5Z	Jun 7-16	
"	5Z, 6	Jun 20-Jul 29		
"	6	May 31-Jun 5		
"	6	Aug 29-Sep 3		

3. Processing Facilities for Survey Work

A pilot project was initiated in 1976 for survey data of Federal Republic of Germany to be processed by the ICNAF Secretariat (*Redbook* 1976, page 122). Dr Messtorff reported that work was in

progress in completing the various forms but that the data had not yet been submitted to the Secretariat. He indicated that the data would be sent to the Secretariat in August 1977. The Assistant Executive Secretary noted that the Secretariat was prepared to process the data but had no guidelines on desired reports. The Subcommittee suggested that calculations of abundance indices by number and weight, and length frequencies by sex for each strata and for the area as a whole, together with mean length and age-length keys be provided. The Secretariat was requested to contact national laboratories concerning the availability of suitable computer programs.

4. ICNAF Manual for Groundfish Surveys

Dr Doubleday reported, as Chairman of the Editorial Group, that drafts of most sections for the Manual had been received. The most important section lacking was the stratification of Subarea 1 and the subdivision of strata in Subarea 2 and Div. 3K. It was noted that the Editorial Group met on 21 April 1977 (during the Meeting of the Assessments Subcommittee) and agreed to continue the project despite the extension of fisheries jurisdiction by the coastal states. It was also agreed that preferred procedures for conducting surveys should be established, where possible.

Further discussions on the Manual took place at the present meeting. Dr Messtorff indicated that the stratification of Subarea 1 had been delayed due to the lack of suitable charts. Mr Horsted observed that suitable charts were available at his laboratory, and the Subcommittee suggested that Dr Messtorff consult with Mr Horsted on the stratification of Subarea 1. It was noted that a stratified survey for shrimp was conducted by Denmark in Subarea 1 in 1976.

The Subcommittee welcomed the progress of the Editorial Group and agreed that the preparation of the Manual should be continued.

5. Hydroacoustic Surveys

The Subcommittee reviewed Summ. Doc. 77/VI/9 and Res. Doc. 77/VI/32 and 33, and Canadian and USA scientists reported orally on their respective hydroacoustic programs. It was noted that Cuban scientists are developing an echo-integration survey technique for silver hake on the Scotian Shelf.

The Subcommittee noted that USSR has conducted combined acoustic and photographic surveys for capelin involving techniques developed for the Barents Sea. The camera is used to calibrate the echo-integrator. Due to difficulties of mixing, only the first wave of capelin approaching the spawning grounds can be surveyed. It is important that the survey be conducted over a brief period, using prior information on distribution obtained from scouting and commercial vessels. Such surveys are not successful when a stock is rapidly migrating. Control trawl hauls are carried out to establish the size, age and weight compositions of the schools. Photographs are analyzed on shore and densities are contoured as in hydrography.

Canadian scientists reported that hydroacoustic research at the St. John's laboratory was directed toward echo-integration surveys of capelin while activity at the St. Andrews laboratory and the Bedford Institute of Oceanography concentrated on echo-counting of groundfish. Surveys of capelin on the Grand Bank and groundfish on the Scotian Shelf were carried out in 1976. Further capelin surveys are planned for 1977, together with a survey of either the southern Gulf of St. Lawrence cod stock or an isolated redfish stock. The latter survey is aimed at comparing acoustic estimates of abundance with data from other sources. Preliminary analysis of the 1976 groundfish survey on the Scotian Shelf based on a two-stage procedure indicated the resulting increased precision of a trawl survey abundance index was not sufficient to justify the added survey complexity. Target strength studies are in progress at all three Canadian laboratories.

Dr Grosslein (USA) reported that results of the 1975 "Heligoland" experiment were still being analyzed. Studies at Woods Hole are concentrated on the validation of acoustic techniques. A cooperative experiment with USSR is tentatively planned for 1977.

6. Review of Relevant Matters from the May 1977 Meeting of Flemish Cap Working Group

The Subcommittee noted that a full report of that meeting is given in Appendix IV, Annex 1, and concentrated its attention on consideration of juvenile and adult fish surveys resulting from that meeting, particularly the proposal that stratified random surveys of juvenile and adult cod and redfish consist of 35 sets each to be conducted in March and September on Flemish Cap for at least two years. The Subcommittee questioned whether sufficient precision could be obtained by basing abundance indices on only 35 sets. The Chairman of the Environmental Subcommittee indicated that, although no calculations had been made, the concentration of the stocks in limited areas facilitated an efficient allocation of trawling effort. In response to a comment that a much longer time series than two or three years was desirable, Mr Sandeman indicated that survey plans would be modified in the light of experience gained from the initiation of the program in 1978.

7. Other Business

a) Stratification of Flemish Cap

The Subcommittee reviewed the proposed stratification scheme for Div. 3M (Res. Doc. 77/VI/29), noting that large-scale charts are available from the Biological Station, St. John's, Newfoundland, Canada. The Subcommittee

recommends (17)

that the stratification scheme for Div. 3M be incorporated in the proposed Manual on Groundfish Surveys.

b) Guidelines for Assigning Survey Priorities

At the 1976 Annual Meeting, the Subcommittee was informed by Mr Pope (UK) that he had received responses from experts of the Assessments Subcommittee to a questionnaire on the value of surveys for stocks under quota regulation and that he would complete a paper on guidelines and priorities for survey activity. No information on the status of this paper was available. It was agreed that the Chairman of the Subcommittee should contact Mr Pope to obtain the questionnaire data.

c) Coordination of Survey Activity

The role of the Subcommittee in identifying the needs for surveys and in coordinating survey activity was discussed. It was agreed that the detailed coordination of vessel scheduling for surveys planned for the ensuing year could not be carried out at the Annual Meeting due to the inability of national advisers to commit research vessel time so far in advance. The likely future role of coastal states in coordinating the scheduling of surveys in their zones was also recognized. The desirability of systematic review of survey indices now available and of the needs for survey data by the Subcommittee, especially in the long term, was discussed. It was agreed that the Assessments Subcommittee has not been able to fulfil this role due to the lack of time and data, although in some specific cases survey needs have been identified. The Subcommittee accordingly

recommends (9)

that sufficient time be allowed at the 1978 Annual Meeting for the Subcommittee to analyse in detail the precision of all available survey indices.

Scientists from the various countries indicated that the necessary data on variability of survey catches can be made available for this purpose.

APPENDIX IV. REPORT OF ENVIRONMENTAL SUBCOMMITTEE

Chairman: E. J. Sandeman

Rapporteurs: S. A. Akenhead
J. J. Gagnon
R. W. Trites

The Subcommittee met during 26-27 May 1977 to consider and report on the various matters referred to it by STACRES (see Part D of this volume for Agenda). Prior to this meeting, the Flemish Cap Working Group met to review the available data and appraise the suitability of Flemish Cap as an area worthy of a special study aimed at determining the factors involved in the production of good and poor year-classes.

1. Results of Meeting of Flemish Cap Working Group

The Working Group met at Murmansk, USSR, during 16-19 May 1977, with representatives attending from Canada, Poland, USA and USSR. The report of this meeting (Annex 1) was presented by Dr Trites (Canada). Based on this report, the Subcommittee

recommends (10)

- i) that a coordinated international research project be launched on the factors determining year-class success for Flemish Cap (Div. 3M) groundfish, with emphasis on cod and redfish;
- ii) that a planning group of national representatives be formed to plan the project; and
- iii) that the Task Force Leader of the planning group be a Canadian scientist who will be involved in the Flemish Cap Project.

Three major problem areas were identified as critical to knowledge about the production of year-classes and where serious information gaps exist: (i) larval fish survival and retention; (ii) juvenile fish survival; and (iii) assessment of cod and redfish spawning stocks. The greatest effort is required for item (i), involving ideally a survey of the area every two weeks throughout the period of spawning and larval development (February to June). Noting the proposal of the Working Group that initial investigations should begin in 1978 and that a fully-integrated and comprehensive program should commence in 1979, the Subcommittee, with the success of the Georges Bank herring project in mind, considered that a Task Force Leader should be appointed as soon as possible, together with a planning group of national representatives who would be actively involved in the project. Member countries, intending to support the Flemish Cap project are urged to name their representatives as soon as possible. The Subcommittee therefore

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

The Task Force Leader (M. D. Grosslein, USA) reported on the status of this program. The larval herring surveys were conducted again in 1976, the sixth consecutive year of intensive monitoring of larval herring production on Georges Bank. Seven cruises were carried out between October 1976 and March 1977 by Federal Republic of Germany, Poland, USSR and USA. The vessels, cruise dates and geographic areas surveyed are listed in Table 1.

Table 1. ICNAF larval herring surveys, 1976/77 season.

Country	Vessel	Cruise No.	Cruise Dates	Geographical Area Surveyed
USA	<i>Annandale</i>	76-1	Oct 1-18, 1976	Western Gulf of Maine
USSR	<i>Belogorsk</i>	76-3	Oct 4-13, 1976	Nantucket Shoals, Georges Bank
Poland	<i>Wieczno</i>	76-3	Oct 13-Nov 4, 1976	Nantucket Shoals, Georges Bank, Jeffrey's Ledge
F. R. Germany	<i>Anton Dohrn</i>	76-2	Nov 14-Dec 1, 1976	Nantucket Shoals, Georges Bank, Jeffrey's Ledge
USA	<i>Researcher</i>	76-1	Nov 26-Dec 12, 1976	Nantucket Shoals, Georges Bank, Jeffrey's Ledge
USA	<i>Mount Mitchell</i>	77-1	Feb 12-26, 1977	Nantucket Shoals, Georges Bank, Jeffrey's Ledge
F. R. Germany	<i>Anton Dohrn</i>	77-1	Mar 15-21, 1977	Nantucket Shoals, Western Georges Bank

One survey was conducted in coastal waters of western Gulf of Maine in October 1976. All other surveys concentrated their sampling effort on the standard grid of stations in the Georges Bank-Nantucket Shoals area. Plankton samples, using bongo and neuston nets, and hydrographic observations were collected by the standard procedure as in previous years. Nutrient and primary productivity data were collected on five of the seven cruises (*Amundale, Wleczno, Anton Dohrn* (76-2), *Researcher, Mount Mitchell*). In addition, nighttime plankton samples were obtained in March and early April 1977 by the German Democratic Republic research vessel *Goerlitz* during the juvenile herring trawl survey, but the speed and profile of tows were different from the ICNAF sampling standard.

Preliminary results indicate that the 1976 larval herring production on Georges Bank was the lowest observed to date. Small numbers of recently-hatched larvae were observed along the northern edge of Georges Bank in late October and relatively few larvae ($<10/10\text{ m}^3$) were found in November, mostly on the northeast peak of the Bank. Densities of larvae appeared to be about an order of magnitude lower during the 1976/77 season than in the previous three winters (see Res. Doc. 76/VI/123 for comparison).

Plankton sorting, computer processing and analysis of the larval herring data (1971-76), as well as the processing of available hydrographic, nutrient and primary production data, are still in progress. A review of existing plankton data and analyses is scheduled to take place at a workshop in Poland during 20-25 June 1977, organized by laboratories involved in the work. At that time, it is expected that the first complete analysis of the 0.505 mm mesh larval herring data will be available to compare production, growth, mortality and dispersal of larvae. It is hoped that an analysis of larval gut contents and associated fine-mesh zooplankton samples for several winters will have been completed, in order to determine if larval growth and mortality are related to average density of food organisms during the over-wintering period.

Processing of the backlog of hydrographic and primary production data from the larval herring surveys is continuing. The sampling of temperature-salinity profiles at larval herring plankton stations has been fairly complete, especially since 1974 when emphasis was placed on the Georges Bank-Nantucket Shoals region. Oxygen analysis was also added to the sampling procedures in 1975. The data for all years and all countries participating in the surveys have been compiled at the Woods Hole laboratory, but only a small part of the integrated data base has been analyzed to date. However, during the next several months the entire series is scheduled to be put into the standard NODC format and into the NODC computer file, and analyses should then proceed at a much faster pace. Once the data are in the NODC computer file, it will facilitate the work of MEDS in producing a hydrographic atlas for the series of larval herring cruises, a task which had been recommended by the Subcommittee at the 1976 Annual Meeting (*Redbook* 1976, page 137).

Since 1975, the hydrographic and zooplankton sampling has been augmented by measures of nutrients, chlorophyll and primary production. In general, nutrients, salinity, temperature and dissolved oxygen were obtained at each station (weather permitting) at depths of 0, 10, 20, 30, 50, 75, 100, 125, 150, 175, 200, 250 and 300 m. Chlorophyll samples were taken at approximately one-half of the stations (0, 10, 20, 50, 75, 100 m). On a few cruises, *in vivo* fluorescence was measured continuously at the surface, and, on eight cruises, the primary production was measured at selected stations at 100%, 50%, 25% 10% and 1% light depths, based on secchi disk or Lambda light meter readings. An inventory of the status of processing and analysis of these data is given in Table 2. A preliminary analysis and summary report of all data for 1975 and 1976 is expected to be completed by June 1978.

Monitoring of the larval herring production on Georges Bank is expected to continue in 1977 and 1978, with participation by Federal Republic of Germany, German Democratic Republic, Poland, USSR and USA. In addition, plans are well advanced for a larval patch study in 1978, which will include participation by two Canadian vessels. The purpose of the patch study is to gain a basic understanding of short-term physical and biological mechanisms controlling growth, mortality and dispersal of recently-hatched herring larvae and their food organisms from the northeast Georges Bank spawning ground, and the related question of possible mechanisms for their retention on Georges Bank. The proposed study would involve intensive sampling of the horizontal and vertical structure of a patch of larvae by several vessels working simultaneously for a period of 3-4 weeks beginning in October 1978, and would include measures of water motion using moored current meters, drifting buoys with drogues and dye experiments. Up to 5 vessels are expected to participate in the study. One vessel would do hydrographic and current studies; another would monitor patch boundaries by continuous high-speed sampling with plankton nets; a third vessel would sample the vertical and horizontal patchiness with opening-closing samplers; a fourth vessel would study the fine-scale structure of phytoplankton and zooplankton with a plankton pump; and a fifth vessel would do quantitative sampling of zooplankton (bottom to surface) using standard bongo samplers. At the same time, a sixth vessel is scheduled to provide broad plankton-hydrographic survey coverage for the Georges Bank-Gulf of Maine region, similar to that of the ICNAF larval herring program. A schedule of vessels participating in the 1978 patch study will be circulated in the

near future, together with plans for special preliminary studies of a patch structure in October 1977.

Table 2. Status of processing and analysis of nutrient, chlorophyll and primary production samples for 1975 and 1976.

Contractor	Vessel	Cruise	Phosphate Silicate Nitrate	Chlorophyll	<i>In vivo</i> fluorescence	Primary Production	Remarks
Bigelow Lab. 03-6-043-35112	<i>Belogorsk</i>	75-02	617	205	None	None	Data report available
	"	75-03	628	241	None	None	
	<i>Delaware II</i>	75-15	248	168	None	None	
	<i>Anton Dohrn</i>	75-187	523	330	None	None	
U.R.I. (Dr T. Smayda) 03-6-043-35116	<i>Albatross IV</i>	75-14	491	195		9 stations	Data report and analysis available
	"	76-01	304	255		5 stations	
Bigelow Lab. 03-6-043-35128	<i>Albatross IV</i>	75-07	211	315	None	None	Data report and preliminary analysis available
	"	76-03	722	604		8 stations	
	<i>Wieczno</i>	76-07	292	164	None	7 stations	
	<i>U.S.C.G.</i>	005	87	None	None	None	
Bigelow Lab. 03-6-043-35158	"	006	87	None	None	None	
	<i>Albatross IV</i>	76-05	682	1009	None	22 stations	Data report and preliminary analysis available
	<i>Ammandale</i>	76-01	153	153	None	7 stations	(See footnote 1)
	<i>Wieczno</i>	76-03	755	300	None	10 stations	
	<i>Anton Dohrn</i>	76-02	1200	900	None	27 stations	
	<i>Researcher</i>	11-76	590	590	None	None	

¹ Chlorophyll and primary production have been processed. Nutrient samples, stored at Woods Hole Lab., will be processed soon at the Sandy Hook Lab.

3. Review of Environmental Conditions in the ICAF Area During 1976

The following highlights of environmental conditions during 1976 are based on information contained in national research reports and oral presentations by some representatives.

a) Subarea 1

Environmental data were reported by Denmark, Federal Republic of Germany and USSR. Winter-spring conditions in the Fylla Bank section were observed to be colder than normal. On the shallower part of the Bank, ice was present in March. These relatively low temperature conditions persisted in the southern area during the spring and summer. On the northern banks (Store Hellefiske and Lille Hellefiske), summer temperatures were comparable to those of 1975 and near normal. During the autumn, an increasing influence of the Irminger Current occurred in the deeper part of the West Greenland Current, and the early part of the 1976/77 winter was exceptionally warm off southern Greenland, and the usual cooling of the water masses did not occur in the earliest part of the winter. USSR scientists forecast that summer temperatures in 1977 and 1978 will be above normal, on the basis of a harmonic analysis of temperature data from two of their standard sections (11A and 32A).

b) Subarea 2

Environmental data were reported by Canada, Federal Republic of Germany, German Democratic Republic and USSR. Surface temperatures over the Labrador Shelf in early August were similar to those of 1975 and to the long-term average for 1951-71, but the volume of <0°C water was greater, especially in the coastal area. Temperatures were slightly lower than average at intermediate depths and well below average in the near bottom layer. Except for the abnormally low temperature conditions in 1972, the deep water temperatures on the shelf were lower than any of the earlier observations. In the deeper layers over the slope, temperatures were below average and lower than any previously encountered, including the unusually "cold" year of 1972. These below normal temperatures appear to have existed throughout part of the

autumn months. However, preliminary results from Federal Republic of Germany data in late autumn indicate that significant changes may already have occurred in at least a part of the area, resulting in above normal temperatures. Geostrophic currents for the April-July period (Res. Doc. 77/VI/36) showed slightly higher transport through the Seal Island section than in 1975, the strongest currents having been centered over the slope.

c) Subarea 3

Environmental data were reported by Canada, German Democratic Republic and USSR. Temperatures in the Flemish Cap section for May, at least for some layers, were below those of 1975, but summer surface temperatures, while higher than in 1975, were similar to the 1951-71 average. The Labrador Current water, which usually forms an unbroken core from the Avalon Channel to the eastern Grand Bank, was divided thermally into inshore and offshore streams, with bottom temperatures on the western slope and on top of the Grand Bank being well above the 1951-71 average. Water temperatures along the seaward slope of Flemish Cap during the spring and summer were lower than in the previous year, being similar to conditions in other "cold" years in the 1951-71 period.

d) Subarea 4

Environmental studies were reported by Canada, Cuba, France and USSR, but no reports on the 1976 data were available for review by the Subcommittee. Attention was drawn to geostrophic maps of currents on the Scotian Shelf, prepared by USSR (Res. Doc. 77/VI/38). It was noted that these maps, covering the January, April-May, August and November periods, were compiled from data collected during 1962-75.

e) Subarea 5

Environmental studies were reported by Federal Republic of Germany, German Democratic Republic, Poland, USSR and USA. Temperatures on Georges Bank and in the eastern Gulf of Maine during the latter part of the year were observed to be well above those of 1975. Salinity over Georges Bank during the early months of 1977 was extremely high. It was thought that this condition arose from unusually intense vertical mixing (induced by storms) in the Gulf of Maine, thus bringing the deep saline water into the upper layers, and subsequent southerly drifting was presumed to have carried this mixed water over Georges Bank. Attention was again drawn to the monthly geostrophic maps of currents for the Georges Bank-Gulf of Maine region (Res. Doc. 77/VI/38), prepared by USSR from data collected during 1962-75.

f) Statistical Area 6

Only Poland reported that environmental data were collected in this area during 1976.

4. Marine Environmental Data Service (MEDS)

a) Progress Report for 1976-77

A summary of oceanographic data exchanged between MEDS and various member countries was presented (Res. Doc. 77/VI/52), and some of the historical data sets still outstanding from the ICNAF data base were discussed. It was noted at the Flemish Cap Working Group Meeting in May 1977 that USSR bathythermograph data were submitted to World Data Center B in Moscow for key-punching and that requests for such historical data should be directed to that data center. However, the Subcommittee noted that these data, as well as most of the oceanographic station data, had not reached the MEDS data bank. USSR representatives agreed to investigate the problem and report on its finding in the ensuing months.

In order to aid MEDS in its data acquisition role and to assist with the development of its capability to produce an annual review of environmental conditions, the Subcommittee agreed that each country should submit to MEDS early in the year an inventory of oceanographic stations occupied during the previous year. Accordingly, the Subcommittee

recommends (11)

that a form for reporting an inventory of oceanographic station data be adopted, completed by each country, and submitted to MEDS by 31 March of each year.

A draft form for use in providing the inventory of oceanographic data is at Annex 2, and it was suggested that the Secretariat should distribute copies of the form through its Circular Letter series.

The Subcommittee expressed the desire that MEDS prepare a unified assessment of environmental conditions in the ICNAF Area during 1977 prior to the 1978 Annual Meeting. The inventory form would aid in this task, but regular communication between MEDS and the various national representatives would also be required for the program to be successful. Dr Trites (Canada) agreed to assist MEDS with the assessment task. It was indicated by MEDS, at the Meeting of the Flemish Cap Working Group, that the ICES formats were more generally acceptable as the basis for exchanging oceanographic data, but it was emphasized that MEDS was not restricted by other formats and consequently did not wish to restrict countries from using their own formats when submitting data. As a result of initial bilateral exchange between MEDS and designated national representatives, all historical oceanographic station data collected in the ICNAF Area prior to 1976 by Federal Republic of Germany and UK are now in the MEDS data bank, and optimism was expressed that historical data acquired by several other member countries would be forthcoming during the next year.

b) Data Products Presently Produced and Envisaged

MEDS reported that it was now capable of producing machine-contoured plots of vertical sections as well as depth-time contours of oceanographic parameters for fixed stations. Attention was drawn to the publication "Time series of oceanographic bottle stations along ICNAF standard sections", as an example of a MEDS data product (Res. Doc. 77/VI/48). Another publication, summarizing the data products available from MEDS, is in preparation and will upon completion be forwarded to the Secretariat for distribution. It was also indicated that the "System 2000" data management system of MEDS enabled access to any subset of data by the following:

- i) Area: coted square, Marsden square, latitude-longitude span, circular area, and irregularly shaped areas (up to a 19-sided polygon);
- ii) Time: year, month, day, hour, and minute;
- iii) Identification: cruise number, station number, country, institute, and ship code;
- iv) Depth: range, level, and bottom distance;
- v) Parameter: observed or calculated data.

c) National Representatives for Data Exchange

The Subcommittee was informed that the following national representatives have been identified by MEDS: Cuba (R. Delgadø); Denmark (to be named); France (G. Stanislas); Federal Republic of Germany (D. Kohnke); German Democratic Republic (B. Schreiber); Japan (F. Nagasaki); Norway (R. Leinebø); Poland (A. Piotrowski); USSR (V. Ponomarenko); UK (P. Edwards); and USA (T. Winterfield).

d) Experimental Use of ROMBI Forms

National representatives were requested by the Chairman of the Subcommittee to report on the extent to which the ROMBI forms were being used. Problems in obtaining the forms were mentioned and only a single trial was reported. Representatives were in general unaware of the attempted introduction of the form, despite the requests to do so by STACRES (*Redbook* 1975, page 93; *Redbook* 1976, page 138). Thus there was still no basis for evaluating the ROMBI form as a means of summarizing the types of biological data being collected. Member countries are again urged to use the ROMBI form on an experimental basis, and the Secretariat is requested to circulate to each institute a copy of the ROMBI form with the request that it be completed.

5. Standard Oceanographic Stations and Sections

The Subcommittee noted that Circular Letter 76/79 (10 November 1976), which lists the standard sections and the positions of the stations, had been sent to all member countries. Attention was drawn to a probable error in the position of one of the stations on the Seal Island line. Dr Trites agreed to investigate and inform the Secretariat of any corrections to be made. The Subcommittee urges that all member countries should occupy these sections whenever possible. The matter of publication and widespread distribution of the standard sections and stations is referred to the Steering and Publications Subcommittee.

6. Plankton Studies

a) Continuous Plankton Recorder Results for 1976

The Subcommittee noted that the only information available for 1976 is given in the United Kingdom Research Report (Summ. Doc. 77/VI/24). Routes D and Z through the area east of Newfoundland and Routes MA and MB to Ocean Weather Station HOTEL are the only tracks for which collections were made in 1976. It was indicated that a report on these observations would be circulated later this year.

b) Progress Report on Plankton Sorting Center at Szczecin, Poland

The sorting of all fish larvae for the entire time series of ICNAF larval herring surveys (1971-76) is expected to be completed by June 1977. All phases of the work at the Center have been speeded up by the addition of 10 more plankton sorters to the staff, and virtually the entire work at the Center is being devoted to the ICNAF plankton data. However, progress on the invertebrate components of the 0.333 mm mesh samples has been less (only 3 cruises completed to date) because of the very large numbers of species and life stages to be identified and measured. Methods of streamlining this process are now under study.

7. Weather and Ice Reporting by Fishing Vessels (SHRED)

Some members of the Subcommittee wondered to what extent meteorological data were being transmitted to coastal radio stations by commercial fishing vessels and used by forecasting institutes in accordance with previous recommendations of STACRES. The Subcommittee accordingly

recommends (18)

that the Secretariat contact the relevant meteorological and ice forecasting institutes to determine how successful the program is and whether they wish it to be extended further.

8. Other Matters

The Subcommittee's attention was drawn to an interesting relationship between water temperature and the timing of the migrations of cod which occur between the Burgeo-Rose Blanche Bank area and the northern Gulf of St. Lawrence (Res. Doc. 77/VI/49).

ANNEX 1. REPORT OF FLEMISH CAP WORKING GROUP

Convener: K. G. Konstantinov

Rapporteur: D. M. Ware

The Working Group met at Murmansk, USSR, during 16-19 May 1977, with 5 representatives from Canada (including one from MEDS), 2 from Poland, 1 from USA and 17 from USSR. The Group used as its terms of reference a STACRES recommendation from the 1976 Annual Meeting "that Dr Konstantinov be asked to convene a small group of scientists, who might be directly concerned with a coordinated international experiment on Flemish Cap, to further examine the data base, to appraise the suitability of Flemish Cap as an area worthy of special study, and, if the outcome of the appraisal is favourable, to develop a preliminary proposal for consideration by the Subcommittee at its meeting in 1977" (Redbook 1976, pages 60 and 136).

1. Review of Available Information on Flemish Cap

A number of papers dealing with the Flemish Cap area were presented (Res. Doc. 77/VI/48, 51, 52, 53, 54, and several working papers), and these together with material already published generated considerable discussion which focused on the desirability of studying the combined effects of biological and environmental factors on the survival of year-classes of certain groundfish in the area. The following points related to the planning of a research proposal were especially noted:

- a) The main spawning of cod occurs in late February and March on the southwestern and eastern slopes of the bank above depths of about 500 m, and the greatest number of early larvae are found over the shallower central part of the bank. The timing of the extrusion of redfish larvae is more complex, because not only is there a problem of identifying the different species involved, but also a time sequence of spawning on different parts of the bank can be seen. In March, the main concentration of larvae were found at the northeast corner of the bank where commercial catches were predominantly *Sebastes mentella* in appearance. In April, 7-8 mm larvae were mainly found on the eastern and western slopes of the bank above depths greater than 400 m, and, in May, the main concentrations were on the western and southern slopes. Peak extrusion of redfish larvae occurred in the April-May period. The seasonal pattern of spawning at Flemish Cap can be approximately summarized as in Fig. 1.
- b) Work by USSR scientists indicated that there is a possible loss of eggs and larvae during some years from the southeastern corner of the bank. This confirms the necessity of extending the survey area beyond the confines of the bank itself.

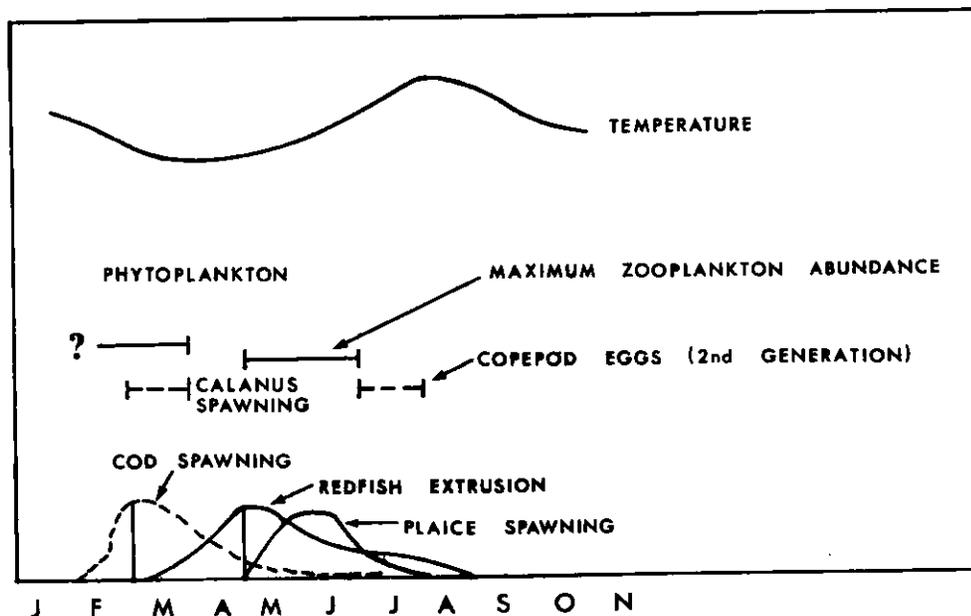


Fig. 1. Conceptual summary of the spawning sequence in relation to biological and environmental events.

- c) There are strong indications that environmental factors play an important role in determining year-class success and failure on the bank. Evidence was presented that cooler-than-average water temperatures to the south of Flemish Cap (USSR Section 4A) correlate with good year-classes of cod in that area (Res. Doc. 77/VI/53), while other data showed that recruitment of 4-year-old cod increases with increasing population size, with increasing temperature on and to the north of the Cap, with decreasing southerly Ekman transport, and with increasing easterly Ekman transport (Res. Doc. 77/VI/54). At first glance, it appears that there is disagreement in the temperature correlations presented in the two papers. However, in the former paper, the temperature data used for the correlation were from the area south of the bank where the pre-dominating influence may have been the warmer North Atlantic Current, whereas, in the latter paper, the temperature data were strongly influenced by the colder Labrador Current regime, in which warmer temperatures were correlated with year-class success in cod.
- d) The Flemish Cap area is quite evidently a very dynamic one which may be considerably influenced by the relatively large-scale oceanographic events which occur to the south of it. A mixing of water masses occurs on and in the vicinity of the Cap, with several areas tentatively identified as being potentially highly productive. This potential productivity is implied by the existence of upwelling water and from actual observations of zooplankton productivity and chlorophyll A concentration.
- e) The Flemish Cap waters are warm enough to allow a second generation of at least calanoid copepods in July, probably a significant factor in the schedule of biological events. After the cod larvae are reared on the zooplankton generation of February-March, this second occurrence of zooplankton nauplii and copepodites could be important to the later spawning of redfish.

2. Development of International Research Project

Following discussions on the data base, it was agreed that a continuing international program of research toward understanding the recruitment processes of the Flemish Cap cod and redfish stocks would be extremely valuable and that such a study had a reasonable probability of yielding useful results. Therefore, in accordance with the Subcommittee's recommendation at the 1976 Annual Meeting, the Working Group proceeded forthwith to develop a preliminary proposal for a cooperative international experiment in the area.

In developing the proposal, the Working Group attempted to restrict discussions to deriving an overview of the proposal with emphasis on the time and space scales involved and the general levels of research effort likely to be required. The Working Group was guided by research proposals presented in a working paper by PINRO scientists, and identified three major problems that should be considered in order to predict the survival of different year-classes: (i) the effect of water circulation patterns and the abundance and size composition of the planktonic food supply on the retention and the survival of fish larvae on Flemish Cap; (ii) the effect of intraspecific and interspecific predation on the survival of juvenile fish; and (iii) improved assessment of the size of the spawning stocks.

The parameters and frequency of measurement suggested in relation to each of the above-mentioned problems are indicated below.

- a) Larval Survival. It was proposed that a grid of about 50 oceanographic and simultaneously-occupied ichthyoplankton stations (Fig. 2), situated to cover important oceanographic events, be occupied every two weeks from February to June by two ships working jointly. Measurements of temperature, salinity, oxygen, nutrients and zooplankton biomass would be made at each station. The ichthyoplankton samples should be stratified so that the vertical distribution of eggs and larvae can be determined. A number of moored buoys should be placed on the Cap during the spawning and larval development period to measure current velocities. In addition, the following hydrographic sections should be occupied: ICNAF Flemish Cap, US Coast Guard 1, and USSR 7A (Fig. 2).

The Group strongly encourages the development of oceanographic modelling applicable to the area, the use of remote sensing techniques, satellite tracking of drifting buoys, and any other available tools that would aid in clarifying the circulation pattern and the oceanographic regime.

To ensure that all data collected can be usefully exchanged, it was agreed that careful inter-calibration of methods and instrumentation of the various countries is essential, and that this must be given high priority when future details of the proposal are developed.

- b) Juvenile Fish Survival. It was proposed that a pelagic and bottom trawl survey, each consisting of a minimum of 35 hauls, should be conducted in both March and September to assess juvenile abundance. The spring survey could be combined with the ichthyoplankton work. The young fish would be examined to determine their feeding habits and the length and age compositions.

- c) Assessment of Adult Cod and Redfish. It was agreed that the bottom trawl juvenile survey conducted in early March could also be used to assess the abundance of spawning cod. It was recommended that the USSR groundfish survey (continuing a time series) should be carried out in March or April. Furthermore, it was agreed that the participating countries should conduct joint cruises to calibrate fishing gear and other instruments. In addition to the increased research vessel effort, participating countries are urged to make a special effort to sample the commercial catches of their fleets during the duration of the joint research project.

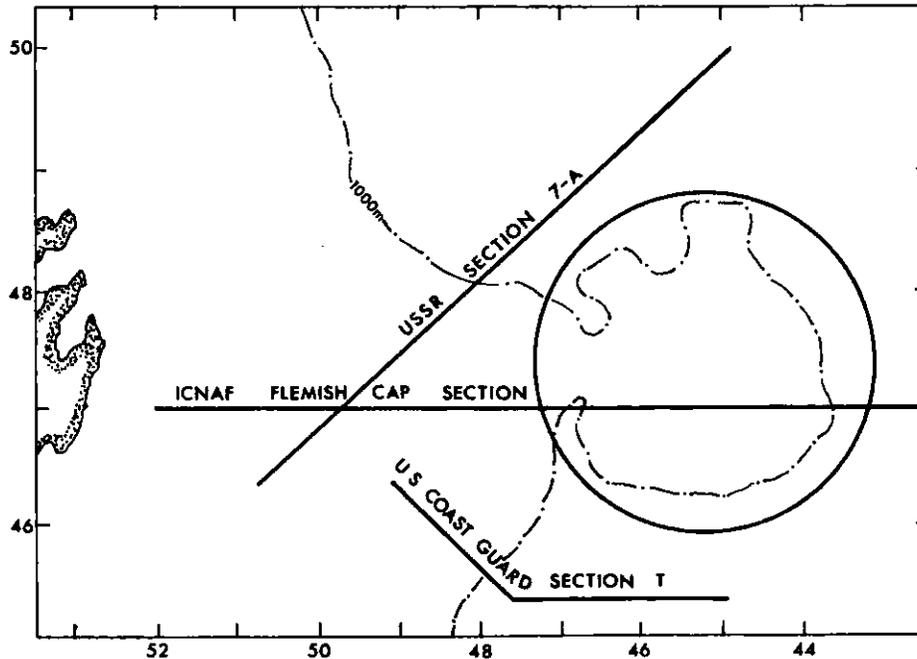


Fig. 2. Location of oceanographic sections and survey area. (Approximately 50 oceanographic and ichthyoplankton stations to be situated within the circle.)

The foregoing proposals are considered to be necessary in order to ensure a reasonable probability of a successful outcome from the studies, and the participation of as many countries as possible is strongly encouraged so that the full program can be developed. However, the scientists from Canada and USSR consider the Flemish Cap study to be so important that they plan to undertake a less extensive program on a bilateral basis even if broader international participation is not possible. If this lesser research effort occurs, it was agreed that attempts would be made to conduct surveys in late March, in April and in May to estimate the size of the cod stock and to identify the drift pattern of eggs and larvae. In such a bilateral program, the pelagic survey for juvenile fish would have a low priority.

3. Preliminary Plans for 1978

The Working Group agreed that the program should be flexible and proceed in stages, with each stage contributing to a rapidly improving data base. The first stage of the proposal should begin in 1978, and to this end preliminary consideration was given to the scheduling of ship time as follows:

- a) USSR scientists indicated that they would conduct a bottom trawl survey (for juveniles) followed by two oceanographic and ichthyoplankton surveys during the March-May period, using the research vessels *Persey III* and *Protzion*.
- b) Canadian scientists were unable to indicate how much ship time would be available for work on the Flemish Cap, due to uncertainty about scheduling of ship time for 1978, but they were optimistic that a chartered stern trawler would be available for work in the area for about three weeks in March.

- c) US Coast Guard plans to continue its standard section cruises and would be able to spend up to 15 days of "on station" time occupying oceanographic stations on Flemish Cap in February and August. These vessels could collect conductivity, temperature and density data, water samples, release drogues and possibly set ABS buoys (automatic buoy system), which would remain moored for a minimum of three months. It is also possible that the USA vessels could collect some biological data if experienced persons were provided by member countries.
- d) Polish scientists indicated that the research vessel *Wieczno* might be available for 7-10 days of oceanographic and ichthyoplankton work in 1978. They suggested that participants in the Flemish Cap project should use the most modern equipment available.

The Working Group strongly emphasized the need for the rapid exchange of data, by radio if possible and/or immediately after each cruise rather than at some later time. This would allow the optional allocation of survey effort on the following cruise and overcome the problem of "working blind", which often hinders the potential productivity of projects of this type. It was agreed that all oceanographic data be sent directly to MEDS for input into the ICNAF data base and for distribution to member countries. In addition, MEDS indicated that it could act as the data center for biological data collected during the Flemish Cap project, if required.

PART C

REPORTS OF SCIENTIFIC ADVISERS

Annual Meeting - June 1977
Special Meeting - October 1976

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I. REPORT OF SCIENTIFIC ADVISERS TO PANEL 1¹

Saturday, 28 May 1977, 1000 hours

The meeting was opened by Dr A. Schumacher (Federal Republic of Germany), acting as Chairman in the absence of Mr Ø. Ulltang (Norway). The meeting was attended by scientific advisers from all member countries of the Panel except Norway and USSR, and by observers from Bulgaria, Canada, Cuba, German Democratic Republic and Japan. Mr B. W. Jones (UK) was appointed Rapporteur. The agenda proposed for Panel 1 was adopted as the basis for this meeting.

1. Conservation Requirements

For all stocks considered, the advice given by the Assessments Subcommittee (this volume, Part B, Appendix I) was endorsed by the Scientific Advisers.

a) Cod in Subarea 1

Since the present level of the spawning stock is considered to be very low (about one-tenth of the level prevalent in the 1960's), it is advised that the stock be managed in such a way as to allow the greatest possible improvement in the spawning stock, that is, the catch in 1978 should be kept at the lowest possible level. In the discussion on this stock, it was noted that recent data from the fisheries of Denmark and Federal Republic of Germany showed that the 1973 year-class, as predicted, was dominant in the catches.

b) Roundnose Grenadier in Statistical Area 0 and Subarea 1

Lacking any evidence to warrant revising the TAC, it is advised that the TAC for 1978 should remain at the 1977 level of 8,000 tons.

c) Greenland Halibut in Statistical Area 0 and Subarea 1

The advice is that a precautionary TAC of 25,000 tons should be set for 1978.

d) Shrimp (*Pandalus borealis*) in Subarea 1

The conservation measures adopted for 1977 were based on events that occurred during the 1976 fishing season (this volume, Part A, Appendix I), and it was considered too risky at the present time to use these events to extrapolate conservation measures for 1978. It is considered much more appropriate to assess the stock and advise on conservation measures for 1978 at a meeting near the end of 1977 when data for most of the 1977 fishing season would be available.

2. Future Research Requirements

a) Cod

It is advised that groundfish surveys in this area be continued to provide up-to-date information on the strength of pre-recruit year-classes.

b) Greenland Halibut

The Scientific Advisers reiterate their request of the 1976 Annual Meeting that studies on trawl codend mesh selection, yield per recruit, and additional information on by-catches in the fishery for Greenland halibut be carried out.

c) Shrimp

The Advisers note that there is a need to conduct stratified random surveys on the offshore shrimp fishing grounds, and to undertake an intensive sampling program for shrimp, including the by-catches of species taken in the shrimp fishery.

3. Adequacy of Sampling

The Advisers noted that the overall level of sampling of cod and Greenland halibut was only about 40% of the recommended minimum level and it was only 20% for roundnose grenadier. There is, there-

¹ Presented to the June 1977 Annual Meeting as Proceedings No. 4, Appendix I (Serial No. 5111)

fore, a need for improvement in the sampling of the commercial catches of these species. In addition, there is the need for special attention with regard to sampling the catches of cod taken by gears other than trawl, e.g. gillnets and longlines, whose selection characteristics are different from that of otter trawls.

4. Time and Place of Next Meeting

It was agreed that the next meeting of the Scientific Advisers to Panel 1 would take place prior to the next meeting of the Panel.

II. REPORT OF SCIENTIFIC ADVISERS TO PANELS 2, 3 AND 4¹

Saturday, 28 May 1977, 1100 hours

The Chairman, Dr G. H. Winters (Canada), opened the meeting with scientific advisers present from Bulgaria, Canada, Cuba, Denmark, Federal Republic of Germany, German Democratic Republic, Japan, Poland, Portugal, Spain, USSR and UK. Mr R. Wells (Canada) was appointed Rapporteur. An agenda, similar to that of Panel 3 but including conservation requirements for all stock in Subarea 2, 3 and 4 considered by the Assessments Subcommittee, was adopted as the basis for this meeting.

1. Conservation Requirements

The Scientific Advisers reviewed the Report of the Assessments Subcommittee (this volume, Part B, Appendix I) and noted that specific TACs for 1978 were advised for some stocks, whereas a number of options for 1978 TACs was put forward for other stocks. The Advisers endorsed all of the specific recommendations as follows:

Species	Stock area	1977 TAC (tons)	Advised 1978 TAC (tons)	Remarks
Cod	2GH	20,000	20,000	No re-assessment, lack of sampling data.
	3M	25,000	40,000	
Redfish	2+3K	30,000	30,000	Recruitment prospects good.
	3M	16,000	16,000	
	3LN	16,000	16,000	
	3O	16,000	20,000	
Silver hake	4VWX	70,000	81,000	
American plaice	2+3K	8,000	6,000	Decline in inshore catch rates. USSR surveys show improving abundance.
	3M	2,000	4,000	
Witch flounder	2J+3KL	17,000	17,000	
	3NO	10,000	10,000	
Yellowtail flounder	3LNO	12,000	15,000	Biomass improving.
Greenland halibut	2+3KL	30,000	30,000	
Roundnose grenadier	2+3	35,000	35,000	
Argentine	4VWX	20,000	20,000	
Capelin	2+3KLNOPs	417,000+	500,000	See text below.
Illex	3+4	25,000	25,000	See text below.

With reference to capelin in Subareas 2 and 3, the Advisers noted that no new data were available for 1976 to assess the effects of the capelin fishery on the major predators of this species, and that pre-recruit surveys should be conducted to provide estimates of the strength of year-classes as close as possible to the year for which TACs are to be set. With reference to Illex in Subareas 3 and 4, the Advisers noted the comments of the Assessments Subcommittee that it was extremely difficult to provide adequate assessments well in advance of the fishing season, and that the effectiveness of effort regulation should be evaluated as an alternative to management by catch limitation as currently applied.

The Advisers reviewed the management options put forward by the Assessments Subcommittee for the following stocks for which no specific 1978 TACs were advised:

a) Cod in Divisions 2J, 3K and 3L

The Assessments Subcommittee provided advice on yields associated with fishing in 1978 at three levels of fishing mortality (0.10, 0.15 and 0.20, the last being equal to $F_{0.1}$). The corresponding catches in 1978 would be 85,000, 125,000 and 162,000 tons. Indications of trends in spawning stock biomass (assuming average recruitment) relative to a target level of 1.5

¹ Presented to June 1977 Annual Meeting as Proceedings No. 5, Appendix I (Serial No. 5112)

million tons and of trends in catch are as follows:

	<u>F = 0.10</u>	<u>F = 0.15</u>	<u>F = 0.20</u>
Percent change in 1985 catch relative to 1977 TAC	142	177	198
Percent of target spawning biomass reached in 1985	123	98	78

The advisers noted the conclusion of the Assessments Subcommittee that the cod being exploited by the inshore and offshore fisheries comprise one stock, and they concurred with the advice that, if fishing is conducted at levels of F which result in increased stock biomass, catch rates for both the inshore and offshore fisheries would improve, and that the faster the rate of recovery of the biomass, the faster the catch rates will improve.

b) Cod in Divisions 3N and 3O

Sampling data were inadequate to allow an analytical assessment of this stock. It was agreed, however, that the stock is presently in a depressed condition and that, on the basis of a general production analysis, catches of 20,000 and 30,000 tons in 1978 would correspond to fishing at $2/3 F_{MSY}$ and at F_{MSY} respectively.

c) American Plaice in Divisions 3L, 3N and 3O

The Assessments Subcommittee advises that the catches in 1978 would be 32,000 and 47,000 tons if fishing were conducted at $F = 0.33$ and at $F_{0.1} = 0.43$ respectively. With constant recruitment at the 1971-73 level, relative trends in biomass and catch (tons) between 1978 and 1985 is indicated as follows:

Year	<u>F = 0.33</u>		<u>F_{0.1} = 0.43</u>	
	Biomass	Catch	Biomass	Catch
1978	453,000	32,000	453,000	47,000
1982	528,000	48,000	488,000	56,000
1985	542,000	52,000	495,000	56,000

2. Future Research Requirements

With reference to the Report of the Standing Committee on Research and Statistics, including the reports of the various subcommittees, the Advisers endorsed the needs for research as follows:

- a) A study of the sources of variance in the estimates of abundance indices from research vessel survey data;
- b) The provision of detailed catch and effort data at least on a monthly basis for squid (*Illex*) in Subareas 3 and 4 by countries with directed fisheries for squid and by other countries with significant catches of squid in fisheries directed toward other species;
- c) The implementation of coordinated international research on the factors determining year-class success in major groundfish species on Flemish Cap (Div. 3M);
- d) Further studies on the ageing of silver hake, involving otolith exchanges and a workshop in the early part of 1978;
- e) Mesh selection experiments to be carried out in 1977 to determine the consequences of the mesh size regulation for silver hake in Div. 4VWX;
- f) Scientific investigation of the probable segregation of mature and immature Greenland halibut to be continued and expanded, together with intensive sampling of the commercial catches;
- g) The provision of adequate sampling data from the commercial catches of cod in Div. 2GH and 3NO and argentine in Div. 4VWX, in view of the fact little or no sampling data have been provided for these stocks and analytical assessments were consequently not carried out.

3. Time and Place of Next Meeting

The Advisers agreed that the next meeting will be held prior to the meetings of the appropriate Panels at the next Annual Meeting.

III. REPORT OF SCIENTIFIC ADVISERS TO PANEL A (SEALS)¹

Copenhagen, Denmark, 11-13 October 1976

The meeting was convened by the Chairman, Dr A. W. Mansfield (Canada), and Mr M. C. Mercer (Canada) was appointed rapporteur. Representatives attended from Canada (C. K. Capstick, P. F. Lett, A. W. Mansfield, A. W. May, M. C. Mercer, D. E. Sergeant, G. H. Winters), from Denmark (Sv. Aa. Horsted, F. O. Kapel), and from Norway (T. Benjaminsen, T. Øritsland). The agenda, as proposed by the Chairman, was adopted without revision (see Part D, this volume). During the course of the discussions, the Advisers reviewed five working papers and the following research documents: Res. Doc. 76/X/124, 125, 126, 127, 130, 131, 132 and 133.

1. Conservation of Harp Seals

a) Results of Research in 1976

Canada reported on the results of 1976 studies relating to estimation of selectivity in the shooting kill of moulting seals, age at sexual maturity and age composition of seals taken in the shore-based fisheries (Res. Doc. 76/X/124). The planned aerial census of Front and Gulf herds by the University of Guelph, using ultra-violet photography, was not completed. Estimates of mortality, stock size and production were made, and various management strategies indicated (Res. Doc. 76/X/127, 130, 132).

In addition to participation in the studies described in Res. Doc. 76/X/130, Norway reported on field operations at the Front in 1976 (Res. Doc. 76/X/132) and provided further estimates of mortality and production from age samples collected there in 1976.

Denmark provided catches and age composition data for harp seals in Northwest Greenland, 1972-75, which indicated an inverse correlation between catch of pups in the Front and Gulf areas and subsequent catches of beaters and bedlamers in Northwest Greenland during the following summer.

b) Mortality Estimates

Estimates of total and natural mortalities were obtained in several ways:

- i) In Res. Doc. 76/X/127, estimates of total mortality (Z) were derived from catch curves based on age composition data (sexes combined) for moulting seals of age-groups 5-13 for the 1968-74 period. These were adjusted for instantaneous rates of change in recruitment (due to declining pup production) and changes in hunting mortality (F) with time. The instantaneous hunting mortalities were calculated separately for each sex, combined and weighted by the catch composition, and then subtracted from Z to give $M = 0.115$ for sexes combined. The mortality rate of immature seals was computed from cohort analysis and did not appear to be significantly different from that of the adults.
- ii) In Res. Doc. 76/X/130, instantaneous total mortality rates were calculated using Paloheimo's linear formula (excluding age-group 1), and the hunting mortality (F) was derived from halving of the hunting effort following implementation of quota regulations in 1971. The estimate of natural mortality from the solution of the appropriate equations was $M = 0.114$.
- iii) In Res. Doc. 76/X/132, hypothetical natural mortalities were applied to each age-group, with relatively high values for age-groups 0 to 2 and rapidly increasing values for age-groups 22 to 29. The weighted average annual natural mortality was similar to that used in Res. Doc. 76/X/130. Mortality resulting from the northern Canadian and the Greenland hunt was considered as part of the natural mortality.
- iv) Unpublished data presented by Norway included age frequencies of moulting males in 1969-76. Mortality rates, calculated from catch curves for males of age-groups 2 to 12 and corrected for changes in recruitment, gave a mean value of $M = 0.1058$.

c) Estimates of Production in 1976 and Sustainable Yield in 1977

- i) In Res. Doc. 76/X/127, survival indices and a stock recruitment model were used to derive estimates of production of 310,000-340,000 with a sustainable yield of 215,000 seals,

¹ Presented to the Special Meeting of Panel A, October 1976 (Summ. Doc. 76/XII/47, Appendix III).

- ii) In Res. Doc. 76/X/130, cohort analysis was used to derive a figure for the population in 1961. This population, projected forward to 1976, gave a pup production of 327,000, with a sustainable yield of 190,000 seals in 1977. These values were lower than those given in (i) above, due in part to the incorporation of random variation in natural mortality (M) and the landsmen's catches.
- iii) In tables of unpublished data presented by Norway, the mortality rate was used to estimate a production of 346,000, or a more conservative estimate of 315,000 using functional regression. The sustainable yield from the latter estimate is 210,000 seals.
- iv) In Res. Doc. 76/X/132, a model (hereinafter called the Guelph model) was used to derive five population forecasts. These gave pup productions ranging from 193,000 to 321,000 with sustainable yields from 65,000 to 160,000 (exclusive of aboriginal catch). Three of these, considered by the authors to be most appropriate, gave productions ranging from 249,000 to 313,000 and sustainable yields from 103,000 to 130,000.

The Guelph model is based on: (1) a projection forward from a population based on a pup production of 645,000 in 1951, obtained from the first aerial census performed on harp seals in Canada; (2) distribution of the bedlamer and adult catches in proportion to relative abundance in each age-group; and (3) hypothetical age-specific natural mortality rates, which are much higher in the immature age-groups than those described in other studies (Res. Doc. 76/X/127, 130, and the Norwegian unpublished data). It is considered that the low sustainable yields in the Guelph model were largely due to the above-mentioned factors.

d) Advice on Catch Levels in 1977

Res. Doc. 76/X/133 suggested that management criteria, established by the International Whaling Commission (IWC) in 1974, should be considered when formulating management policy for the harp seal population. The Advisers concluded that:

- i) harp seal and large whale populations have quite different vital rates which would affect their recovery time;
- ii) the IWC management regime was formulated as a response to widely different management objectives, some of which were not biologically based, and it has no particular relevance to harp seal management; and
- iii) there is no biological reason why a seal stock cannot be managed at a much lower level than that providing the maximum sustainable yield (MSY)

The Scientific Advisers' interpretation of the current management policy for the Northwest Atlantic harp seal stock is that the stock be allowed to rebuild toward the MSY level. These objectives may require re-examination depending on the future assessment of relationships between seals and other marine life.

The majority of the Advisers agreed that the MSY population size lay between 1.6 and 2.0 million seals (age 1 and older). The sustainable yields associated with this level of population were from 240,000 to 270,000, assuming the same proportion of adults to pups in catches as those presently observed. Furthermore, a total allowable catch (TAC) of 170,000 (including aboriginal kill) would allow a continued increase toward the attainment of the MSY level in 15 to 20 years. However, the population projections in the Guelph model, considered appropriate by the authors, indicate that a level of kill above 130,000 (excluding aboriginal kill) would cause a population decline.

e) Recent Trends in Landsmen's Catches

The Advisers noted the recent increase in the landings by landsmen, particularly in the catch by vessels less than 150 tons (Fig. 1). Participation in the hunt consistently increased from 45 vessels in 1972 to 180 vessels in 1976. It was also noted that the average level of annual catch over the 1965-76 period was 48,421 seals.

f) Future Research on Harp Seals

The Advisers agreed on the following priorities in research for 1977:

- i) complete aerial photographic (ultra-violet) census of pups, with refined survey design and rigorous ground control;

- ii) detailed age and sex sampling of landsmen's catches;
- iii) refined estimates of natural mortality, especially of juveniles;
- iv) refined estimates of age at maturity and pregnancy rates in the Gulf and Front areas;
and
- v) refined estimates of sex ratio by age-classes.

The Advisers agreed that, since age samples of moulting seals were necessary for the best scientific advice and since quota catches by large vessels rarely included moulting seals, scientific permits might be required for Canada and Norway to take a total of about 1,200 animals, this number being necessary to ensure a sufficient sample of 800 males.

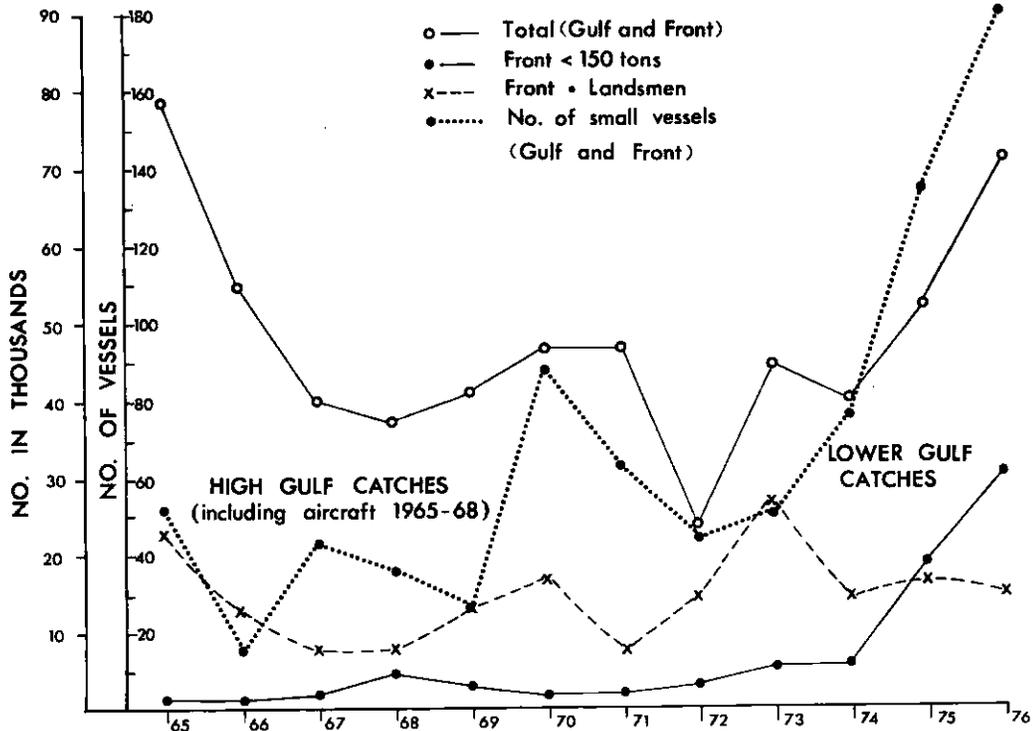


Fig. 1. Harp seal catches by landsmen, 1965-1976.

2. Conservation of Hooded Seals

a) Results of Research in 1976

Canada reported the results of 1976 studies concerning the aerial survey of breeding seals in Davis Strait, recoveries of tagged and branded seals, and estimates of production and yield (Res. Doc. 76/X/126). Norway reported on field operations at the Front in 1976, during which a few hooded seals were tagged and a large number sampled for age (Res. Doc. 76/X/131). Recoveries in Newfoundland and on the west coast of Greenland of 3 hooded seals tagged in Denmark Strait in 1974 were also reported. Denmark provided preliminary data on catches of hooded seals in Greenland (Fig. 2) which suggest that the species has become more readily available in the last decade, especially in South Greenland.

b) Mortality Estimates

No new data were available to provide further estimates of mortality rates.

c) Estimates of Production in 1976 and Sustainable Yield in 1977

- 1) Davis Strait. Whelping hooded seals were discovered by aerial survey on 22 and 24 March 1976 close to where they had been located in March 1974. Incomplete photographic

estimates of the small patch seen on 22 March gave a count of 4,200 adult seals. On 24 March, a patch of scattered seals was seen on more diffuse ice in the same general area, but it could not be determined if this was the same group seen previously. Visual estimates suggested a population size of between 5,000 and 10,000 adults.

- ii) The Front. A sample of 208 females collected in 1976 was aged and combined with similar Norwegian data for 5 years collected in 1967 and 1971-74 and with Canadian data for 1953 and 1966. The percentage of 5-year-old females in each sample was plotted against the catch of young, and a population estimate of 23,000 was obtained by functional regression. Although there is some evidence that the hunt is intensive, it was noted that the catch per unit effort from Norwegian fleet statistics for 1966-76 remained stable.

d) Advice on Catch Levels in 1977

The Advisers considered that the new evidence did not provide a firm basis for altering for 1977 the TAC of 15,000 which was recommended for 1976 at their last meeting in December 1975.

e) Future Research on Hooded Seals

The Advisers agreed on the following programs of research for 1977:

- i) the joint development of a population model, utilizing all available data; and
- ii) a further aerial survey of whelping seals in Davis Strait.

The Advisers noted that Norway had a large age sample from the moulting patches in Denmark Strait which still needs to be analyzed. Although outside the ICNAF Area, Denmark Strait is thought to be the main moulting area for hooded seals from both the Front and the Jan Mayen populations, and Norwegian scientists are urged to complete the analysis of these data.

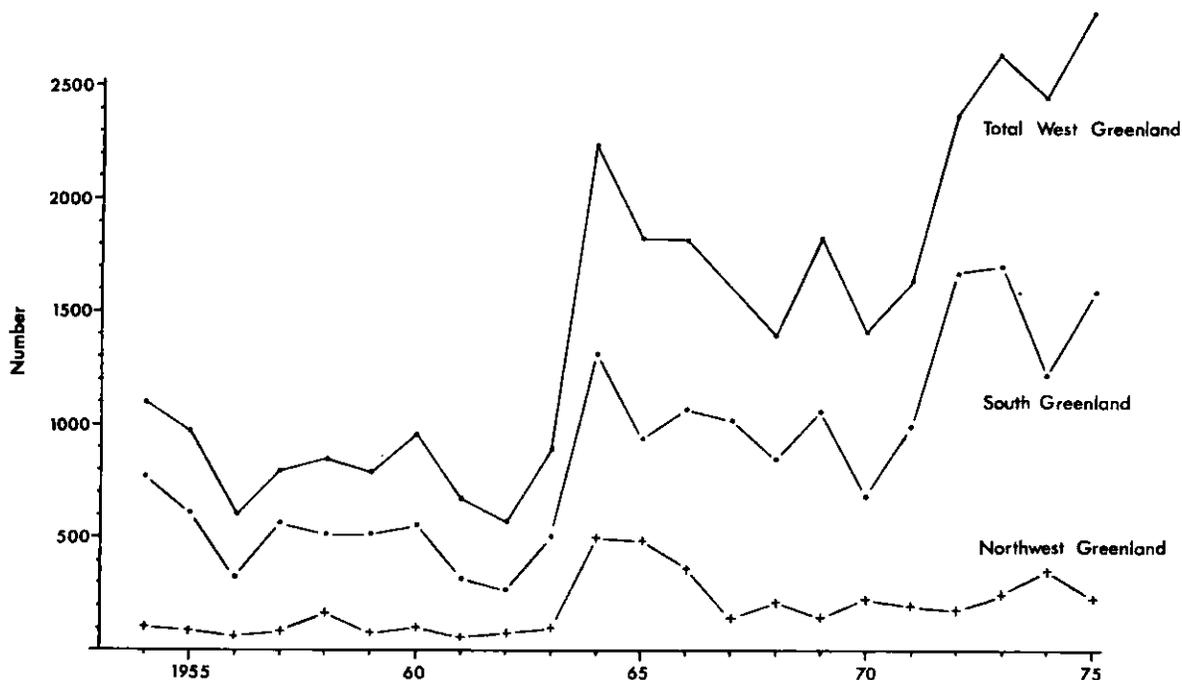


Fig. 2. Hooded seal catches in West Greenland, 1954-75.

3. Assessment of Relationship Between Seal and Fish Populations

Harp seals have a very wide food spectrum which consists of small pelagic fish, shrimps and euphausiids. In the Northwest Atlantic, capelin forms the most important part of the diet. At the present population level of harp seals, annual consumption of capelin has been variously estimated to be in the order of 300,000-500,000 tons (Res. Doc. 76/X/125), most of which was taken in the Newfoundland area but some also at West Greenland. A similar amount of capelin may also be eaten by the great whales. The dependence of a vast biomass of cod and many species of sea-birds on

capelin means that complex models will have to be constructed. The use of such models to predict changes in the level of one species from changes in the level of another will require the input of much biological and environmental data which may take many years to obtain.

4. Other Business

Because of the general public interest in the subject of seal management, the Advisers agreed that pertinent research documents should be released with the prior approval of the authors. It is suggested, therefore, that the label "Restricted" currently on the documents should be replaced by the label "Not to be cited without prior reference to the author", which is the practice currently followed by ICES. The Advisers also recommend to the Panel that the Commission should be requested to consider the early release of the reports of Panel meetings together with reports of its Scientific Advisers.

5. Time and Place of Next Meeting

The Advisers stress the difficulty of providing analyses of new data from the current sealing season in time for consideration at the Annual Meeting and therefore recommends that their next meeting take place in the fall of 1977.

6. The Advisers met briefly on 13 October 1976 to approve the draft report, following which the meeting was adjourned.

PART D

CONTENTS

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I. AGENDA FOR STACRES MEETINGS

NINTH SPECIAL COMMISSION MEETING - DECEMBER 1976

1. Opening (Chairman: M. D. Grosslein)
 - a) Appointment of rapporteur
 - b) Adoption of agenda and plan of work
 - c) Formation of working groups and approval of conveners
2. Stock Assessments
 - a) Shrimp (1)
 - b) Mackerel (3-6)
 - c) Silver hake (4VWX)
3. Adoption of Working Group Reports
4. Other Matters
5. Adjournment

27TH ANNUAL MEETING - MAY-JUNE 1977

1. Opening (Chairman: to be elected)
 - a) Appointment of rapporteur
 - b) Adoption of agenda
 - c) Plan of work
2. Assessments (Chairman: A. T. Pinhorn)
 - a) Review of catch statistics and fishing activity in 1976
 - 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 (Comm. Doc. 77/VI/4, 12):
 - Cod (2GH, 2J+3KL, 3NO)
 - Redfish (2+3K, 3LN, 3O)
 - Silver hake (4VWX)
 - American plaice (2+3K, 3LNO)
 - Witch flounder (2J+3KL, 3NO)
 - Yellowtail flounder (3LNO)
 - Greenland halibut (2+3KL)
 - Roundnose grenadier (2+3)
 - Argentine (4VWX)
 - Capelin (2+3K, 3LNOPs)
 - Squid-*Illex* (3+4)
 - iii) Stocks in the northern part of the ICNAF Area, as suggested by Canada (Comm. Doc. 77/VI/4) and subject to the concurrence of Denmark:
 - Cod (1)
 - Greenland halibut (0+1)
 - Roundnose grenadier (0+1)
 - Shrimp (1)
 - c) Preliminary review of results of ageing workshops on cod and silver hake
 - d) Preliminary review of results of international herring tagging program
 - e) Relevant information from coordinated larval herring surveys
 - f) Implementation of ICNAF data base (*Redbook* 1976, page 59)
 - g) General productivity studies
 - h) Other matters
3. Statistics and Sampling (Chairman: J. Messtorff)
 - a) CWP activities and plans for ninth session in August 1977 (*Redbook* 1976, page 59)

- b) ICNAF statistical activities, 1976/77
 - i) Statistical Bulletin Vol. 25 for 1975, and Summ. Doc. 77/VI/3
 - ii) Advance monthly statistics for selected species, 1976
 - iii) Statistics on discards
 - iv) Adequacy of national reporting of fishery statistics
 - v) Review of STATLANT and other statistical forms and deadlines for submission
 - c) ICNAF sampling program, 1976/77
 - i) Sampling Yearbook Vol. 20 for 1977 (Summ. Doc. 77/VI/5)
 - ii) Adequacy of sampling and national reporting of sampling data (Summ. Doc. 77/VI/31)
 - iii) Early requirement for sampling data
 - iv) Review of sampling forms and deadlines for submission
 - v) Implementation of sampling data base
 - d) List of vessels for 1975 (Summ. Doc. 77/VI/4)
 - e) International scientific observer program
 - f) Review of relevant papers
 - g) Other matters
4. Biological Surveys (Chairman: W. G. Doubleday)
- a) Review of survey activity in 1976 (groundfish and pelagics)
 - b) Proposed survey activity for 1977
 - c) Processing facilities for survey work
 - d) Editing of manual on ICNAF groundfish surveys
 - e) Hydroacoustic surveys
 - f) Review of relevant matters from Environmental Working Group and Subcommittee
 - g) Other matters
5. Environmental (Chairman: E. J. Sandeman)
- a) Report of Working Group on Flemish Cap project (results of meeting held at Murmansk, USSR, in May 1977)
 - b) Report of progress on Gulf of Maine-Georges Bank project (related to herring)
 - c) Review of environmental conditions in ICNAF Area during 1976
 - d) Marine Environmental Data Service (MEDS)
 - i) Progress report for 1976/77
 - ii) Data products presently produced and envisaged
 - iii) National representatives for data exchange
 - iv) Experimental use of ROMBI forms
 - e) Standard oceanographic sections and stations (Circular Letter 76/79)
 - f) Plankton studies
 - i) Continuous plankton recorder results for 1976
 - ii) Progress report on Gdynia Plankton Sorting Center
 - g) Weather and ice reporting by fishing vessels (SHRED)
 - h) Other matters
6. Fishing Effort Studies
- a) Review of relevant documentation
7. Ageing Techniques and Validation Studies
- a) Final report of ageing workshop on cod held at Vigo, Spain, in October 1975 (*Selected Papers* No. 2)
 - b) Report of ageing workshop on cod held at St. John's, Newfoundland, Canada, in February 1977 (Summ. Doc. 77/VI/12)
 - c) Report of ageing workshop on silver hake held at St. Andrews, New Brunswick, Canada, in March 1977 (Summ. Doc. 77/VI/13)
 - d) Need for further workshops and/or otolith exchange programs
 - e) Review of papers on validation studies
 - f) Other matters
8. Gear and Selectivity Studies
- a) Trawl materials and mesh size sampling for 1976
 - b) Consideration of recent selectivity studies
 - c) Other matters
9. Review of Tagging Activities
- a) International herring tagging program
 - b) Other tagging activities

10. Collaboration with Other Organizations

- a) Status of publication of results of Greenland Salmon Tagging Experiment
- b) Status of publication of papers presented at Symposium on Acoustic Methods in Fishery Research
- c) Symposium on Biological Basis of Pelagic Fish Stock Management, proposed by ICES for 1978
- d) Second Symposium on Early Life History of Fish, proposed by ICES for 1979
- e) Ninth Session of CWP to be held in August 1977

11. Steering and Publications

- a) Membership on the Subcommittee
- b) Review of meeting agenda and timetable
- c) Organization and operation of STACRES and its Subcommittees
- d) Review of ICNAF publications
- e) Review of editorial policy relating to Research Bulletin and Selected Papers series
- f) Progress on editing of shrimp papers for publication in *Selected Papers* No. 3
- g) Consideration of research documents for publication in *Selected Papers* No. 4
- h) Other matters

12. Other Matters

13. Mid-year Meetings in 1977/78 and 1978 Annual Meeting of STACRES

14. Election of Officers

15. Adjournment

II. AGENDA FOR MEETINGS OF SCIENTIFIC ADVISERS

SCIENTIFIC ADVISERS TO PANEL 1 - MAY 1977

1. Opening
 - a) Election of chairman
 - b) Appointment of rapporteur
 - c) Adoption of agenda
2. Conservation Requirements
 - a) Cod in Subarea 1
 - b) Roundnose grenadier in Subarea 1 and Stat. Area 0
 - c) Greenland halibut in Subarea 1 and Stat. Area 0
 - d) Shrimp (*Pandalus borealis*) in Subarea 1
3. Future Research Requirements
4. Other Business
5. Date and Place of Next Meeting
6. Approval of Report and Adjournment

SCIENTIFIC ADVISERS TO PANELS 2, 3 AND 4 - MAY 1977

1. Opening by Chairman (G. H. Winters)
 - a) Appointment of rapporteur
 - b) Adoption of agenda
2. Conservation Requirements
 - a) Cod (2GH, 2J+3KL, 3M, 3NO)
 - b) Redfish (2+3K, 3M, 3LN, 3O)
 - c) Silver hake (4VWX)
 - d) American plaice (2+3K, 3M, 3LNO)
 - e) Witch flounder (2J+3KL, 3NO)
 - f) Yellowtail flounder (3LNO)
 - g) Greenland halibut (2+3KL)
 - h) Roundnose grenadier (2+3)
 - i) Argentine (4VWX)
 - j) Capelin (2+3)
 - k) Squid-*Illex* (3+4)
3. Future Research Requirements
4. Other Business
5. Date and Place of Next Meeting
6. Approval of Report and Adjournment

SCIENTIFIC ADVISERS TO PANEL A (SEALS) - OCTOBER 1976

1. Opening by Chairman (A. W. Mansfield)
 - a) Appointment of rapporteur
 - b) Adoption of agenda
2. Conservation of Harp Seals
 - a) Population status
 - b) Recommendations for 1977 total allowable catch
 - c) Future research
3. Conservation of Hooded Seals
 - a) Population status
 - b) Recommendations for 1977 total allowable catch
 - c) Future research
4. Assessment of Relationship between Seal and Fish Populations
5. Other Business
6. Time and Place of Next Meeting
7. Approval of Report and Adjournment

III. LIST OF STACRES RECOMMENDATIONS

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<u>Ninth Special Meeting, December 1976</u>	
Rec. 1 Silver hake ageing workshop to be held in March 1977	8,19
Rec. 2 Sampling data requirements for April 1977 Meeting of Assessments Subcommittee, including age-length keys for individual mackerel samples	11
Rec. 3 Establishment of scheme for stratified trawl surveys for shrimp in Subarea 1, minimum sampling level for shrimp, and detailed studies of shrimp samples	17
<u>Annual Meeting, May-June 1977</u>	
Rec. 4 Reporting of detailed catch and effort data for <i>Illex</i> in Subareas 3 and 4 for special assessment in 1978	37
Rec. 5 Expansion of studies on and sampling of Greenland halibut	37,61
Rec. 6 Guidelines for improved statistics on discards	41,66
Rec. 7 Countries not now required to report by small unit areas and twice-monthly periods, but complete STATLANT 21B in accordance with past practices	41,67
Rec. 8 Need for coordination of future survey activity	42
Rec. 9 Comprehensive review of survey results to date from data to be provided by member countries	42,76
Rec. 10 International research project for Flemish Cap to be planned by group of national representatives	43,77
Rec. 11 Form for providing an annual inventory of oceanographic station data .	43,80
Rec. 12 Further workshop on ageing of silver hake to be held in early 1977, supplemented by prior otolith and photograph exchanges	44,57
Rec. 13 Mesh selection experiments on silver hake in 1977	45,58
Rec. 14 Co-sponsorship with ICES and FAO of Symposium on Biological Basis of Pelagic Fish Stock Management	46
Rec. 15 Requirement for countries to check the lists of sampling data for 1976 and update where necessary	67
Rec. 16 Lists of fishing vessels for 1976 and 1977	69
Rec. 17 Adoption of stratification scheme for Div. 3M	76
Rec. 18 Weather and ice reporting by fishing vessels	82

IV. LISTS OF SUMMARY AND RESEARCH DOCUMENTS - 1976 (CONTINUED)¹

SUMMARY DOCUMENTS

<u>Sum. Doc. No.</u>	<u>Serial No.</u>	
76/XII/47	4020	<u>ICNAF</u> . Report of Special Meeting of Panel A (Seals), Copenhagen, Denmark, 14 October 1976 (15 pages)
76/XII/48	4070	<u>ICNAF Secretariat</u> . Nominal catches (1965-74) by country and stock area, with national allocations and catches (1973-76) for stocks proposed for regulation at the 9th Special Commission Meeting, December 1976 (21 pages)

RESEARCH DOCUMENTS

<u>Res. Doc. No.</u>	<u>Serial No.</u>	
76/VI/123	4004	<u>Lough, R. G.</u> The distribution and abundance, growth and mortality of Georges Bank-Nantucket Shoals herring larvae, during the 1975-76 winter period (30 pages)
76/X/124 (Rev.)	4010	<u>Sergeant, D. E.</u> Studies on harp seals of the western North Atlantic population in 1976 (32 pages)
76/X/125	4011	<u>Sergeant, D. E.</u> The relationship between harp seals and fish populations (19 pages)
76/X/126 (Rev.)	4012	<u>Sergeant, D. E.</u> Research on hooded seals, <i>Cystophora cristata</i> Erxleben, in 1976 (8 pages)
76/X/127	4014	<u>Winters, G. H.</u> Estimation of mortality rates and surplus production of Northwest Atlantic harp seals (23 pages)
76/X/128		Not assigned
76/X/129		Not assigned
76/X/130	4016	<u>Benjaminsen, T., and P. F. Lett.</u> A stochastic model for the management of the northwestern Atlantic harp seal, <i>Pagophilus groenlandicus</i> , population (68 pages)
76/X/131	4017	<u>Bergflødt, B.</u> The sealing season and Norwegian seal investigations off Newfoundland-Labrador in 1976 (8 pages)
76/X/132	4018	<u>Capstick, C.K., D. M. Lavigne, and K. Ronald.</u> Population forecasts for Northwest Atlantic harp seals, <i>Pagophilus groenlandicus</i> (16 pages)
76/X/133	4019	<u>Lavigne, D. M.</u> The present status of western Atlantic harp seals: a management consideration (4 pages)
76/XII/134	4025	<u>Brennan, J. A., and J. E. Palmer.</u> Estimates of variance of age composition of mackerel catches taken in Northwest Atlantic Ocean (22 pages) + Addendum (5 pages)
76/XII/135	4030	<u>Ivanov, L. S.</u> Relative assessment of mackerel stock in the ICNAF Area and forecast of the possible catch in 1977 (7 pages)
76/XII/136	4031	<u>Hunt, J. J., and W. T. Stobo.</u> Conversion factors for length measurements of Atlantic mackerel (2 pages)
76/XII/137	4033	<u>Anderson, E. D., P. W. Wood, B. B. Ackerman, and F. P. Almeida.</u> Assessment of the mackerel stock in ICNAF Subareas 3-6 (21 pages)
76/XII/138	4034	<u>Anderson, E. D., and B. B. Ackerman.</u> Comparison of USA spring bottom trawl survey abundance indices for mackerel based on day, night and total catches (5 pages)

¹ These 1976 documents were issued after *Redbook* 1976 was published.

<u>Res. Doc.</u> <u>No.</u>	<u>Serial</u> <u>No.</u>	
76/XII/139	4035	<u>Anderson, E. D., and M. M. McBride.</u> Relationship between environmental factors and mackerel recruitment (6 pages)
76/XII/140	4036	<u>Berrien, P. L., and E. D. Anderson.</u> <i>Scomber scombrus</i> spawning stock estimates in ICNAF Subarea 5 and Statistical Area 6, based on egg catches during 1966, 1975, and 1976 (10 pages)
76/XII/141	4037	<u>Serchuk, F. M.</u> Analyses of mackerel by-catch in the international fishery in ICNAF Subarea 5 and Statistical Area 6 determined from individual trawl hauls (18 pages)
76/XII/142	4038	<u>Christensen, D. J., B. L. Freeman, and S. C. Turner.</u> The United States recreational fishery for Atlantic mackerel (7 pages)
76/XII/143	4039	<u>Olla, B. L., A. J. Bejda, and A. L. Studholme.</u> Swimming speeds of Atlantic mackerel, <i>Scomber scombrus</i> , under laboratory conditions: relation to capture by trawling (6 pages)
76/XII/144	4040	<u>Sissenwine, M. P.</u> Using the USA research vessel spring bottom trawl survey as an index of Atlantic mackerel abundance (11 pages)
76/XII/145	4041	<u>Walter, G. G.</u> A surplus yield model which incorporates recruitment with applications to a stock of mackerel (17 pages)
76/XII/146	4042	<u>Anderson, E. D., C. F. Cole, and P. W. Wood.</u> Variability in mackerel age data reported to ICNAF (13 pages)
76/XII/147	4043	<u>Henderson, E. M.</u> Time series analysis of the Northwest Atlantic mackerel catches (6 pages)
76/XII/148	4044	<u>Penttila, J. A., and E. D. Anderson.</u> Mackerel age-length keys from 1973-76 bottom trawl surveys in SA 5-6 (7 pages)
76/XII/149	4045	<u>Smidt, E.</u> Diurnal variations in shrimp catches on the offshore grounds of ICNAF Div. 1B (9 pages)
76/XII/150	4046	<u>Horsted, Sv. Aa.</u> A trawl survey of the offshore shrimp grounds of ICNAF Div. 1B and an estimate of the shrimp biomass (14 pages)
76/XII/151	4047	<u>Smidt, E.</u> Information on the <i>Pandalus</i> stocks in the Disko Bay from interviews with fishermen in 1975 and 1976 (2 pages)
76/XII/152	4048	<u>Kanneworff, P.</u> Estimated density of shrimps in the Disko Bay by means of bottom photography (5 pages)
76/XII/153	4049	<u>Kanneworff, P.</u> Midwater trawling on two types of echo scatterers (3 pages)
76/XII/154	4050	<u>Horsted, Sv. Aa.</u> The life cycle of the shrimp (<i>Pandalus borealis</i> Kr.) in Greenland waters discussed in relation to the potential yield of the stocks (21 pages)
76/XII/155	4051	<u>Ulltang, Ø., and P. Øynes.</u> Norwegian investigations on the deep sea shrimp (<i>Pandalus borealis</i>) in West Greenland waters (15 pages)
76/XII/156	4052	<u>Klimenkov, A. I., B. I. Berenboim, and A. Yu. Lysy.</u> The Soviet shrimp investigations in the West Greenland area in 1976 (10 pages)
76/XII/157	4053	<u>Noskov, A. S.</u> The assessment of the silver hake stocks at Nova Scotia in Div. 4VWX (4 pages)
76/XII/158	4054	<u>Zilanov, V. K.</u> On specific composition and size of by-catch obtained while conducting the specialized searching and fishing for silver hake, herring, and mackerel in Subareas 4, 5 and Statistical Area 6 (7 pages)
76/XII/159	4055	<u>Scott, J. S.</u> Distribution of squid (<i>Illex illecebrosus</i>) on the Scotian Shelf, 1970-74 (2 pages)

<u>Res. Doc.</u> <u>No.</u>	<u>Serial</u> <u>No.</u>	
76/XII/160	4056	<u>Doubleday, W. G., and J. J. Hunt.</u> A revised assessment of the 4VWX silver hake fishery incorporating preliminary 1976 data (23 pages)
76/XII/161	4057	<u>Moores, J. A.</u> A preliminary analysis of mackerel sampled in Newfoundland during 1976 (3 pages)
76/XII/162	4058	<u>Hunt, J. J.</u> Preliminary mackerel catches and removals by Canada and the USSR in ICNAF Subarea 3 and 4 in 1976 (3 pages)
76/XII/163	4059	<u>Scott, J. S.</u> Summer distribution of groundfish on the Scotian Shelf, 1970-74 (33 pages)
76/XII/164	4060	<u>Hunt, J. J.</u> Age, growth and distribution of silver hake (<i>Merluccius bilinearis</i>) on the Scotian Shelf from modal analysis of length frequencies (12 pages)
76/XII/165	4061	<u>Garcia, C., and A. Mari.</u> Fisheries oceanographic conditions on the continental shelf of Nova Scotia in the early summer of 1976 (16 pages)
76/XII/166 (Rev.)	4062	<u>Fraga, S.</u> Contribution to the study of the prawn (<i>Pandalus borealis</i> , Kroyer) fishery at Greenland (4 pages)
76/XII/167	4063	<u>Noskov, A. S., V. I. Rikhter, and V. A. Isakov.</u> A brief description of the Soviet herring, mackerel, silver hake and red hake fisheries in ICNAF Subarea 5 and Statistical Area 6 (5 pages)
76/XII/168 (Rev.)	4064	<u>Hoydal, K.</u> Faroese investigations of the prawn fishery at Greenland and an attempt to estimate total mortality on the oldest age-groups (12 pages)
76/XII/169	4065	<u>Isakov, V. I., L. Ivanov, P. Kolarov, W. Mahnke, A. Paciorkowski, V. A. Rikhter, S. Ucinski, and B. Vaske.</u> Reassessment of the mackerel stock in the ICNAF Area (10 pages)
76/XII/170	4066	<u>Overholtz, W. J., and E. D. Anderson.</u> Relationship between mackerel catches, water temperature, and vessel velocity during USA spring bottom trawl surveys in SA 5-6 (5 pages)
76/XII/171	4067	<u>Waring, G.</u> A look at the age distribution of mackerel (27-30 cm) in mackerel age samples of Poland, January-June 1976 from ICNAF SA 5-6 (5 pages)
76/XII/172	4068	<u>Ulltang, Ø.</u> A note on a method to determine the total allowable catch of shrimps (<i>Pandalus borealis</i>) at West Greenland (2 pages)
76/XII/173	4069	<u>Sullivan, K. R., and E. C. Lopez-Veiga.</u> Report of voyage on Spanish stern trawler <i>Corba</i> , 16-21 October 1976 (15 pages)

V. LISTS OF SUMMARY AND RESEARCH DOCUMENTS - 1977

SUMMARY DOCUMENTS

<u>Sum. Doc. No.</u>	<u>Serial No.</u>	
77/VI/1	4099	<u>ICNAF</u> . Report of the Standing Committee on Research and Statistics (STACRES), Ninth Special Commission Meeting, December 1976 (28 pages)
77/VI/2	5016	<u>ICNAF</u> . Proceedings of Ninth Special Commission Meeting, Tenerife, Canary Islands, Spain, 1-9 December 1976 (110 pages)
77/VI/3	5006	<u>ICNAF Secretariat</u> . Supplement to <i>Statistical Bulletin</i> Vol. 25: detailed catch and effort statistics for Ireland (3 pages)
77/VI/4	5007	<u>ICNAF Secretariat</u> . List of fishing vessels, 50 GRT and over, for 1975 (32 pages)
77/VI/5	5013	<u>ICNAF Secretariat</u> . Lists of sampling data for 1975 (28 pages)
77/VI/6	5019	<u>Ulltang, Ø., and T. Øritsland</u> . Norwegian research report, 1976 (5 pages)
77/VI/7	5020	<u>NEAFC</u> . Northeast Atlantic Fisheries Commission, Special Conference on the Future of the Commission, 29 March-2 April 1977: press notice (1 page)
77/VI/8	5022	<u>ICNAF Secretariat</u> . Historical catches of regulated species by stock area and country for the period 1966-75 (37 pages)
77/VI/9	5025	<u>Varea, J. A., and A. Marf.</u> Cuban research report, 1976 (6 pages)
77/VI/10	5045	<u>Chevalier, R.</u> French research report, 1976: St. Pierre and Miquelon fishery (6 pages)
77/VI/11	5046	<u>Paciorkowski, A., and E. Stanek</u> . Polish research report, 1976 (18 pages)
77/VI/12	5048	<u>ICNAF</u> . Preliminary report of ageing workshop on cod held at St. John's, Canada, 31 January-5 February 1977 (54 pages)
77/VI/13	5073	<u>ICNAF</u> . Report of the silver hake ageing workshop, St. Andrews, Canada, 14-18 March 1977 (15 pages)
77/VI/14	5070	<u>Mahnke, W., U. Berth, and P. Ernst</u> . German Democratic Republic research report, 1976 (10 pages)
77/VI/15	5071	<u>Konstantinov, K. G., and A. Noskov</u> . USSR research report, 1976 (39 pages)
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77/VI/24	5086	<u>Jones, B. W.</u> United Kingdom research report, 1976 (2 pages)
77/VI/25	5091	<u>Fleming, A. M., and J. S. Scott.</u> Canadian research report, 1976 (13 pages)
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77/VI/32	5100	<u>Nagasaki, F.</u> Japanese research report, 1976 (1 page)
77/VI/33	5117	<u>Anon.</u> United States research report, 1976 (14 pages)

RESEARCH DOCUMENTS

<u>Res. Doc. No.</u>	<u>Serial No.</u>	
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77/VI/2	5002	<u>Chekhova, V. A., and K. G. Konstantinov.</u> The catches of the beaked redfish (<i>Sebastes mentella</i> Travin) with bottom and midwater trawls on the Flemish Cap Bank (8 pages)
77/VI/3	5003	<u>Chekhova, V. A., K. G. Konstantinov, and I. S. Shafran.</u> On the age contingent of catches of beaked redfish (<i>Sebastes mentella</i> Travin) (9 pages)
77/VI/4	5012	<u>Mesnil, B.</u> Biological characteristics and biomass estimates of squid, <i>Loligo pealei</i> and <i>Illex illecebrosus</i> , on the mid-Atlantic and southern New England shelves (13 pages)
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