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# NORTHWEST ATLANTIC FISHERIES ORGANIZATION

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# PREFACE

This second issue of *NAFO Scientific Council Reports* contains the reports of four meetings held during the calendar year 1981: (A) Special Meeting during 17–20 February 1981; (B) Regular Meeting during 3–19 June 1981; (C) Annual Meeting during 12–18 September 1981; and (D) Special Meeting during 23–26 November 1981. Part E contains the agenda, list of recommendations, list of research and summary documents, and list of participants relevant to meetings of the Scientific Council and its Standing Committees during 1981.

The *NAFO Scientific Council Reports* series was initiated with the first issue in December 1980 and replaces the *ICNAF Redbook* series which terminated with the last issue in 1979.

31 December 1981

V. M. Hodder
Assistant Executive Secretary

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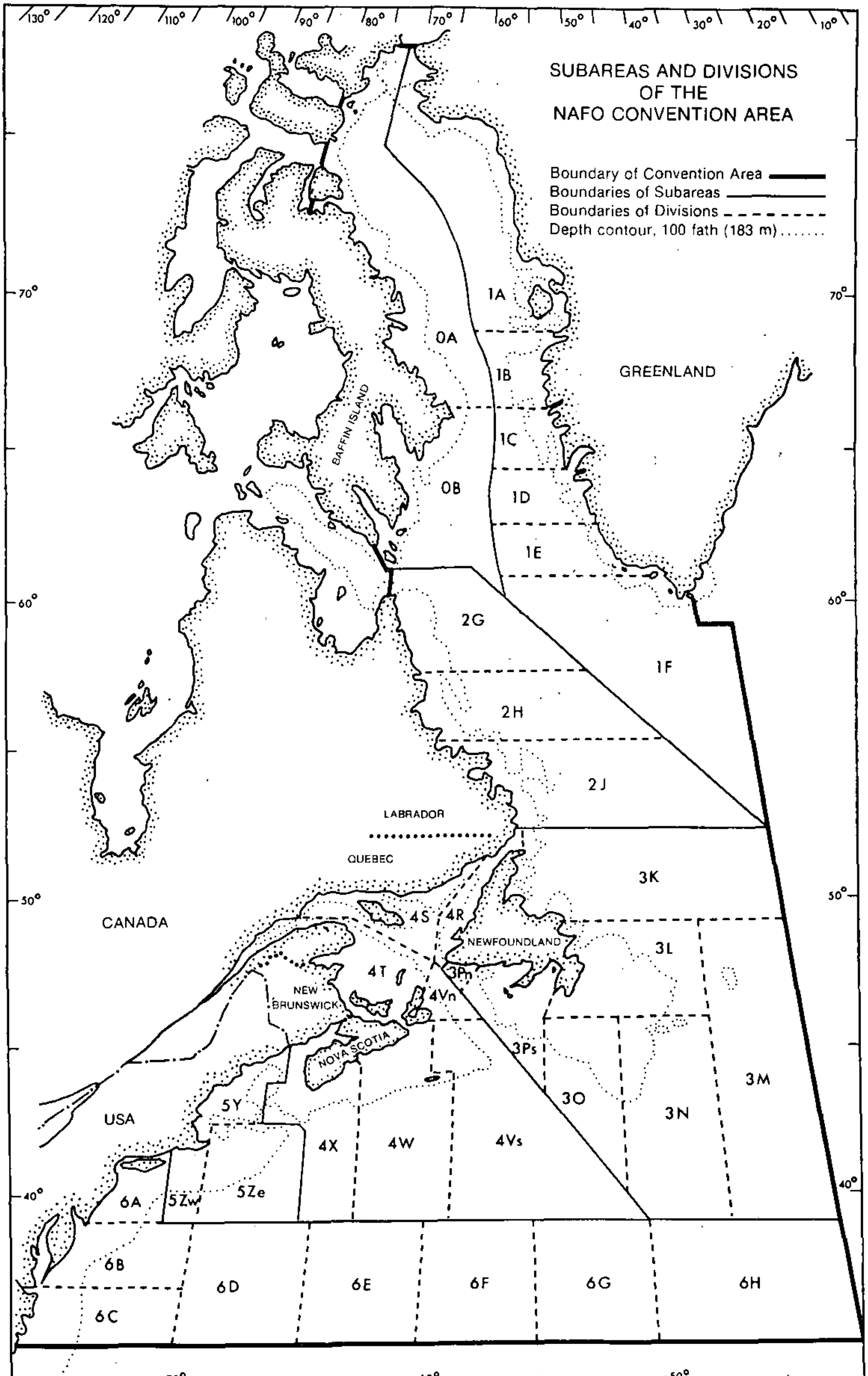
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# PART A

## REPORT OF SCIENTIFIC COUNCIL

Special Meeting, February 1981

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# REPORT OF SCIENTIFIC COUNCIL

Special Meeting, February 1981

Chairman: R. H. Letaconnoux Rapporteur: V. M. Hodder

The Council met at NAFO Headquarters, Bedford Institute of Oceanography, Dartmouth, Canada, during 17-20 February 1981 to provide advice for 1981 on the conservation of the cod stocks in Div. 3M and 3NO and the capelin stocks in Subareas 2 and 3, for which management measures had been deferred from the 1980 Annual Meeting (*NAFO Sci. Coun. Rep.* 1979-80, pages 70 and 117). Representatives attended from Canada, European Economic Community (EEC) and Union of Soviet Socialist Republics (USSR), and an observer attended from Spain.

The stock assessments were undertaken by the Standing Committee on Fishery Science (STACFIS), whose report as approved by the Council is given in Appendix I. The agenda, list of participants, and lists of research and summary documents for this meeting are given in Part E of this volume. Brief summaries of the assessments and other matters considered by the Council are given below.

## I. STOCK ASSESSMENTS (APP. I)

1. Fishery Trends

For the stocks considered at this meeting of the Council, the nominal catches and total allowable catches (TACs) since 1973 were as follows:

| Species | Stock area | | TACs and Catches (000 tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980[1] |
| Cod | 3M | TAC | - | 40 | 40 | 40 | 25 | 40 | 40 | 13 |
| | | Catch | 23 | 25 | 22 | 22 | 27 | 33 | 30 | 10 |
| | 3NO | TAC | 103 | 101 | 88 | 43 | 30 | 15 | 25 | 26 |
| | | Catch | 80 | 73 | 44 | 24 | 18 | 15 | 28 | 19 |
| Capelin | 2+3K | TAC | - | 110[2] | 160[2] | 160[2] | 212[2] | 212 | 75 | 5 |
| | | Catch | 136 | 127 | 199 | 216 | 152 | 55 | 12 | 6 |
| | 3LNO | TAC | - | 148[3] | 180[3] | 180[3] | 200[3] | 200 | 10 | 16 |
| | | Catch | 132 | 158 | 166 | 144 | 74 | 30 | 12 | 14 |

[1] Catches for 1980 are provisional.
[2] Countries without specific allocations could each take up to 10,000 tons.
[3] Countries without specific allocations could each take up to 5,000 tons.

2. Cod in Division 3M

The provisional nominal catch in 1980 was 10,000 tons from a TAC of 13,000 tons. Except in 1977 when the TAC was reduced, the catches have been less than the TACs since their introduction in 1974. Commercial catch rates in 1979 continued at the low level of recent years. USSR research vessel survey data for 1978-80 indicated a decline in biomass from 75,000 tons in 1978 to 48,400 tons in 1980. A similar decline was observed in data from Canadian research vessel surveys during the same period.

A non-equilibrium general production model, utilizing catch and effort data for 1960-79, indicated a yield at 2/3 $F_{MSY}$ of 1,000 tons in 1981 and an equilibrium maximum sustainable yield of 29,000 tons.

Cohort analyses, with fishing mortality in 1980 derived from Canadian survey data, indicated that the mean biomass (age 3+) had declined from a high of 92,000 tons in 1976 to 41,000 tons in 1980. The biomass is projected to increase slightly to 46,000 tons in 1981, and a catch of 5,000 tons is projected for 1981 with fishing mortality at $F_{0.1} = 0.20$. The Council emphasizes that the projected catch for 1981 is well below the equilibrium maximum sustainable yield (29,000 tons) and that a gain in yield per recruit could be achieved by reducing fishing mortality in 1981, because the stock is now dominated by young fish whose growth potential is substantial up to ages 6 and 7. Such a reduction in fishing mortality below the $F_{0.1}$ level in 1981 would also increase the rate of recovery of this depleted cod stock.

3. Cod in Divisions 3N and 3O

The provisional nominal catch in 1980 was 19,000 tons from a TAC of 25,000 tons. Catches have declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Catch rates have declined greatly from the mid-1960's to 1978, with some slight improvement in 1979 and 1980.

A non-equilibrium general production model, utilizing catch and effort data for 1959-80, indicated an equilibrium maximum sustainable yield of about 125,000 tons and a yield at 2/3 $F_{MSY}$ of 22,000 tons in 1981. A symmetrical general production model fitted to two series of catch-effort data (1960's and 1970's) showed maximum but different yields at the same level of effort. The difference in the two curves was hypothesized to have resulted from reduced recruitment in the 1970's because of some undefined ecological change affecting the survival of cod larvae in Div. 3NO. An alternative explanation of reduced recruitment during the 1970's is that heavy fishing on the stock in the late 1960's and early 1970's substantially reduced the stock, thereby causing the fishery to concentrate on fish of smaller size with possible enhanced discarding of undersized fish. Data were not available to distinguish between the two hypotheses.

Correlations between commercial catch rates and biomass estimates from preliminary cohort analyses indicated a fishing mortality of 0.25 in 1980. Recruitment of age 3 cod in 1980 was estimated from research vessel survey data to be about 60 million fish, about 50% more than the mean recruitment level for the 1971-79 period. The results of the final cohort analysis indicated that the mean biomass (age 3+) had declined from a level of 335,000 tons during 1966-70 to 72,000 tons in 1976-80. The mean biomass is projected to be 132,000 tons in 1981, and an optimal yield of 15,000 tons is projected for 1981 with fishing mortality at $F_{0.1} = 0.18$. The Council emphasizes that the stock is in a depleted state, consisting mainly of young fish, and that low fishing mortality in the next few years would provide a gain in yield per recruit. The Council therefore advises that a cautious approach to the exploitation of cod in Div. 3NO should be maintained.

The Council noted the reservation of USSR scientists who felt that the increase in biomass levels estimated from USSR surveys in 1978 to 1980 justified an increase in catch in 1981 to 30,000 tons.

4. Capelin in Subareas 2 and 3

a) Fishery trends

Nominal catches of capelin in Subareas 2 and 3 increased from 2,800 tons in 1971 to 366,000 tons in 1975 and then declined to 24,000 tons in 1979. Provisional data for 1980 indicated a further decline to 20,000 tons. Commercial catch and effort data for Subarea 2 and Div. 3K indicated a decline from 6.47 tons per hour in 1975 to 1.34 tons per hour in 1979. Catch rates for the special experimental fishery in 1980 by USSR vessels showed an increase to 4.57 tons per hour, but this was considered to be biased upwards and not indicative of stock status due to the seasonal and spatial distribution of fishing activity.

b) Subarea 2 and Division 3K

Acoustic surveys by Canada and USSR in the autumn of 1980 indicated very low levels of abundance. Since the near-shore areas were not surveyed, the resultant biomass estimate is considered to be an under-estimate, but the degree of under-estimation cannot be quantified. The age composition of catches from the USSR experimental fishery indicated that the 1976 and 1977 year-classes predominated, whereas the 1977 and 1978 year-class were dominant in the Canadian survey. A sequential capelin abundance model (SCAM) calibrated with 1972-79 commercial catch rates indicated that the biomass of age 2+ capelin was highest in 1975 and declined to about 10% of that level in 1978 and 1979, with some increase estimated for 1980. This increase in 1980 was largely the result of the recruitment of the 1978 year-class which was estimated by SCAM to be the third largest in the time series of data. The Council noted, however, that evidence from the two acoustic surveys conducted in 1980 did not support the observation that the 1978 year-class was as large as calculated from the model. Nevertheless, using the results of the SCAM model and assuming that the 1979 year-class at age 2 is equal to the geometric mean of the 1970-78 year-classes, projections to 1981 indicate that the total biomass (age 2+) of this stock will be lower than estimates for all years from 1972-77. In addition, the biomass of mature capelin, although higher than in 1980, will be relatively low in 1981. In view of the conflicting evidence available and the uncertainty about the size of the 1978 year-class which comprises a large proportion of the projected biomass in 1981, the Council advises the continued closure of the autumn fishery for capelin in Div. 2J+3K in 1981 or a small nominal TAC. A small fishery of 10,000-15,000 tons in 1981 would provide scientists with data comparable to those collected previously and would allow them to better assess the status of the stock in 1981 and to quantify their advice for 1982.

c) Capelin in Divisions 3L, 3N and 3O

Acoustic surveys by Canada and USSR in 1980 indicated that this stock is substantially below historical levels of abundance. Although juvenile capelin of the 1979 year-class were found over a large area, the surveys indicated very low abundance of mature fish in Div. 3NO, particularly in the spawning area of the Southeast Shoal. A sequential capelin abundance model (SCAM), using both inshore and offshore catch data, provided biomass estimates (age 3+) for Div. 3L in the 1967-80 period. The age structure of the population in 1980 was derived from correlations between year-class strength of capelin in Div. 2J+3K and Div. 3L. The results indicated a decline in biomass from over 500,000 tons in 1976 to 170,000 and 160,000 tons in 1979 and 1980 respectively. The biomass is projected to increase to 300,000 tons in 1981, but this value depends largely on the strength of the 1978 year-class which was derived from the estimate of the size of that year-class in Div. 2J+3K. Therefore, taking into account these uncertainties, the Council advises that an exploitation rate of 10% should be maintained for 1981, implying a TAC of 30,000 tons of capelin for Div. 3L. The Council noted the continued depressed state of the spawning stock in Div. 3NO and advises that there should be no fishery for capelin in these divisions in 1981, in order to allow a further increase in the spawning stock in Div. 3N and to protect this stock during its migration through Div. 3O to Div. 3N.

5. Biological Studies

Information presented on changes in capelin abundance in relation to variations in cod growth and the success of the inshore cod fishery indicated no significant relationship between the growth rate of cod and capelin abundance, but positive correlations were found between inshore catches (both poundnet and all gears) and abundance indices for mature capelin. However, because of the short time series of historical data and some uncertainty about the data, it was concluded that the present analysis does not constitute an adequate test of the postulated dependency of cod on capelin. Likewise, the estimates of the quantity of capelin (1.2-4.4 million tons) that might be consumed by cod in 1981, were considered to be uncertain due to data limitations.

6. Future Research Requirements

The Council endorsed the recommendations for future research listed in the Report of STACFIS (Appendix I), concerning the need for intensified research on cod-capelin interaction, for expanded pre-recruit capelin surveys, and for better coordination of capelin acoustic surveys such that maximum areal coverage be achieved.

## II. OTHER MATTERS

1. Agenda and Timetable for the June 1981 Meeting

The Council reviewed a tentative timetable and agenda for its June 1981 Meeting and requested the Secretariat to circulate the information as soon as possible. It was noted that a special session on squid biology and distribution would be held during 3-6 June 1981, followed by meetings of the Scientific Council and its Standing Committees (STACFIS, STACREC and STACPUB) during 8-20 June 1981.

2. Assessment of Redfish Stocks at Greenland

The Council was informed of the positive reaction of ICES (International Council for the Exploration of the Sea) regarding the proposal for cooperation between NAFO and ICES on assessment of the redfish stocks at West and East Greenland. It was noted that ICES had invited the Council to participate in a meeting of the ICES Working Group on redfish in the East Greenland area during 11-19 March 1981 when the interaction of the redfish stocks at East and West Greenland will be assessed. Dr W. D. McKone and Mr W. R. Bowering were nominated to participate on behalf of the Scientific Council.

## III. ADJOURNMENT

The Chairman expressed his appreciation for the excellent meeting facilities provided for the meeting. He thanked the Chairman of STACFIS, Dr G. H. Winters, and all participants for their interest and cooperation in dealing with the assessment matters, and the Secretariat staff for their efficiency in servicing the meeting. The meeting adjourned at 1930 hours on 20 February 1981.

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

Chairman: G. H. Winters                                                        Rapporteurs: Various

The Committee met at NAFO Headquarters, Dartmouth, Canada, during 17-20 February 1981 to assess the status of the cod stocks in Divisons 3M and 3NO and the capelin stocks in Subareas 2 and 3, as requested by the Scientific Council (see Part E, this volume). Advice on conservation measures for these stocks in 1981 was deferred from the June 1980 Meeting of the Council (*NAFO Sci. Coun. Rep.* 1979-80, pages 70 and 117). Instead of appointing a single rapporteur to record the results of the discussions, the Chairman designated scientists to prepare draft summaries of the various topics for approval and incorporation into the STACFIS report. Scientists attended from Canada, European Economic Community (EEC), Spain, and Union of Soviet Socialist Republics (USSR).

## I. STOCK ASSESSMENTS

1. Cod in Division 3M (SCR Doc. 81/II/6, 9, 12, 13, 15)

a) Fishery trends

Nominal catches from this stock were as high as 60,000 tons in 1965 and 58,000 tons in 1972. Total allowable catches (TACs) have been in effect since 1974, but actual catches have generally been less than the TACs. Recent TACs, catches and catch rates were as follows:

| | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|
| TAC (000 tons) | 40 | 40 | 40 | 25 | 40 | 40 | 13 |
| Catch (000 tons) | 25 | 22 | 22 | 27 | 33 | 30 | 10[1] |
| Tons/hour | 1.16 | 0.90 | 0.73 | 0.68 | 0.45 | 0.50 | ... |

[1] Preliminary data.

b) General production model

The Committee reviewed a series of standardized catch rates for the 1960-79 period, derived from all available catch and effort data for otter trawlers of tonnage class 6 of Portugal and tonnage class 7 of USSR in January, February and October (SCR Doc. 81/II/12). The standardized catch rate declined from 2.0 tons per hour fished in 1969 to 0.78 tons per hour in 1973. There was some improvement in 1974 and 1975 followed by a steady decline to a low level of 0.45-0.50 tons per hour in 1978 and 1979. Data are presently insufficient to estimate a standardized catch rate for 1980. It was noted that the catch rates for the 1960-72 period were at a level distinctly higher than those for 1973-79. A discussion of the interpretation of this phenomenon is given below in the section on cod in Div. 3NO.

A non-equilibrium multiplicative model, based on the standardized catch rates for 1960-79, indicated a yield of about 1,000 tons in 1981 at 2/3 $F_{MSY}$ effort. The equilibrium maximum sustainable yield of about 29,000 tons was estimated from the model.

c) Estimates of stock biomass from research vessel surveys

From the distribution of catches by USSR research vessels at standard fixed stations in the area, and with the application of an experimentally derived catchability coefficient (6.2%), estimates of biomass in 1978-80 were 75,000, 67,200 and 48,200 tons respectively. From the Canadian surveys in the same period, the catch rate (number per 30-minute tow) declined substantially from 1978 to 1979 and either remained stable (from arithmetic means) or continued to decline (from logarithmic means) in 1980.

The Committee noted a discrepancy in the age compositions of catches from the Canadian and USSR surveys, although the length compositions were quite similar.

d) Cohort analysis parameters

Age compositions. Sampling data for the Polish and Portuguese fisheries in 1980 were obtained by observers operating under the NAFO Scientific Observer Program. The samples were small, were taken in the autumn, and were not necessarily representative of total removals over the whole year.

Partial recruitment. Partial recruitment factors were derived from a comparison of age compositions of the commercial catch and the Canadian survey. Values for the older age-groups fluctuated widely, but age 5 and older cod were considered fully recruited after examining the historical fishing mortality rates from preliminary cohort analyses. The partial recruitment values used were 0.05 for age 3, 0.50 for age 4, and 1.00 for age 5+.

Recruitment. Evidence from the Canadian research surveys (from the arithmetic index) indicated that the 1978 year-class was about the same size as the 1975 year-class. Consequently, a recruitment of 10 million fish was used for the projection to 1981.

Terminal F. A series of cohort analysis were examined over a range of terminal F from 0.3 to 1.2. The terminal F value of 0.74, computed for ages 4-11 from Canadian research survey data (using a log transformation to estimate total abundance), was considered representative for the stock in 1980.

Yield per recruit. A yield-per-recruit calculation, using average weights at age from Canadian surveys in 1978-80 and the above partial recruitment pattern implied an $F_{0.1}$ value of 0.13. However, the Committee agreed to use the previous estimate of $F_{0.1}$ = 0.20, which was considered to be more representative of the long-term situation.

e) Results of cohort analysis and projections

The catch-at-age matrix for 1972-80 and the relevant parameters outlined above, including a recruitment value of 34 million fish as the size of the 1977 year-class at age 3 in 1980 (based on the indication from survey data that the 1977 year-class was about 4 times the size of the 1975 year-class at age 3), were utilized in a cohort analysis, which resulted in the following estimates of biomass (average biomass during the year):

| Year | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|---|
| Biomass (000 tons) | 51 | 32 | 26 | 40 | 92 | 62 | 35 | 29 | 41 |

Projections of catch in 1981 and mean biomass in 1981 and 1982 with $F_{0.1}$ = 0.20 are as follows:

| Year | Recruitment at age 3 ($10^6$) | F for fully recruited ages | Projected catch (tons) | Mean biomass (000 tons) | | |
|---|---|---|---|---|---|---|
| | | | | Age 3+ | Age 4+ | Age 6+ |
| 1981 | 10 | 0.20 | 5,000 | 46 | 38 | 9 |
| 1982 | - | - | - | - | 50 | 11 |

It was noted that the projected catch for 1981 is well below the estimated maximum equilibrium yield (29,000 tons). It is further noted that a possible gain in yield per recruit from the relatively strong 1977 year-class could occur by reducing the fishing mortality in 1981 since growth up to ages 6 and 7 is substantial.

f) Conclusions

The low level of catch projected for 1981 at the $F_{0.1}$ level is a clear indication that the stock is severely depleted. The rate of recovery would increase if fishing mortality were maintained below the $F_{0.1}$ level for the immediate future. The Committee further noted that the present low level of spawning biomass may be such as to impair potential recruitment, and accordingly

recommends

*that the Scientific Council at its June 1981 Meeting consider specific measures to ensure maximum spawning potential for the cod stock in Div. 3M.*

2. Cod in Divisions 3N and 3O (SCR Doc. 81/II/6, 9, 11)

a) Fishery trends

Nominal catches from this stock declined from a high of 227,000 tons in 1967 to a low of 15,000 tons in 1978. Total allowable catches have been in effect since 1973, but the actual catches were substantially less than the TACs during 1973-77. Recent catches and TACs were as follows:

| | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|
| TAC (000 tons) | 101 | 88 | 43 | 30 | 15 | 25 | 26 |
| Catch (000 tons) | 73 | 44 | 24 | 18 | 15 | 28 | 19[1] |

[1] Provisional.

The Committee reviewed a series of standardized catch rates for the 1959-79 period, equivalent to catch per hour fished in February, May and August by Canadian (M) and Spanish trawlers. In 1967, when the highest catch in the entire series occurred, the standardized catch rate was 2.1 tons per hour. A fairly consistent decline in catch rate occurred with values falling below 1.0 tons per hour for the first time in 1973. The standardized catch rates for 1973-80 were as follows:

| Year | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|
| Catch/hour | 0.81 | 0.76 | 0.71 | 1.03 | 0.45 | 0.30 | 1.28 | 0.68 |

It was noted that the Committee in its report of the February 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, page 45) implied that the standardized catch rate for 1979 might in fact be somewhat over-estimated.

b) General production model

A non-equilibrium version of the surplus production model, based on the standardized catch rates for 1959-80, indicated an equilibrium maximum sustainable yield of about 125,000 tons. The yield in 1981, if the standardized catch rate is at the estimated 1980 level of 0.68 tons per hour, would be about 22,000 tons. The catch rates for 1963-71 were distinctly higher than those for 1973-79. The 1972 catch rate was intermediate between the two levels, and the 1978 rate was clearly anomalously low.

The Committee reviewed SCR Doc. 81/II/6 which hypothesized that the observed difference in catch rates between the two periods noted above was due to reduced recruitment during the 1970's, which could be explained by the influence of large-scale oceanographic events upon, for example, the food supply of cod larvae and hence upon cod recruitment. Symmetrical general production curves fitted to the two series of catch/effort data showed different maximum yields at the same effort level, and it was suggested that fishing effort could appropriately be maintained at a relatively high level, recognizing that the yield would be at a substantially lower level than in the 1960's because of ecological changes.

An alternative explanation of the trend in catch rates was that fishing effort had been at or above the level corresponding to $F_{MSY}$ during the 1967-74 period with a consequent reduction in stock biomass. Furthermore, because of the absence of older and larger cod, the fishery in the 1970's had concentrated on younger and smaller fish with possible enhanced discarding of under-sized specimens. However, data were not available to distinguish whether this hypothesis or the hypothesis of an ecological change is the more reasonable.

c) Estimates of stock biomass from research vessel surveys

From the distribution of catches by USSR research vessels at standard fixed stations in the area, and with the application of an experimentally derived catchability coefficient (6.2%), estimates of biomass in 1978-80 were 76,400, 96,900 and 135,900 tons respectively. From the Canadian random-stratified surveys in 1977-79, the catch rate (mean number per 30-minute tow) was fairly constant at 23.3, 19.6 and 22.6 specimens. In 1980, the mean number per tow was only 4.3 specimens, but this anomalous result may be due to the difference in the time of the 1980 survey.

The Committee noted that, although the length compositions of cod taken in the Canadian and USSR surveys were similar, there was a discrepancy in identification of the dominant year-class.

d) Cohort analysis parameters

Age compositions. Sampling data for the Portuguese and Spanish fleets obtained through the NAFO Scientific Observer Program and for the Canadian fleet amounted to 56,000 length measurements and 3,200 age determinations, which were used to construct an age composition of overall removals in 1980. With some adjustment to the previous 1979 age composition due to the availability of final catch statistics and the inclusion of an estimated age composition for 1971, a matrix of catch-at-age for the 1959-80 period was available for use in the cohort analysis.

Partial recruitment. Partial recruitment factors for 1980 were derived from a comparison of age compositions of the commercial catch and the Canadian survey. Although the ratios indicated declining availability after age 6, full recruitment at age 6 and older was considered more reasonable. Consequently, the partial recruitment values used were 0.05 for age 3, 0.36 for age 4, 0.77 for age 5, and 1.00 for age 6+.

Recruitment. From a rather poor relationship ($r^2$ = 0.38) between abundance at age 3 in the cohort analysis (with terminal F = 0.25) and the catch per tow of age 2 fish in the Canadian survey, the 1978 year-class was estimated to consist of about 60 million fish at the beginning of 1981. The geometric mean abundance of age 3 cod during 1971-80 was about 40 million, and this value was used to represent the sizes of recruiting year-classes at age 3 in 1982 and 1983.

Terminal F. A series of cohort analyses were examined for a range of terminal F values with M = 0.2. With a terminal F of 0.25, the age 3+ biomass of 101,000 tons in 1980 was equal to that predicted from the application of the 1980 catch rate to the regression ($r^2$ = 0.85) of age 3+ biomass against catch rate for the 1959-75 period (excluding the 1963 point). Also, the predicted age 4+ biomass from a regression of age 4+ biomass against catch rate for the 1959-78 period (excluding the 1976 point) was intermediate between the age 4+ biomasses from cohort analyses with terminal F values of 0.20 and 0.30, the correlation coefficients ($r^2$) being 0.79 and 0.80 respectively. Furthermore, there was a good correlation ($r^2$ = 0.80) between the cohort numbers of age 3 and older cod (terminal F = 0.25) and the numbers per tow of the same age-groups in the Canadian surveys for the 1971-79 period (excluding the 1973 point). The terminal F value of 0.25 was therefore accepted as reasonable for use in the assessment.

Yield per recruit. A yield-per-recruit calculation, using average weights at age up to age 20 for the 1978-80 period and the above partial recruitment pattern implied an $F_{0.1}$ value of 0.14. However, the Committee noted that $F_{0.1}$ values may fluctuate from year to year depending on the input parameters and agreed to use the previous estimate of $F_{0.1}$ = 0.18 which was considered to be a reasonable approximation of the average situation.

e) Results of cohort analysis and projections

Utilizing the catch-at-age matrix for 1959-80 and the relevant parameters outlined above, the results of the cohort analysis indicate the following historical trend in mean biomass of age 3 and older cod:

| Period | Mean biomass |
|---|---|
| 1961-65 | 231,000 tons |
| 1966-70 | 335,000 tons |
| 1971-75 | 155,000 tons |
| 1976-80 | 72,000 tons |

Projections of catch and stock size in 1981, 1982 and 1983, with recruitment at age 3 assumed to be 60 million fish in 1981 and 40 million fish in 1982 and 1983 and $F_{0.1}$ = 0.18, are as follows:

| Year | Recruitment at age 3 ($10^6$) | F for fully recruited ages | Projected catch (tons) | Mean biomass (000 tons) | | |
|---|---|---|---|---|---|---|
| | | | | Age 3+ | Age 4+ | Age 6+ |
| 1980 | 25 | 0.25 | 19,000 | 101 | 85 | 39 |
| 1981 | 60 | 0.18 | 15,000 | 132 | 96 | 64 |
| 1982 | 40 | 0.18 | 20,000 | 164 | 140 | 96 |
| 1983 | 40 | 0.18 | 25,000 | 193 | 170 | 92 |

f) Conclusions

It is evident that the biomass has declined substantially over the period. The biomass of age 3+ cod in 1980 was estimated to be about 100,000 tons. The Committee noted that the stock is composed mainly of young and small fish, primarily of the 1978 year-class, and that low fishing mortality in the next few years would provide a gain in yield per recruit and a return to a more broadly based age structure in the stock. The Committee reiterates the concerns expressed at the February 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, page 47) and advises that a cautious approach to the exploitation of the cod stock in Div. 3NO should be maintained.

g) Reservation by USSR scientists

On the basis of the increase in biomass levels obtained from USSR research surveys in 1978 to 1980, USSR scientists felt that levels of catch up to 30,000 tons in 1981 may be considered appropriate for this cod stock.

3. Capelin in Subareas 2 and 3 (SCR Doc. 81/II/3, 4, 5, 10, 14)

a) Fishery trends

Nominal catches of capelin in Subareas 2 and 3 increased from 2,800 tons in 1971 to 366,000 tons in 1975 and declined to 24,000 tons in 1979. Preliminary statistics indicate a catch of 20,000 tons in 1980. No offshore fishing was allowed in Div. 3LNO during 1979 and 1980 and only a small experimental offshore fishery was allowed in Subarea 2 and Div. 3K. Recent TACs and catches were as follows:

| | | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|
| 2+3K | TAC (000 tons) | 110[1] | 160[1] | 160[1] | 212[1] | 212 | 75 | 5 |
| | Catch (000 tons) | 127 | 199 | 216 | 152 | 55 | 12 | 6 |
| 3LNO | TAC (000 tons) | 148[2] | 180[2] | 180[2] | 200[2] | 200 | 10 | 16 |
| | Catch (000 tons) | 158 | 166 | 144 | 74 | 30 | 12 | 14 |

[1] Countries without allocations could each take up to 10,000 tons.
[2] Countries without allocations could each take up to 5,000 tons.

b) Subarea 2 and Division 3K

i) Commercial catch-effort analysis

The series of catch rates of USSR BMRT-type trawlers has been considered as a useful index of abundance (*ICNAF Redbook* 1979, page 34; *NAFO Sci. Coun. Rep.* 1979-80, page 49). However, the 1972-80 series is composed of estimates from two different classes of trawler, the 1972-78 estimates being for the larger and more powerful BMRT-A class and the 1979 and 1980 estimates being for the smaller BMRT class. During periods of high stock abundance, catch rates are likely to be similar for both types of trawler, but in periods of low abundance, as in recent years, the catch rates of the BMRT trawler are likely to be underestimates relative to previous years. The catch rates peaked in 1975 at 6.47 tons per hour and declined to 1.34 tons per hour in 1979 (SCR Doc. 80/II/13).

The results from an experimental capelin fishery by USSR BMRT-type trawlers in 1980 indicated a catch rate of 4.57 tons per hour. The fishery in 1980 was concentrated in a small area with fewer vessels (3) for a shorter period than in previous years and was therefore able to sustain a relatively high catch rate. As the results of both the Canadian and USSR acoustic surveys indicated that capelin abundance was low in 1980, the Committee concluded that the catch rate for 1980 was not a reliable indicator of stock abundance.

ii) Research vessel surveys

An acoustic survey conducted by USSR in late October and early November 1980 resulted in a biomass estimate of 20,200 tons of capelin in Div. 2J. No capelin were found in Div. 3K. The area inside the 12-mile limit was not surveyed and the indicated biomass estimate should be considered a minimum. The experimental capelin fishery by USSR commercial vessels was conducted on capelin concentrations in a limited area on the southwest part of Hamilton Bank from mid September to early November. The catch rate declined throughout the period such that it was not efficient to fish by early November. The age composition of catches indicated a predominance of ages 3 and 4 capelin (1977 and 1976 year-classes).

A Canadian acoustic survey in Div. 2J and 3K during 24 October-18 November 1980 indicated low pelagic fish abundance throughout the area. Since capelin made up a small proportion of the total pelagic biomass sampled with the midwater trawl, it was not possible to provide an estimate of the capelin biomass from the acoustic data. The 1977 and 1978 year-classes predominated in the catches.

Results from Canadian groundfish surveys in the autumns of 1977-80, immediately after the Canadian acoustic surveys, indicated higher proportions of catches with capelin in 1979 and 1980. In these years, more catches with capelin were reported from deepwater stations although the numbers per set were very low. The larger catches of capelin in 1979 and 1980 were reported from the Hamilton Bank area. The Canadian acoustic surveys for capelin are conducted in an area more shoreward than the groundfish surveys, but, considering the results of both types of surveys, the acoustic surveys appear to have covered the area of capelin distribution reasonably well. Neither type of survey covers the extreme inshore area.

iii) Numerical population models

A sequential capelin abundance model (SCAM) was used to estimate abundance of capelin in 1972-80. Estimates of the population mature at age in 1980, calculated from catch-per-unit-effort data, were considered unreliable because of the suspected bias in the 1980 catch rate. Consequently, mean values of the population mature at age, calculated from 1973-78 values, were used for 1980. Partial recruitment factors were estimated by comparing research and commercial age compositions. Exploitable biomass, defined as the biomass of capelin available to the fishery in each year, was compared with commercial catch rate data to determine terminal F. Exploitable biomass was considered better than total biomass, used in previous assessments (*NAFO Sci. Coun. Rep.* 1979-80, page 49), because the fishery mainly exploits maturing fish. Because the 1980 catch rate was considered unreliable, only catch rates for 1972-79 were used, and the results of the analysis at terminal F = 0.03 was accepted as the best assessment of the status of the stock.

The assessment indicated that the biomass of capelin on 1 September was highest in 1975, declined to about 10% of the 1975 biomass in 1978 and 1979 and increased in 1980. This increase was largely a result of the 1978 year-class which at age 2 was estimated to comprise 51 × $10^9$ fish, the third highest year-class in the 1972-79 data series and about one-third of the size of the largest (1973 year-class consisting of 184 × $10^9$ individuals at age 2). However, the Committee noted that evidence from the two acoustic surveys in 1980 did not support the observation that the 1978 year-class was as large as calculated from the model.

iv) Recruitment estimation and prognosis for 1981

Estimates of year-class size from the sequential abundance model were used as the basis of the projection for 1981. The geometric mean of the 1970-78 year-classes at age 2 was taken as the estimate of the size of the 1979 year-class on 1 January 1981 (31.7 × $10^9$ individuals). The estimated stock size on 1 September 1980 and projected stock sizes in 1981 are as follows:

| Age | Stock size in numbers ($10^6$) | | |
|---|---|---|---|
| | 1 Sep 1980 | 1 Jan 1981 | 1 Sep 1981 |
| 2 | 51,200 | 31,700 | 25,900 |
| 3 | 9,200 | 46,200 | 32,700 |
| 4 | 1,100 | 8,200 | 3,000 |
| 5 | 130 | 970 | 200 |
| 6 | 87 | 100 | 21 |
| Total biomass (000 tons) | 1,180 | 1,420 | 1,320 |
| Mature biomass (000 tons) | | 325 | |

The total biomass projected for 1 January 1981 is lower than estimates for all years in the 1972-77 period. Because a large proportion of this total stock consists of age 2 fish, which are not mature, and age 3 fish, some of which are immature, the biomass of mature capelin on 1 January 1981 is projected to be relatively low although higher than in January 1980. The projection indicates that the biomass on 1 September 1981 will be higher than in 1979 and 1980 but only about one-third of the peak biomass level in 1975. Although the catch rate from the experimental fishery in Div. 2J in 1980 was higher than that for 1979, the results of two independent acoustic surveys indicated a relatively low level of abundance. Because of the conflicting evidence from the numerical analysis, the catch rate data and the acoustic surveys concerning the status of the stock, the estimate of the size of the 1978 year-class and consequently the biomass projected for 1981 may be subject to substantial error and be optimistic. Because of these uncertainties, the Committee advises the continued closure of the autumn fishery for capelin in Div. 2J+3K or a small nominal TAC. A small fishery of 10,000-15,000 tons in 1981 would provide scientists with information comparable to that collected previously and would allow them to better assess the status of the stock in 1981 and to quantify their advice for conservation in 1982.

c) Divisions 3L, 3N and 3O

i) Commercial catch-effort analysis

There was no offshore commercial fishery in these divisions in 1979 and 1980. However, the variation in catch rates for USSR trawlers (>2000 GRT) in Div. 3L during 1973-78 was not great, the range being from 2.27 tons per hour fishing in 1973 to 3.88 tons per hour in 1976.

ii) Research vessel surveys

An acoustic survey by USSR during 26 May-14 June 1980 indicated a mixture of mature and juvenile capelin in Div. 3L, the latter belonging to the 1977 year-class. The biomass of mature capelin in Div. 3L could not be estimated from the acoustic data, as only small quantities of capelin were observed and it was not possible to separate the acoustic counts of mature capelin, juvenile capelin and sand lance. It is possible that, at the time of the survey, most of the mature stock was in inshore Newfoundland waters. Age-groups 3 and 4 (1977 and 1976 year-classes) predominated in the catches of mature capelin. No mature capelin were found in Div. 3NO, but juvenile capelin of the 1979 year-class were found over a large area.

Canadian acoustic surveys of Div. 3LNO were carried out during 12 June-7 July 1980. From a large-scale survey in Div. 3L, the biomass was estimated to be 16,700 tons, consisting of 2,600 tons of mature capelin and 14,100 tons of juveniles mostly of the 1979 year-class. This survey did not cover inshore areas where mature capelin were congregating prior to beach spawning. In the survey of Div. 3NO, mature capelin were detected only on the Southeast Shoal (Div. 3N). Of the estimated biomass of 9,900 tons in Div. 3NO, 1,300 tons were mature fish mostly of the 1977 year-class and the remainder were juveniles mostly of the 1979 year-class.

An analysis of sampling variation and survey design for the Canadian acoustic survey in Div. 3LNO in 1980 indicated a 95% confidence interval of ±61.9% for the large-scale survey in the whole area and intervals from ±16.5% to ±18.6% for the concentrated surveys of the spawning population in Div. 3N. These confidence intervals are comparable to those reported for acoustic surveys on other species of fish. It was emphasized that this source of variation is related only to sampling design and that other sources of variation in acoustic surveys also exist. However, the present analysis will allow future surveys to be planned in such a way that variance due to sampling design can be reduced.

iii) Numerical population models

A sequential capelin population model (SCAM) was used to estimate abundance of capelin in Div. 3L during 1967-80. Catches from both the inshore fishery and the offshore fishery (1972-78) were used in the analysis. Estimates of the proportions mature at age were calculated from catch rate data when available (1972-78), and averages were used when such data were not available. The relationship between catch rate (1974-78) and total biomass was used to determine a terminal F of 0.10 for 1980. The results of the analysis with this terminal F value was considered to provide the best assessment of status of the stock during 1972-78.

There was a statistically significant relationship between the estimates of year-class strength of age 2 capelin in Div. 2J+3K and age 3 capelin in Div. 3L for the 1968 to 1974 year-classes. This relationship was used to refine the estimates of year-class strength in the early years and the more recent years of the series. The results of this analysis indicated that the 1973, 1969 and 1964 year-classes were large, and that the 1975, 1976 and 1977 year-classes were relatively small, about one-fifth the size of the large 1973 year-class ($24 \times 10^9$ individuals). These small year-classes resulted in rather low biomass estimates of 170,000 and 150,000 tons in 1979 and 1980 respectively.

iv) Recruitment estimation and prognosis for 1981

Stock size projections for capelin in Div. 3L were made, using estimates of year-class strength based on the relationship between capelin year-class size in Div. 3L and Div. 2J+3K. These projections indicated that the 1978 year-class, which will form the bulk of the stock in 1981, is larger than the 1977 and 1976 year-classes but still below the long-term average. The projected stock size of capelin (age 3 and older) in Div. 3L on 1 January 1981 indicates a total biomass of 300,000 tons.

| Stock size on 1 Jan 1981 ($10^6$) | | | Total Biomass (tons) |
|---|---|---|---|
| Age 3 | Age 4 | Age 5+ | |
| 9,900 | 2,800 | 500 | 300,000 |

The Committee emphasizes that the estimated size of the 1978 year-class in Div. 3L may be subject to substantial error because of the method of estimation noted above. The Committee also recognizes that capelin are an important source of food for predators, especially cod. In view of these factors, the Committee advises that an exploitation rate of 10% should be maintained for 1981, resulting in a TAC of 30,000 tons for capelin in Div. 3L.

No stock projections were made for capelin in Div. 3NO in 1981, because no estimates of year-class size were available. However, it was noted that the spawning stock was at a very low level in 1980 and would still be at a low level in 1981 if estimates of year-class strength in these divisions followed the pattern of other areas. Consequently, in order to allow further increase in the spawning stock in Div. 3N and to protect this stock during its migration through Div. 3O to Div. 3N, the Committee advises that there should be no fishery for capelin in Divisions 3N and 3O during 1981.

4. Cod Predation on Capelin (SCR Doc. 81/II/1, 7, 8)

The Committee reviewed three papers dealing with the geographical and seasonal patterns of predation by cod on capelin in Div. 2J+3KL and 3NO, the association of capelin with the cold inshore branch of the Labrador Current for much of the year, and the influence of this distribution on the cod-capelin interaction.

The possibility that changes in capelin abundance might influence the growth rate of cod and the success of the inshore fishery was examined by correlation analysis, using 1970-79 data for the capelin stock in Div. 2J+3K and the cod stock in Div. 2J+3KL (SCR Doc. 81/II/1). No significant relationship between cod growth rate and capelin abundance was demonstrated. However, significant positive correlations were found between the proportion of available cod biomass taken by poundnet in inshore waters and one of the two available indices of mature capelin abundance, and between the proportion of available cod biomass taken by the total inshore fishery and the same index of mature capelin biomass and water temperature. Because of uncertainties in the data and the shortness of the time series, it was considered that the analysis did not constitute an adequate test of the postulated dependency of cod on capelin. It was noted, however, that, particularly for cod in Div. 2J+3KL, there may be no alternative prey of comparable size which could provide adequate forage for cod on a sustained basis.

Estimates of the quantity of capelin which might be consumed by cod in Div. 2J, 3K, 3L, 3N and 3O in 1981 were in the range of 1.2-4.4 million tons (SCR Doc. 81/II/8). These estimates were considered to be very tenuous, because the cod-feeding studies on which they were based suffered from inadequate spatial and seasonal sampling and were conducted during a period (1973-76) when capelin abundance was high and cod abundance was low.

## II. FUTURE RESEARCH REQUIREMENTS

1. Cod Predation on Capelin

The Committee, noting with concern that estimates of the consumption of capelin by cod in Subareas 2 and 3 approached the projected biomass, and considering the need for studies on the trophic interaction between cod and capelin,

recommends

*that extensive sampling of cod stomachs should be continued both inshore and offshore in Subareas 2 and 3, with emphasis on providing more reliable estimates of capelin consumption by cod and on establishing whether lowered levels of capelin biomass can detrimentally affect production of the cod stocks and success of the cod fishery.*

2. Pre-recruit Capelin Surveys

In view of the potentially high contribution of recruiting year-classes of capelin to the total biomass, the Committee

recommends

*that the 0-group and 1-group capelin surveys be expanded to provide better estimates of recruitment.*

3. Acoustic Surveys for Capelin

The Committee, noting the desirability of achieving maximum coverage,

recommends

*that the acoustic sruveys for capelin should be coordinated between countries and that inshore surveys should be conducted concurrently with offshore surveys.*

## III. OTHER MATTERS

1. Working Group on Flemish Cap Project

The Committee, noting that Mr R. Wells has previously resigned as convener of the Working Group, agreed that Canada be asked to appoint a Canadian scientist as Convener. Dr G. Nizovtsev, Deputy Director of the Polar Institute of Marine Fisheries and Oceanography (PINRO) kindly agreed to act as the USSR coordinator.

2. Mesh Assessment of Cod and Redfish in Div. 3M

The Committee noted that this item would be dealt with at the June 1981 Meeting and agreed to defer consideration of SCR Doc. 81/II/2, "Effects of changes in mesh size upon yield per recruit of cod in Division 3M", to that meeting.

3. Acknowledgements

The Chairman expressed his thanks to all participants for their interest and cooperation during the meeting, especially to those scientists who contributed to the report by summarizing the results of the discussions on particular topics, and to the Secretariat staff for their usual efficient work.

# PART B

## REPORT OF SCIENTIFIC COUNCIL

Regular Meeting, June 1981

CONTENTS

# REPORT OF SCIENTIFIC COUNCIL

Regular Meeting, June 1981

Chairman: R. H. Letaconnoux　　　　Rapporteur: V. M. Hodder

The Council and its Standing Committees met at NAFO Headquarters, Bedford Institute of Oceanography, Dartmouth, Canada, during 3-19 June 1981, to consider and report on the various matters listed in the agenda (see Part E, this volume). In addition to dealing with matters of general scientific interest, the Council considered requests by the Fisheries Commission and the coastal Contracting Parties (Canada and European Economic Community) for advice on management in 1982 of a number of stocks in Subareas 0 to 4. Prior to the opening session of the Council on 8 June, the *ad hoc* Working Group on Squid Research met during 3-6 June to review all available information on squid-*Illex* biology and distribution, and its report was considered by the Standing Committee on Fishery Science. Representatives attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France, and Commission of the European Communities), Japan, Portugal, and Union of Soviet Socialist Republics (USSR), and observers attended from Spain and United States of America (USA) (see Part E, this volume).

The reports of the Standing Committees, as adopted by the Council at this meeting, are given in Appendix I (STACFIS), Appendix II (STACREC) and Appendix III (STACPUB). Lists of research and summary documents are given in Part E of this volume. Brief summaries of the committee reports and other matters considered by the Council are given below.

## I. FISHERY SCIENCE (APP. I)

### 1. General Fishery Trends

The total nominal catch of all species (except seaweeds) in Subareas 0 to 6 was 2.85 million tons in 1980, a decrease of 6% from the 1979 nominal catch of 3.03 million tons (see Appendix I, Table 1). The total catch of "groundfish" species decreased to 1.21 million tons in 1980 from 1.25 million tons in 1979, largely due to decreased catches of redfish, silver hake and Greenland halibut. The total catch of "pelagic" species in 1980 was 642,000 tons, a slight increase from the 1979 catch of 631,000 tons. For the "other fish" category, the total catch continued to decline to 102,000 tons in 1980 from 129,000 tons in 1979 and from 308,000 tons in 1977, mainly due to the rapid decline in the capelin fishery. The total catch of "invertebrate" species declined to 0.90 million tons in 1980 from 1.03 million tons in 1979, due mainly to decreased catches of squid and scallops.

With respect to the nominal catches of all species (except seaweeds) by subarea, increases from 1979 to 1980 were recorded for Subarea 0 (2,400 to 2,700 tons), Subarea 4 (745,000 to 762,000 tons) and Subarea 5 (533,000 to 561,000 tons), whereas decreases were recorded for Subarea 1 (165,000 to 124,000 tons), Subarea 2 (70,000 to 58,000 tons), Subarea 3 (616,000 to 489,000 tons) and Subarea 6 (894,000 to 857,000 tons).

### 2. Stock Assessments

#### a) Summary

STACFIS reviewed the state of, and advised on catch levels in 1982 for, a number of stocks in Subareas 0 to 4 which lie completely or partly within the 200-mile fishery zones of Canada and the European Economic Community (Agenda annexes 1 and 2) and the three stocks which lie outside national fishery zones in Div. 3M. Insofar as it was possible, total allowable catches (TAC's) for 1982 were advised and these are listed in the last column of Table 1. Details of the stock assessments are given in the report of STACFIS (Appendix I).

For the cod stocks in Subarea 1 and Div. 2J+3KL, management options at various levels of fishing mortality and the short-term effects on catch and biomass are presented rather than a TAC associated with a particular level of fishing mortality, in accordance with the requests of Canada and the EEC.

An increase in TAC for 1982, compared with 1981, was advised only for yellowtail flounder in Div. 3LNO, and a decrease was advised for silver hake in Div. 4VWX (Table 1). No changes in TAC were advised for redfish in Div. 3M and 3LN, American plaice in Div. 3M and 3LNO, witch flounder in Div. 3NO, Greenland halibut in Subareas 0+1, roundnose grenadier in Subareas 0+1 and 2+3, argentine in Div. 4VWX, and squid-*Illex* in Subareas 3+4. In the case of the redfish and wolffish stocks in Subarea 1, the information available was inadequate for assessment, and the Council can only indicate approximate yield levels based mostly on historical catch data.

In view of the substantial contribution of recruiting year-classes to annual yields, no TACs were advised for the shrimp stocks in Subareas 0 and 1 and the capelin stocks in Subareas 2 and 3. It

Table 1. Summary of recent catches (1975-80) and TACs (1975-81) for stocks reviewed at the June 1981 Meeting of STACFIS, together with the advised TACs for 1982.

| Species | Stock area | Nominal catches (000 tons) | | | | | | TACs (000 tons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1975 | 1976 | 1977 | 1978 | 1979 | 1980[1] | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
| Cod | 1 | 48 | 33 | 38 | 38 | 48 | 48 | 60 | 45 | 31 | ...[2] | ...[2] | ...[2] | ...[2] | ( )[3] |
| | 2J+3KL | 288 | 214 | 173 | 139 | 165 | 172 | 554 | 300 | 160 | 135 | 180 | 180 | 200 | ( )[3] |
| | 3M | 22 | 22 | 25 | 33 | 30 | 10 | 40 | 40 | 25 | 40 | 40 | 13 | 12.7 | ( )[4] |
| | 3NO | 44 | 24 | 18 | 15 | 28 | 19 | 88 | 43 | 30 | 15 | 25 | 26 | 26 | ( )[4] |
| Redfish | 1 | 9 | 14 | 31 | 8 | 9 | 7 | - | - | - | 13 | ... | ... | ... | ( )[3] |
| | 3M | 16 | 17 | 20 | 17 | 20 | 16 | 16 | 16 | 16 | 16 | 20 | 20 | 20 | (20) |
| | 3LN | 18 | 21 | 16 | 12 | 14 | 16 | 20 | 20 | 16 | 16 | 18 | 25 | 25 | (25) |
| Silver hake | 4VWX | 116 | 97 | 37 | 48 | 52 | 44 | 120 | 100 | 70 | 70 | 70 | 90 | 80 | (75) |
| A. plaice | 3M | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | ( 2) |
| | 3LNO | 43 | 52 | 44 | 50 | 49 | 49 | 60 | 47 | 47 | 47 | 47 | 47 | 55 | (55) |
| Witch | 3NO | 6 | 6 | 6 | 3 | 3 | 2 | 10 | 10 | 10 | 10 | 7 | 7 | 5 | ( 5) |
| Yellowtail | 3LNO | 23 | 8 | 12 | 15 | 18 | 12 | 35 | 9 | 12 | 15 | 18 | 18 | 21 | (23) |
| G. halibut | 0+1 | 25 | 16 | 13 | 12 | 19 | 8 | - | 20 | 20 | 20 | 25 | 25 | 25 | (25) |
| | 2+3KL | 29 | 25 | 32 | 39 | 34 | 32 | 40 | 30 | 30 | 30 | 30 | 35 | 55 | (55) |
| R. grenadier | 0+1 | 5 | 9 | 3 | 6 | 7 | 2 | 10 | 14 | 8 | 8 | 8 | 8 | 8 | ( 8) |
| | 2+3 | 27 | 21 | 15 | 21 | 8 | 2 | 32 | 32 | 35 | 35 | 35 | 30 | 27 | (27) |
| Wolffishes | 1 | 6 | 6 | 6 | 6 | 17 | 5 | - | - | - | - | - | - | - | ( )[3] |
| Argentine | 4VWX | 15 | 7 | 2 | 2 | 3 | 2 | 25 | 25 | 20 | 20 | 20 | 20 | 20 | (20) |
| Capelin | 2+3K | 199 | 216 | 152 | 55 | 12 | 6 | 160 | 160 | 212 | 212 | 75 | 5 | ... | ( )[4] |
| | 3LNO | 166 | 144 | 74 | 30 | 12 | 14 | 180 | 180 | 200 | 200 | 10 | 16 | 30 | ( )[4] |
| Shrimp | 0+1 | 38 | 50 | 42 | 34 | 35 | 43 | - | - | 36[5] | 40[5] | 29.5[5] | 29.5[5] | ... | ( )[4] |
| Squid-*Illex* | 2-4 | 18 | 42 | 83 | 94 | 162 | 70 | - | - | - | 100 | 120 | 150 | 150 | (150) |

1 Provisional statistics.
2 Catches restricted to Greenlanders' fishery and to by-catch.
3 See relevant subsections of STACFIS report (Appendix I).
4 Deferred to mid-term meeting.
5 TACs pertain to offshore grounds.

was agreed to defer the assessment of these stocks to a mid-term meeting, because of the necessity of having available complete information from the commercial fishery and research vessel surveys in 1981. Advice on TAC levels in 1982 for the cod stocks in Div. 3M and 3NO was also deferred to a mid-term meeting, due to the depleted condition and the continued uncertainty about the status of these stocks.

b) Additional comments relevant to assessments

i) Greenland halibut in Subarea 2 and Divisions 3KL

The Council noted that the advised TAC of 55,000 tons for this stock should apply only to Div. 2J+3KL, and that any increase in the TAC should be related to removals from Div. 2GH.

ii) Squid-*Illex* in Subareas 3 and 4

In view of the continued inability to predict squid abundance in 1982, the Council reiterates the management regime proposed for squid at the February 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, pages 39-40). The Council also noted that the present management regime implies substantial loss of yield to the fishery in years of high abundance and that, through predation by squid, there may also be a loss of yield to the fishery for other species in years of high squid abundance.

The Council endorsed the recommendations for future research on squid, as indicated in Annex 1 to the report of STACFIS, and agreed that the *ad hoc* Working Group on Squid Research should meet for two days during the September 1981 Meeting to carry out a more complete review of the 1981 survey results and to develop a program for 1982.

iii) Cod in Division 3M

The Council noted that a stock-recruitment relationship has not been demonstrated for this stock and endorsed the recommendation of STACFIS that the *ad hoc* Working Group on the Flemish Cap Program examine the data base to determine if such a relationship can be defined for cod in this area.

3. Mesh Assessment for Cod and Redfish in Division 3M

The Council noted that the present data base is not sufficient to provide advice on the impact of changes in mesh size on the interaction of the cod and redfish fisheries in Div. 3M and strongly urges that the deficiencies in the data base be defined at the September 1981 Meeting, so that a full and complete evaluation of this problem can be undertaken as soon as possible.

4. Gear and Selectivity

The Council noted the results of the mesh selection studies on silver hake in 1980 and endorsed the recommendation of STACFIS that sufficient data be collected under commercial conditions to allow accurate descriptions of the selectivity of the 60-mm and 90-mm codend mesh sizes for silver hake. The Council noted that additional selection studies on Greenland halibut had not been carried out and urged that these be continued. The results of the 1981 redfish selection experiment by Cuba in Div. 3M were utilized by STACFIS in its mesh assessment of the cod and redfish fisheries in that area.

5. Ageing Techniques and Validation Studies

The Council welcomed the initiation of comparative ageing studies on redfish but noted that the exchange of ageing material for roundnose grenadier has not yet been undertaken, as recommended at the June 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, page 65). The Council noted that time was insufficient at the Shrimp Ageing Workshop in Quebec City, Canada, during 11-14 May 1981 to cover all aspects of ageing shrimp and agreed that two days should be added to the mid-term meeting for shrimp assessments, so that further consideration can be given to the various aspects of ageing techniques and management implications.

6. Other Relevant Papers

The Council welcomed the presentation of several research documents not directly related to stock assessments and noted that these probably represented a very small proportion of the research information available for the Northwest Atlantic but not submitted for consideration by the Council.

## II. RESEARCH COORDINATION (APP. II)

1. Statistics and Sampling

a) CWP activities relevant to NAFO statistics

The Council noted that STACREC had reviewed the report of the 10th Session of the Coordinating Working Party on Fishery Statistics, held at Madrid, Spain, in July 1980, particularly in regard to the classification of fishing gears, the use of 3-alpha species identifiers, the operation of the STATLANT system, and the allocation of catches by nationality, and reaffirmed previous commitments on these matters. It was also noted that the 11th Session of the CWP will be held at Luxembourg during 21-28 July 1982 and that it was necessary for the Scientific Council to designate a country that would nominate one of the NAFO representatives to attend that session.

b) Fishery statistics

The Council expressed concern about the difficulties being encountered by the Secretariat in obtaining and compiling fishery statistics for stock assessments and for publication annually in the Statistical Bulletin. The problems relate in part to the late submission of STATLANT 21A and 21B reports by some member states and in part to complications arising from the reporting of statistics accruing from joint venture operations. Consequently, the publication of Vol. 28 of the Statistical Bulletin was delayed by nearly one year and Vol. 29 by 8 months. The Council noted that the responsibility lies with the national statistical agencies and that no obvious solution was evident except to request Council representatives to impress upon their statistical officers the importance of accurate and prompt reporting.

c) Sampling data

The Council noted that the Secretariat had received and processed a large volume of sampling data for 1979, including some data collected through the Scientific Observer Program. It was observed that some of the national lists of data indicated incomplete coverage of the fisheries, and Council representatives are urged to check these national lists and submit all non-reported length frequencies and age-length keys to the Secretariat as soon as possible.

d) List of fishing vessels for 1980

The Council noted that the national lists of fishing vessels, which operated in the Northwest Atlantic in 1980, was still very incomplete and urged that all outstanding lists be forwarded to the Secretariat as soon as possible to facilitate the publication of the first NAFO issue of List of Fishing Vessels.

## 2. Biological Surveys

### a) Survey activities

The Council noted that STACREC had reviewed research vessel survey activities in the Northwest Atlantic in 1980 and survey plans for 1981, the details of which are listed in Tables 1 and 2 of Appendix II.

b) The Council noted that the editor (Dr. W. G. Doubleday) had prepared a further revision of the Manual on Groundfish Surveys in the NAFO Area and that some new material had been approved by STACREC for inclusion. Subject to final editing, the Council agreed to the publication of the Manual in a special issue of Scientific Council Studies as soon as possible.

### c) Other survey matters

The Council endorsed the recommendations of STACREC regarding the need for calibration of fixed-station and stratified-random surveys, particularly in Div. 3M, and for the inclusion of catchability coefficients in all reports dealing with biomass estimates from surveys.

## 3. Environmental Studies

### a) MEDS progress report for 1980

The Council noted the progress made by MEDS (Marine Environmental Data Service) in acquiring a considerable amount of oceanographic data for 1980 but that this may represent little more than half of the data actually collected. Consequently, the MEDS summary of environmental conditions in 1980 is based on a very incomplete data base. It was agreed that the national representatives should try to speed up the reporting of data and that MEDS should try to speed up the processing of data as well. The Council also noted that MEDS continues to receive outstanding data for previous years.

### b) National representatives

The Council was informed of only one change in the list of national representatives responsible for reporting oceanographic data to MEDS: Dr. H. Hatanaka replaces Dr. F. Nagasaki as the representative for Japan.

### c) Environmental conditions in 1980

The Council noted that MEDS has again provided a summary of environmental conditions in Subareas 0 to 4 from the available data for 1980 (SCR Doc. 81/VI/82) and that this review was supplemented by STACREC from information given in various documents presented at this meeting. It was regretted that no information was available on environmental conditions in Subareas 5 and 6 for 1980.

## 4. Review of Gear Definitions

At the request of the Fisheries Commission, STACREC reviewed the definitions for various components of trawl nets. The Council approved the definitions proposed by STACREC, as given in Annex 1 to Appendix II.

# III. PUBLICATIONS (APP. III)

## 1. Review of Publications

The Council noted STACPUB's review of the status of publications and encouraged support for Vol. 2 of the Journal of Northwest Atlantic Fishery Science through the submission of suitable manuscripts. Concern was expressed about continuing delays in the publication of fishery statistics due to delays in reporting and errors in submissions by national statistical offices. Publication plans for the Manual on Groundfish Surveys and for the proceedings of special sessions at the September 1981 Meeting were approved.

## 2. Coordination of Research Information for the NAFO Area

The Council again encourages countries producing scientific information relevant to the NAFO Convention Area to submit these to the Scientific Council and approved STACPUB's plan to continually monitor success in attracting such material.

## 3. Proposed Ichthyoplankton Identification Manual

The Council agreed to the establishment of an *ad hoc* working group of ichthyoplankton systematic experts to meet during the September 1981 Meeting to review the state of knowledge of ichthyoplankton identification in the NAFO Area, to decide on the feasibility of producing such a manual, and to propose mechanisms for production of a manual if the project is considered a practical and worthwhile venture. The Secretariat was requested to solicit background material, and Dr. R. G. Halliday was asked to contact some experts who could meet during the September 1981 Meeting.

4. Publication and Editorial Policy

The Council approved the actions taken to date by STACPUB to establish an editorial board for its Journal, including the statements developed on the structure and function of the Board and on the terms of reference for editors (Appendix III).

5. Papers for Possible Publication

The Council noted that STACPUB had reviewed all papers presented to the November 1980, February 1981 and June 1981 Meetings and had nominated 16 of them for possible publication in one of the Council's publication series, subject to revision by the authors and acceptance by the Editor.

## IV. COLLABORATION WITH OTHER ORGANIZATIONS

1. NAFO Participation in the Work of the CWP

The Council noted that the Coordinating Working Party on Atlantic Fishery Statistics (CWP) had met at Madrid, Spain, during 22-29 July 1980 and that the Report of the 10th Session was considered by STACREC. It was also noted that the 11th Session will be held at Luxembourg during 21-28 July 1982. It was agreed that the NAFO participants should be: the Chairman of STACREC, a representative to be nominated by Portugal, and a member of the Secretariat to be nominated by the Executive Secretary.

2. Assessment of Shrimp Stock at East Greenland

At the request of ICES in October 1980, the Scientific Council agreed to undertake the assessment of the shrimp stock at East Greenland during its November 1980 Meeting. The results of this assessment was communicated to ICES when the Council's report of that meeting was distributed late in 1980. The Council noted the EEC request for advice on management in 1982 of the shrimp stock at East Greenland, in agreement with ICES Resolution 1980/2:6-19, and agreed to undertake this assessment at the same meeting designated for the assessment of the shrimp stock in Subarea 0 and 1.

3. Proposed NAFO/ICES Study on Redfish at Greenland

The problem of biological relationships between the redfish stocks of West Greenland (NAFO Subarea 1) and the Irminger Sea stock complex (ICES Subareas V and XIV) requires further study and special research which should be separated from the usual assessment work on redfish. The Scientific Council of NAFO therefore

recommends

*that a special NAFO/ICES study group should be established to further examine the biological relationships of the West Greenland and Irminger Sea redfish stocks, and that ICES be requested to make the necessary arrangements at the earliest possible opportunity, the suggested terms of reference of the study group being: (i) to evaluate all available data on the subject, (ii) to plan and coordinate special research on the relationships of the West and East Greenland stocks, and (iii) to evaluate the data from such research projects.*

## V. RULES OF PROCEDURE

1. Proposed Revision to Rule 3

The Council noted the Canadian proposal to amend Rule 3.1 of the Rules of Procedure for the Scientific Council (see Part E, this volume). Although all representatives at this meeting unanimously agreed to the proposed amendment, its formal adoption was deferred due to the lack of a quorum.

## VI. FUTURE SCIENTIFIC MEETINGS

1. Annual Meeting, September 1981

The Scientific Council and its Standing Committees will meet during 8-18 September to consider the following items:

a) Coordination of research surveys for squid in 1982.
b) Evaluation of the Flemish Cap research program.
c) Further evaluation of the Georges Bank-Gulf of Maine larval herring program.
d) Remote sensing methods and their possible application to fishery science.
e) Review of environmental conditions during the 1970-79 decade.
f) Evaluation of scientific advice provided for management of the Northwest Atlantic fish stocks, with particular reference to cod.
g) Further evaluation of changes in mesh size on cod and redfish in Div. 3M.
h) Feasibility of producing an ichthyoplankton identification manual.
i) Establishment of an editorial board for the Journal.

2. Mid-term Meetings for Assessment of Deferred Stocks

The Council noted that STACFIS had not been able to provide advice for management in 1982 of shrimp in Subareas 0 and 1, capelin in Subareas 2 and 3, and cod stocks in Div. 3M and 3NO. It was agreed that, if the Council receives a request to assess the seal stocks, an appropriate time to consider the shrimp and seal stocks would be at a meeting during 20-26 November 1981, allowing the first two days for the Shrimp Ageing Workshop to finish its work. It was further agreed that an appropriate time to assess the capelin and cod stocks would be at a meeting of 5 days in mid-February 1982. Further arrangements for these meetings will be considered at the September 1981 Meeting.

## VII. NOMINATION OF OFFICERS

The Chairman observed that the item "Election of Officers" was put on the agenda for this meeting in anticipation that the proposed amendment to Rule 3.1 of the Rules of Procedure could be adopted. Lacking the necessary quorum to vote on the proposed amendment to Rule 3.1 and consequently to conduct the election of officers at this meeting, it was necessary to defer these important matters. However, the scientific representatives of the six Contracting Parties present acted as a nominating committee, and the following scientists agreed to occupy the respective offices of the Scientific Council, if elected:

| | |
|---|---|
| Chairman : | Mr. R. Wells - nominated by EEC and seconded by USSR and Japan. |
| Vice-Chairman : | Dr. V. A. Rikhter - nominated by Canada and seconded by EEC and Japan. |
| Chairman of STACFIS: | Mr. J. P. Minet - nominated by Canada and seconded by USSR and Japan. |
| Chairman of STACREC: | Dr. T. K. Pitt - nominated by EEC and seconded by Canada and USSR. |
| Chairman of STACPUB: | The Vice-Chairman of the Scientific Council becomes *ex officio* Chairman of this Committee. |

## VIII. OTHER MATTERS

1. Provisional Report of February 1981 Meeting

The Council reviewed and formally approved the report of its meeting at Dartmouth, Nova Scotia, Canada, during 17-20 February 1981 (see Part A, this volume).

2. Chairman's Concluding Remarks on the Work of the Scientific Council

Before adjournment, the Chairman elaborated on several remarks made during the course of this meeting concerning the work and organization of the Scientific Council, as summarized below.

It is apparent that the Rules of Procedure of the Scientific Council, with the constraints imposed by Articles of the Convention, are not flexible enough for scientific meetings, particularly with regard to voting procedures, when, despite the presence of a relatively large number of scientists, there is inadequate scientific representation of the Contracting Parties. Such a problem was evident at this meeting, as noted in the preceding section, and it may be persistent at future meetings unless a less rigid framework is adopted.

There is evidence of imbalance between such activities as providing advice on TACs and scientific discussion of more general problems. On one hand, the Council is requested to assess a limited number of stocks, for which discussion is generally restricted to a selection of data and parameters for assessment purposes, whereas discussion is enlarged to greater consideration of biological and ecological problems for some others such as squid and shrimp, and, in the case of the Flemish Cap, the cooperative research being undertaken gives a new dimension to the work of the Council. Such realities must be taken into account in future consideration of the role of the Scientific Council in these various types of activities.

It must be noted that, while some research activities are coordinated under the responsibility of the

Scientific Council, other research activities are conducted independently or bilaterally outside the coordinating sphere of the Council, and most of the results are not presented to the Council. Also, with the new regime of the sea, the traditional patterns of fisheries have changed drastically and so have the possibilities for many countries to conduct research on the exploited stocks; for example, 83% of the groundfish catch is taken by only one country in Subarea 1, and 72-92% by one country in Subareas 2 to 4. For the main cod stocks, the situation is quite similar: 84% by one country in Div. 2J+3KL, 73% by 2 countries in Div. 3NO, and 65% by 2 countries in Div. 3M. This gives to a limited number of countries the responsibility of collecting all or most of the data necessary for assessment and biological studies. Finally, it should not be forgotten that one coastal state is not yet a member of the Scientific Council and that there has been little or no discussion on research in Subareas 5 and 6 in recent years except through the Task Force on the Larval Herring Program.

Such is the situation, insofar as the Scientific Council is concerned, and it may be difficult to change, but it could be improved if some consideration was given to ways and means of achieving better cooperation in fisheries research by developing programs of more general interest, as indicated by the success of the Working Group on Squid Research and by the willingness of oceanographers to participate in the activities of the Council. The key to the problem lies largely with the coastal states and their willingness to develop and pursue cooperation in fisheries research. One aspect of this problem, i.e., the need for coordination of research information for the NAFO Area, was noted by STACPUB.

## IX. ADJOURNMENT

The Chairman expressed his thanks to the Director of the Bedford Institute of Oceanography for the meeting facilities, to the Secretariat for their efficient work in servicing this meeting, to the chairmen and rapporteurs of committees and working groups, and to all participants for their cooperation and contributions. The meeting adjourned at 1245 hours on 19 June 1981.

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

Chairman: G. H. Winters　　　　Rapporteurs: Various

The Committee met at Dartmouth, Nova Scotia, Canada, during 8-15 June 1981, to consider and report on various matters referred to it by the Scientific Council (see Part E, this volume, for agenda), particularly with regard to the provision of advice on conservation measures for certain stocks in Subareas 0 to 4. Scientists attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France, and the Commission of the European Communities), Japan, Portugal, Spain, USSR and USA.

Various scientists, designated by the Chairman, assisted in the initial preparation of draft reports on the topics considered by the Committee at this meeting. The usual summary of fishery trends from 1979 to 1980 is presented in Section I below, the results of the stock assessments are given in Section II, and other matters considered by the Committee are given in Sections III to VII. The report of the *ad hoc* Working Group on Squid Research, which met during 3-6 June 1981 with T. W. Rowell as Convener, is given in Annex 1.

## I. FISHERY TRENDS

### 1. General Trends for the NAFO Area

Provisional nominal catches in the Northwest Atlantic for 1980, as compiled from the STATLANT 21A reports and presented in SCS Doc. 81/VI/15, are summarized in Table 1, together with similar data for 1979.

The total nominal catch of all finfish and invertebrates decreased from 3.03 million tons in 1979 to about 2.85 million tons in 1980 (6%), after having increased from 2.84 million tons in 1978. The total groundfish catch declined from 1.25 million tons in 1979 to 1.21 million tons in 1980 (2%), largely due

Table 1. Nominal catches (000 tons) for 1979 and 1980[1]. (The symbol + indicates less than 500 tons.)

| | SA 0 | | SA 1 | | SA 2 | | SA 3 | | SA 4 | | SA 5 | | SA 6 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 |
| Atlantic cod | - | - | 48 | 48 | 26 | 39 | 244 | 213 | 203 | 227 | 50 | 62 | + | + | 572 | 589 |
| Haddock | - | - | + | - | - | + | 1 | 1 | 29 | 44 | 24 | 35 | + | + | 54 | 80 |
| Atlantic redfishes | + | + | 9 | 7 | 17 | 4 | 75 | 67 | 28 | 29 | 15 | 10 | - | - | 144 | 118 |
| Silver hake | - | - | - | - | - | - | + | + | 52 | 44 | 9 | 8 | 12 | 10 | 73 | 62 |
| Red hake | - | - | - | - | - | - | - | + | + | 1 | 7 | 3 | 2 | 2 | 9 | 6 |
| Pollock | - | - | + | - | + | - | 1 | 1 | 28 | 32 | 19 | 24 | + | + | 48 | 57 |
| American plaice | - | - | 6 | 1 | + | + | 56 | 58 | 19 | 19 | 11 | 14 | + | + | 93 | 92 |
| Witch flounder | - | - | - | - | + | + | 8 | 6 | 7 | 6 | 3 | 3 | + | + | 18 | 16 |
| Yellowtail flounder | - | - | - | - | - | - | 19 | 13 | 2 | 3 | 16 | 19 | 1 | 1 | 38 | 35 |
| Greenland halibut | 1 | 2 | 18 | 6 | 6 | 2 | 29 | 31 | 10 | 7 | - | + | - | - | 63 | 48 |
| Other flounders | - | + | 1 | 1 | + | + | 1 | 1 | 6 | 7 | 15 | 18 | 14 | 12 | 37 | 40 |
| Roundnose grenadier | + | + | 7 | 2 | 5 | 1 | 3 | 1 | - | - | - | - | - | - | 15 | 4 |
| White hake | - | - | - | - | + | + | 2 | 3 | 12 | 18 | 3 | 4 | + | + | 17 | 23 |
| Wolffishes | - | + | 17 | 5 | + | + | 2 | 2 | 2 | 3 | 1 | 1 | + | + | 22 | 12 |
| Other groundfish | - | + | 4 | 6 | + | + | 4 | + | 8 | 8 | 14 | 12 | 8 | 7 | 38 | 33 |
| Atlantic herring | - | - | + | + | + | + | 32 | 15 | 156 | 161 | 65 | 83 | + | + | 253 | 259 |
| Atlantic mackerel | - | - | - | - | + | - | 15 | 6 | 16 | 16 | 1 | 2 | 1 | 1 | 33 | 25 |
| Atlantic butterfish | - | - | - | - | - | - | - | - | - | - | 2 | 5 | 2 | 1 | 4 | 6 |
| Atlantic menhaden | - | - | - | - | - | - | - | - | - | - | 59 | 69 | 271 | 272 | 330 | 340 |
| Other pelagics | - | - | - | - | - | - | 2 | 1 | 1 | 2 | 3 | 2 | 5 | 6 | 11 | 11 |
| Capelin | - | - | + | + | 11 | 5 | 13 | 19 | 9 | 4 | - | - | - | - | 33 | 28 |
| Other finfish | + | + | 22 | 5 | 1 | 2 | 8 | 5 | 18 | 18 | 10 | 8 | 37 | 35 | 96 | 74 |
| Squids | - | - | - | - | + | + | 89 | 35 | 73 | 35 | 7 | 10 | 28 | 25 | 197 | 105 |
| Clams | - | - | - | - | - | - | - | - | 3 | 4 | 31 | 36 | 237 | 237 | 271 | 277 |
| Scallops | - | - | - | - | - | - | + | + | 13 | 27 | 140 | 106 | 61 | 44 | 214 | 178 |
| Other molluscs | - | - | - | - | - | - | - | - | 2 | 2 | 9 | 7 | 176 | 161 | 187 | 170 |
| Shrimp | 1 | 1 | 34 | 42 | 4 | 4 | - | + | 9 | 9 | + | + | + | 1 | 48 | 56 |
| Other crustaceans | - | - | - | - | - | - | 13 | 11 | 39 | 38 | 18 | 18 | 39 | 41 | 109 | 108 |
| Other invertebrates | - | - | - | - | - | - | - | - | + | + | + | 1 | + | + | + | 1 |
| Total | 2 | 3 | 165 | 123 | 70 | 58 | 616 | 489 | 745 | 762 | 533 | 561 | 894 | 857 | 3025 | 2853 |

[1] Provisional data for 1980 from SCS Doc. 81/VI/15 (Revised).

to declines for redfish (18%), silver hake (15%), Greenland halibut (24%), roundnose grenadier (73%), and wolffishes (45%), with increases noted for cod (3%), haddock (48%) and pollock (19%). The total pelagic fish catch of 642,000 tons in 1980 was only slightly more than that in 1979 (631,000 tons), with small increases in the herring and menhaden catches which constitute 90% of the total for this group. Catches for the "other fish" category decreased from 129,000 tons in 1979 to 102,000 tons in 1980 (21%), following a significant decline from 176,000 tons in 1978 and 308,000 tons in 1977, due almost entirely to a decline for capelin. The total catch of invertebrates declined from 1.03 million tons in 1979 to 0.90 million tons in 1980 (14%), due mainly to decreases for squid (47%) and scallops (17%).

2. Subarea 0

The usual low catch in this subarea increased from 2,400 tons in 1979 to 2,700 tons in 1980 (13%), with Greenland halibut and shrimp being the main species taken.

3. Subarea 1

The total nominal catch of all species declined from 165,000 tons in 1979 to 123,000 tons in 1980 (26%). Significant decreases were noted for Greenland halibut (66%) and wolffishes (71%), and an increase for shrimp (23%).

4. Subarea 2

The total nominal catch of all species declined from 70,000 tons in 1979 to 58,000 tons in 1980 (17%), due mainly to decreased for redfish (76%), Greenland halibut (66%), roundnose grenadier (80%) and capelin (55%), and an increase for cod (50%).

5. Subarea 3

The total nominal catch of all species declined from 616,000 tons in 1979 to 489,000 tons in 1980 (21%), due mainly to descreases for cod (13%), redfish (11%), yellowtail flounder (32%), herring (53%) and squid (61%). For the flatfish species the decline for yellowtail was offset by slight increases for Greenland halibut (7%) and American plaice (4%).

6. Subarea 4

The total nominal catch of all species increased from 745,000 tons in 1979 to 762,000 tons in 1980 (2%). Decreases were noted for silver hake (15%) and squid (52%), but these were offset by increases for cod (12%), haddock (52%), pollock (14%) and scallops (100%).

7. Subarea 5

The total nominal catch of all species increased from 533,000 tons in 1979 to 561,000 tons in 1980 (5%). Increases were noted for cod (24%), haddock (46%), pollock (26%), herring (28%) and menhaden (17%), and a decrease for scallops (24%).

8. Subarea 6

The total nominal catch of all species decreased slightly from 894,000 tons in 1979 to 857,000 tons in 1980 (4%), the most significant decreases being noted for scallops (28%) and other molluscs (9%).

## II. STOCK ASSESSMENTS

1. Cod in Subarea 1 (SCR Doc. 81/VI/48; SCS Doc. 81/VI/12)

a) Fishery trends

Provisional statistics for 1980 show the catch of cod to be 48,000 tons. A catch estimate of 51,000 tons was used in the assessment presented in SCR Doc. 81/VI/48, but it seems likely that the actual catch was somewhat higher (about 55,000 tons). The catch by Greenland fishermen in 1980 was about 47,000 tons, the same as in 1979, with trawlers accounting for 16% in 1980 compared to 23% in 1979. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 107 | 60 | 45 | 31 | ...[1] | ...[1] | ...[1] | ...[1] |
| Catch (000 tons) | 63 | 48 | 48 | 33 | 73[2] | 73[2] | 99[2] | 55[2] | |

[1] Catches limited to Greenlanders' fishery and to by-catch.
[2] Estimates used for assessment of the stock.

b) Trends in distribution, abundance and stock composition

Catch-per-unit-effort for Greenland trawlers was about 25% lower than in 1979 and only about half of the high level of 3.3 tons per hour reached in 1978. This decrease was most pronounced in Div. 1C-1D, probably the result of emigration of the 1973 year-class from these divisions to more southern divisions and to East Greenland and Iceland. However, new year-classes, especially that of 1977, will recruit in the northern divisions (1B-1D) during 1981, and the catch rate will probably increase again. The inshore fishery had its major catch (26,000 tons, or 67% of the total inshore catch) in Div. 1E-1F, where the 1973 year-class predominated. A northward extension of the offshore trawl fishery to the southern part of Div. 1B was noted in 1980.

Recruitment prospects seem somewhat improved. The 1977 year-class is expected to be of major importance during 1982-84 and to offer a new possibility for rebuilding the stock. The 1979 and 1980 year-classes still have to be observed, but environmental conditions in the two years give basis for moderate optimisms for these year-classes. The 1977 year-class will probably remain in Subarea 1 to a much higher degree than did the 1973 year-class because it is of West Greenland origin. The 1975 year-class had been expected to occur as the major contributor to the fishery in 1980-81. In fact, it was the most numerous year-class in offshore catches in Div. 1C-1D in 1980 but not to the extent expected, and in inshore samples it was less important than either the 1973 year-class in Div. 1E-1F or the 1976 and 1977 year-classes in Div. 1D. Only in Div. 1B did it occur as the predominating year-class in the landings.

c) Assessment parameters

Mortality rates. Estimates of total mortality (Z) for 1978-80, derived from catch curves, were averaged for age-groups 5-7 over the period, thereby including the 1973 year-class. This resulted in a Z-value of 0.83, which the Committee considered to be a reasonable estimate when compared with the value of 1.07 estimated at the June 1980 Meeting, considering that fishing effort had decreased about 30% from 1979 to 1980. Deducting natural mortality (M = 0.20), a terminal F-value of 0.63 for 1980 was obtained. Terminal F-values for years prior to 1980 were taken from SCR Doc. 80/VI/113.

Partial recruitment. The catch curve mentioned above indicated that partial recruitment of age-groups 3 and 4 could be about 0.01 and 0.17 respectively. However, these values may be too low due to the great effect of the 1973 year-class on the catch curve. The corresponding estimates used in the assessment at the June 1980 Meeting were 0.02 and 0.47. In the present assessment, values of 0.02 and 0.33 were used as partial recruitment for age-groups 3 and 4, and the older age-groups were considered to be fully recruited.

Year-class estimates. Recruitment at age 3 for the years 1979 and 1980 are based on biological and environmental observations and on information about discarding of small fish. It seems clear that the 1977 year-class is the strongest since that of 1973. The two neighboring year-classes (1976 and 1978) seem to be poor, although the 1976 year-class appears to be of local importance to the Godthaab region (Div. 1D). The 1979 and 1980 year-classes are tentatively estimated with some optimism due to rather favorable water temperatures in these years.

In terms of absolute recruitment values, the 1977 year-class is considered to approach the strength of the 1973 year-class. The analyses indicate that the 1973 year-class at age 3 comprised 225 million recruits, and consequently the 1977 year-class is given an input value of 200 million recruits. The other input values are 30 million recruits for the 1976 year-class, 20 million for the 1978 year-class, 90 million for the 1979 year-class, and tentatively 75 million for the 1980 year-class.

d) Results of assessment

In the virtual population analysis, it was necessary to make some adjustment to the partial recruitment estimates initially used as input values. To bring the strength of the 1977 year-class to 200 million fish at age 3, the partial F-value for this age-group in 1980 had to be adjusted to 0.024. Another uncertainity arose concerning the 1975 year-class. The initial run indicated this year-class to be as low as 32 million fish at age 3. From observations of this year-class in its pre-recruit years and its first two years in the fishery, a much higher value was expected. In fact, an estimate of 115 million fish was obtained at the June 1980 Meeting. However, in order for such a value to be obtained from the analysis of the 1980 age composition of catches, the F-value for age-group 5 in 1980 would have to be reduced to 0.10, which is less than the value used for age-group 4 (0.17). It therefore seems that the first estimate of the size of the 1975 year-class was too large, but the change in the estimate can be accounted for by assuming a high rate of discarding of this year-class in its first year of exploitation. In view of the uncertainity about the actual number of residuals of the 1975 year-class, the Committee considered it prudent not to set the estimated size of this year-class higher than 50 million recruits at age 3, and this value was finally used in the analyses.

The EEC has requested advice on catch and spawning stock size for the years 1982-84 under various fishing strategies. Considering the spawning stock to be all fish of age 6 and older and assuming that the 1981 catch will be about 50,000 tons, the forecasts of stock size (age 3+), spawning stock size (age 6+) and catch under various fishing strategies are as given in Table 2 and illustrated in Fig. 1.

Data available on the dependency of year-class strength upon environmental factors (water temperatures on Fylla Bank in June being the reference) and spawing biomass indicate that good year-classes usually occur in years when the reference temperature is 1.8°C or higher, but not in every such year. The material does not clearly demonstrate the dependency of year-class strength upon spawning biomass, because few years have had good temperatures and medium spawning biomass. However, no really strong year-classes have occurred over the years when spawning biomass has been at its current low level (below 150,000 tons). Since the dependency of recruitment upon spawning stock size cannot be ignored, the Committee advises that rebuilding of the spawning stock to a much higher level than at present should form the basis for management. The recuitment of the 1977 year-class appears to offer such a possibility.

e) Mesh size assessment

The Committee noted the EEC request for an assessment of increasing the mesh size from the present minimum (120 mm) to 130, 140 and 160 mm as alternatives. No new analysis was presented at this meeting, but the Committee refers to the conclusion reached at the June 1980 Meeting (based on the analyses in SCR Doc. 80/VI/76) that an increase in mesh size to 140-160 mm would lead to a moderate (2-9%) increase in yield per recruit and to a substantially larger increase (9-40%) in spawning biomass per recruit. The actual gain in yield and spawning biomass per recruit will vary somewhat from year to year due to the variation in growth rate and emigration rate of year-classes, but there is clearly a gain to be achieved for cod, especially insofar as the spawning stock is concerned.

Table 2. Subarea 1 cod: projections (000 tons) of stock biomass (age 3+), spawning stock (age 6+) and catch under various fishing stategies in 1982-85, assuming that the catch in 1981 will be 50,000 tons.

| Year | Parameter | Options[1] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| 1980 | Stock biomass | 332 | | | | | |
| | Spawning stock | 92 | | | | | |
| | F | 0.63 | | | | | |
| | Catch | 53 | Reference parameters used for | | | | |
| 1981 | Stock biomass | 325 | 1982-85 projections | | | | |
| | Spawning stock | 81 | | | | | |
| | F | 0.39 | | | | | |
| | Catch | 50 | | | | | |
| 1982 | Stock biomass | 401 | 401 | 401 | 401 | 401 | 401 |
| | Spawning stock | 80 | 80 | 80 | 80 | 80 | 80 |
| | F | 0.10 | 0.20 | 0.25 | 0.48 | 0.60 | 0.197 |
| | Catch | 27 | 51 | 62 | 107 | 128 | 50 |
| 1983 | Stock biomass | 491 | 461 | 446 | 389 | 364 | 461 |
| | Spawning stock | 313 | 283 | 270 | 214 | 190 | 284 |
| | F | 0.10 | 0.20 | 0.25 | 0.48 | 0.60 | 0.185 |
| | Catch | 31 | 54 | 63 | 91 | 98 | 50 |
| 1984 | Stock size | 531 | 470 | 443 | 347 | 311 | 475 |
| | Spawning stock | 331 | 271 | 247 | 159 | 126 | 277 |
| | F | 0.10 | 0.20 | 0.25 | 0.48 | 0.60 | 0.149 |
| | Catch | 39 | 65 | 74 | 96 | 100 | 50 |
| 1985 | Spawning stock | 429 | 334 | 296 | 174 | 134 | 356 |

[1] Option 1 with F = 0.10 in 1982-84; Option 2 with F = 0.20; Option 3 with $F_{0.1}$ = 0.25; Option 4 with $F_{max}$ = 0.48; Option 5 with F = 0.60; Option 6 with catch of 50,000 tons in all years.

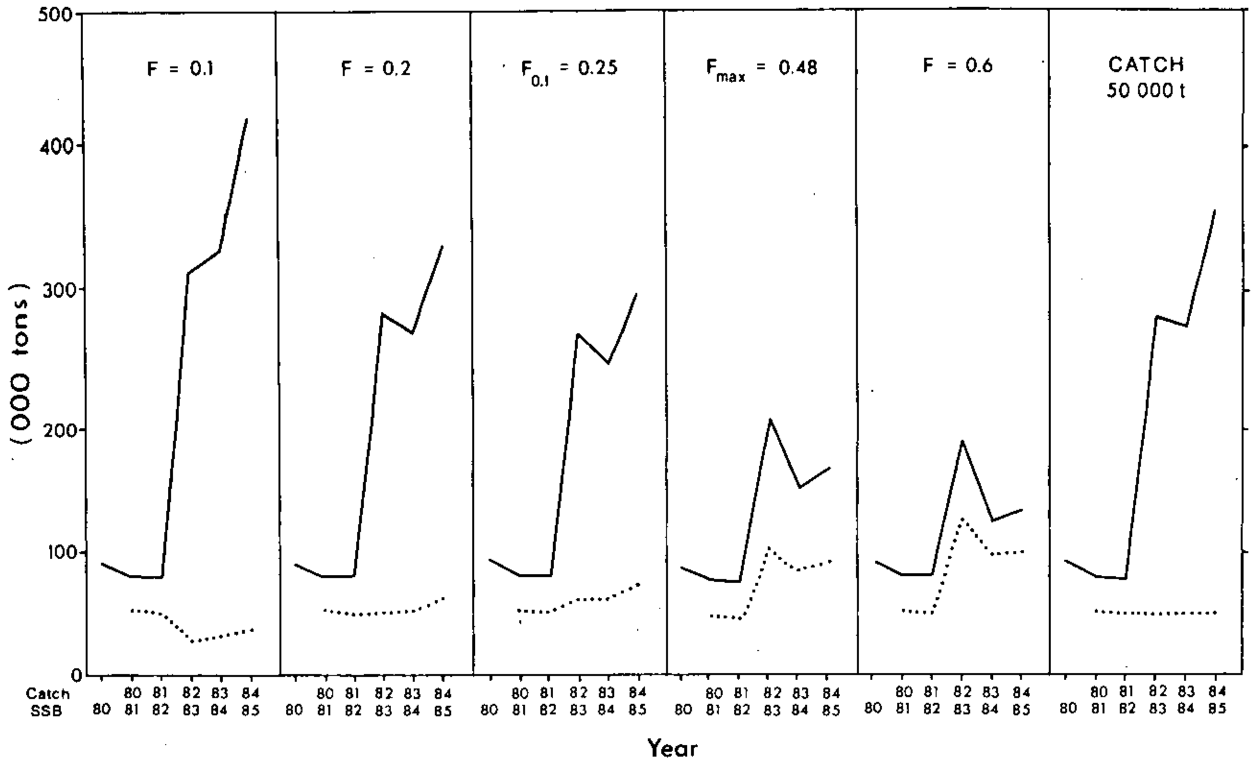



Fig. 1. Subarea 1 cod: projected catches (lower curve) and spawning stock biomass (upper curve) by various fishing strategies and assuming the nominal catch in 1981 to be 50,000 tons. Catches relate to the upper row of years indicated at the bottom of the illustration and spawning stock biomasses relate to the beginning of the years in the bottom row. The plotted data correspond to that given in Table 2.

2. Cod in Divisions 2J, 3K and 3L (SCR Doc. 81/VI/18, 65, 66, 67)

a) Fishery trends

Nominal catches during 1965-69 averaged about 650,000 tons annually but declined to an average of 200,000 tons in 1975-79. Provisional data indicate a catch of 172,000 tons in 1980. The decline in catches coincided with a decline in catch rates, implying a decrease in stock biomass. Catch restrictions were introduced in 1973 on the basis of fishing at the $F_{max}$ level, but the management strategy since 1977 has been to limit catches to a level associated with fishing at the $F_{0.1}$ or lower level. Recent TACs and nominal catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | 666 | 657 | 554 | 300 | 160 | 135 | 180 | 180 | 200 |
| Catch (000 tons) | 355 | 373 | 288 | 214 | 173 | 139 | 167 | 172[1] | |

[1] Provisional data.

b) General production analyses

Catch rates for 1959-80, standardized with respect to gear type by country, division and month, were used with the catches to fit a non-equilibrium surplus production model (SCR Doc. 81/VI/65). Although some information on catch rate was available for early 1981, this point was omitted because of its preliminary nature and extreme value. The equilibrium sustainable yield at the effort level corresponding to 2/3 MSY was estimated at close to 500,000 tons. Catch rates predicted by the model for 1981 and 1982 implies yields at 2/3 MSY effort of about 310,000 and 360,000 tons respectively.

An independently derived series of standardized catch rates showed fairly stable catch rates during 1958-68 over a wide range of effort, followed by a sharp decline from 1968 to 1972 (SCR Doc. 80/VI/67). Recovery did not occur until after 1977, even though effort during 1972-77 was very much reduced. During 1977-80, catch rates increased to the level of the 1960's. Trends in catch rates used in the surplus production model were similar, but the increase during 1977-80 was not

c) Assessment parameters

Biological sampling of commercial catches (or landings) of various countries was used to estimate the age composition of removals in 1980. Cod of age-groups 5-7 predominated. Data from research vessel surveys in 1980 by Canada, Federal Republic of Germany, France and USSR confirmed that these year-classes indeed were most prevalent, and also showed that the 1976 year-class (age-group 4 in 1980) was quite weak.

The partial recruitment pattern was derived from the average percentage distribution of fishing mortality at age in the 1972-78 period. These values and the average weight-at-age values derived from 1978 sampling are as follows:

| Age (years) | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|
| Partial recruitment | 0.27 | 0.57 | 0.77 | 0.92 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Average weight (kg) | 0.77 | 1.16 | 1.72 | 2.39 | 3.58 | 5.03 | 5.59 | 6.73 | 7.89 | 8.73 |

Regression of mean stock biomass of age 4 and older cod on standardized commercial catch rates for 1962-78 (those used in the surplus production model analysis as described above) was used to predict stock biomass from the catch rates for 1979 and 1980. The best agreement between these predicted biomass values and those estimated in the cohort analysis was achieved at a terminal F of 0.17 in 1980.

All research vessel survey data indicated that the abundance of the 1976 and 1977 year-classes was quite low, and arbitrary values of 125 million and 200 million fish respectively were taken as being appropriate for the size of these year-classes when recruiting to the fishery at age 4. For the projections, an average value of 500 million recruits at age 4 was used as the size of each subsequent year-class.

d) Projections of catch and spawning stock biomass

With terminal F = 0.17 in 1980, with partial recruitment and sizes of recruiting year-classes as indicated above, and with an assumed catch of 200,000 tons in 1981, projections (000 tons) of spawning stock biomass (age 7 and older) and catch were made for 1981-83 at three levels of fishing mortality (F):

| Year | F = 0.10 | | F = 0.16 | | F = 0.20 | |
|---|---|---|---|---|---|---|
| | Catch | Spawning biomass | Catch | Spawning biomass | Catch | Spawning biomass |
| 1981 | 200 | 1000 | 200 | 1000 | 200 | 1000 |
| 1982 | 141 | 1300 | 220 | 1300 | 270 | 1300 |
| 1983 | 174 | 1500 | 259 | 1400 | 308 | 1300 |

The Committee points out that the year-classes for which assumed recruitment values were used (i.e. 1976, 1977 and 1978 year-classes) make up 20% of the projected catches in 1982 and 35% in 1983.

3. Cod in Division 3M (SCR Doc. 81/VI/67, 76, 77)

a) Fishery trends

Nominal catches from this stock were as high as 60,000 tons in 1965 and 58,000 tons in 1972, declined to an average level of 24,000 tons during 1973-77, and increased to about 30,000 tons in 1978 and 1979. Provisional data for 1980 indicate a catch of about 11,000 tons. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 40 | 40 | 40 | 25 | 40 | 40 | 13 | 8.5 |
| Catch (000 tons) | 23 | 25 | 22 | 22 | 27 | 33 | 29 | 11[1] | |

[1] Provisional data.

b) Feeding studies

Observations on the food and feeding of cod on Flemish Cap during 1970-80 (SCR Doc. 81/VI/76) indicated that the major food items were Calanoidae, Sagitta, Ctenophora, Themisto, Myctophidae, Shrimps and young redfish. The average annual intensity of feeding is not high, and consumption is of a pronounced seasonal pattern.

c) Spawning biomass

The Committee considered that the mean biomass of age 6 and older cod (age 6+) was a reasonable approximation of spawning biomass, estimates for 1972-80 being as follows:

| | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|---|
| Age 6+ biomass (000 tons) | 17 | 9 | 13 | 7 | 9 | 7 | 5 | 15 | 10 |

The Committee noted that a relationship between water temperature on the standard hydrological section 4A and cod year-class strength has been refined (SCR Doc. 81/VI/77) and may be useful in predicting recruitment. No spawning stock-recruitment relationship has been shown for this stock, and, in view of the small absolute size of the spawning stock, the Committee

recommends

*that the Flemish Cap Working Group examine the data base to determine if a stock-recruitment relationship can be defined for the cod stock in this area.*

d) Assessment

This stock was assessed at the February 1981 Meeting of the Committee (see Part A, this volume), and no new data were available to modify the analysis done at that time or the conclusion that "the low level of catch projected for 1981 at the $F_{0.1}$ level is a clear indication that the stock is severely depleted".

Catch rates for the cod stocks in Div. 2J+3KL, 3NO and 3M apparently decreased sharply in 1968 or 1969 and remained at a low level up to 1978 despite significant reductions in fishing effort for the first two stocks (SCR Doc. 81/VI/67). It was hypothesized that catch rates might in fact remain at a low level if environmental conditions in recent years have been and continue to remain unfavorable for good recruitment. An alternative explanation related to changes in fishing strategy toward catching younger and smaller cod with the attendant enhanced probability for discarding of small fish. Furthermore, it was noted that increased efficiency by the fleets would tend to have the effect of underestimating the effective fishing effort. Because insufficient new data were available for a reassessment of the stock, and noting that 1981 data from research and commercial sources will be available early in 1982, STACFIS advises that the assessment of this stock should be deferred to a mid-term meeting in early 1982.

4. Cod in Divisions 3N and 3O

a) Fishery trends

Nominal catches declined from a high of 227,000 tons in 1967 to 15,000 tons in 1978 and increased to about 28,000 tons in 1979. Provisional data for 1980 indicates a catch of 19,000 tons. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | 103 | 101 | 88 | 43 | 30 | 15 | 25 | 26 | 26 |
| Catch (000 tons) | 80 | 73 | 44 | 24 | 18 | 15 | 28 | 19[1] | |

[1] Provisional data.

b) Assessment

The status of this stock was considered at the February 1981 Meeting of the Committee (see Part A, this volume). In that report, it was noted that the stock is composed mainly of young and would provide a gain in yield-per-recruit and a return to a more broadly-based age structure in the stock. The Committee advised that a cautious approach to the exploitation of this stock should be maintained. The advice was considered at the Special Meeting of the Fisheries Commission in early April 1981 (FC Doc. 81/IV/4), when it was agreed that the TAC for 1981 be maintained at the 1980 level of 26,000 tons until the biomass reaches one-half of the level of biomass associated with the long-term sustainable yield at $F_{max}$.

In the absence of new data on changes in biomass, no additional advice on the status of this stock could be provided at this time, and the Committee advises that further assessment of this stock should be deferred to a mid-term meeting in early 1982 when new information from the commercial fishery and from research surveys in 1981 will be available.

5. Redfish in Subarea 1 (SCS Doc. 81/VI/10)

a) Fishery trends

Nominal catches have fluctuated widely since 1950, increasing from 150 tons in 1951 to a maximum of 61,000 tons in 1962 and generally decreasing thereafter to a low level of about 3,000 tons in 1971-74. Catches increased again to 31,000 tons in 1977. There is some indication that the official catch figures for 1977, 1978 and 1979 may have been overestimated *NAFO Sci. Coun. Rep.* 1979-80, page 78). Recent catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|
| Catch (000 tons) | 3 | 3 | 9 | 14 | 31 | 8 | 9 | 7[1] |

[1] Provisional data.

b) Assessment

Two species of redfish occur in Subarea 1, *Sebastes mentella* and *S. marinus*. These species live in different depths with little overlapping. The fishery has been directed toward *S. marinus*, and the assessment based on catch and effort data therefore refers to this species.

This stock was assessed at the April 1979 Meeting (*ICNAF Redbook* 1979, page 74). A further assessment has not yet been possible due to the lack of sufficiently good fishing effort data for recent years. The previous assessment, based on a general production model analysis, indicated a MSY level of about 10,000 tons and an equilibrium catch at 2/3 $F_{MSY}$ of about 9,000 tons. However, the correlation coefficient for the regression of catch-per-unit-effort on fishing effort ($r = 0.63$) indicated that catch levels derived from the model have fairly large variances.

c) General remarks

Observations in 1980 confirmed that the large quantities of small redfish taken as by-catch in the shrimp fishery belong to the species *S. mentella*. In the Report of the ICES Working Group on Redfish and Greenland halibut in Region 1 (ICES C.M. 1981/G:7), on the basis of young redfish surveys and analysis of 0-group redfish, it is noted that *S. marinus* dominates in the southern part of the East Greenland shelf and that this might indicate the same origin for the species at West Greenland and East Greenland. The same origin for *S. mentella* is less likely.

6. Redfish in Division 3M (SCR Doc. 81/VI/53)

a) Fishery trends

Nominal catches increased from a low of 700 tons in 1967 to a maximum of 42,000 tons in 1972. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 40 | 16 | 16 | 16 | 16 | 20 | 20 | 20 |
| Catch (000 tons) | 22 | 35 | 16 | 17 | 20 | 17 | 20 | 16[1] | |

[1] Provisional data.

b) Abundance

adian research surveys indicate that age-groups 8-11 (22-27 cm in length) were the most important age-groups in the catches. Additionally, there is evidence of a strong 1979 year-class, even though the research trawl is not considered to be efficient for catching redfish of so young an age.

c) Assessment

The Committee noted that the general production model used in previous years may not represent the best estimate of the status of this stock due to the lack of data on catch rates for some years prior to 1968. Commercial catch rates in recent years have remained relatively stable, and Canadian research abundance indices for 1978-81 were generally stable except for 1979. Relatively good year-classes are evident in both the Canadian and USSR survey data. Older redfish are well represented in the age frequencies, which indicate that the stock has not been overexploited at the present level of catch, and STACFIS accordingly advises that the TAC for 1982 should remain at 20,000 tons.

7. Redfish in Divisions 3L and 3N (SCR Doc. 81/VI/59; SCS Doc. 81/VI/13)

a) Fishery trends

Nominal catches declined from a high of 45,000 tons in 1959 to 14,000 tons in 1970 and then increased to 30,000 tons in 1972. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 28 | 20 | 20 | 16 | 16 | 18 | 25 | 25 |
| Catch (000 tons) | 33 | 22 | 18 | 21 | 16 | 12 | 14 | 16[1] | |

[1] Provisional data.

b) Abundance

Length frequencies from Canadian commercial sampling in 1980 indicate that the bulk of the catch in Div. 3L consisted of 35-45 cm fish in the early part of the year and 22-35 cm fish in the second half. In Div. 3N, the fleet has traditionally exploited the smaller redfish because of difficulty due to rough bottom in fishing at depths greater than 350 m where the larger redfish are found, and both Canadian and USSR sampling indicated a concentration of effort on 22-28 cm redfish. Canadian research trawling to 665 m indicates that larger redfish are present in Div. 3N at depths greater than those usually fished by commercial vessels. Catches in USSR research trawling to a depth of 400 m reflect size-classes similar to those in the commercial fishery. From the data available, it is difficult to estimate the absolute abundance of the smaller size groups most evident in Div. 3N, but USSR survey data indicate greater abundance in the late 1970's than in the early 1970's.

c) Assessment

The Committee reviewed the catch rate data used in the general production model analysis which included data up to 1979. The catch rates pertain to Div. 3L and 3N combined, although the trawl regulations require that the fishery be prosecuted with codends of minimum 130-mm mesh in Div. 3L but not in Div. 3N. Also, the proportion of the catch taken in each division is highly variable from year to year and the fishery is on different components of the stock as indicated by the length frequencies. For example, 80% of the overall catch was taken in Div. 3N in 1975 whereas 80% was taken in Div. 3L in 1976 and 1977, thus making analysis of the data by division difficult. However, catch rates have declined during 1960-79.

The general production model analysis, reviewed at this meeting, used standardized catch-per-unit effort values derived from multiplicative models and thus is somewhat different from that presented at the June 1980 Meeting. For the current model, the yield at 2/3 $F_{MSY}$ from unlagged data is 33,600 tons and from lagged data (6-year running average) is 22,800 tons. These yields are similar to those obtained in previous assessments using different effort standards. The appropriateness of using a general production model is suspect, because the catch-per-unit-effort and effort were poorly correlated, r being -0.56 and -0.60 for unlagged and lagged data respectively.

Fishing effort during the early 1970's on redfish in Div. 3L and 3N was considered to be above the level corresponding to $F_{MSY}$ and the TAC was reduced in 1977 to compensate for overfishing in the preceding years. However, any subsequent recovery of the stock would be slow due to the slow growth and long life-span of redfish. The TACs were not fully utilized in 1978-80, possibly reflecting low catch rates or allocation problems with certain segments of the fishing fleet. Market conditions in some countries during 1980 were such that their allocations were not taken

Considering the apparent abundance of young redfish in Div. 3N and the wide range of the length frequencies which might be interpreted as indicating that exploitation of the stock is with acceptable levels, but also noting the inadequency of the available data, the Committee advises that the TAC for 1982 should remain at 25,000 tons.

8. Silver hake in Divisions 4V, 4W and 4X (SCR Doc. 81/VI/49, 63, 74)

a) Fishery trends

The fishery on this stock commenced in 1958, and, with the appearance of USSR vessels in 1962, it became one of the largest single fisheries on the Scotian Shelf. Peak catches occurred in 1963 (123,000 tons), 1970 (169,000 tons) and in 1973 (299,000 tons). Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 100 | 120 | 100 | 70 | 80 | 70 | 90 | 80 |
| Catch (000 tons) | 299 | 96 | 116 | 97 | 37 | 48 | 56 | 44[1] | |

[1] Provisional data.

b) Abundance

The observed monthly distribution of USSR catches of silver hake and several groundfish species were reviewed (SCR Doc. 81/VI/49, 63). As the season progressed, the catch rates for silver hake decreased in areas south of the Small Mesh Gear Line, with an indication of increasing catch rates in areas to the north of this line in 1979. The observed catch rate in 1980 has decreased to the 1978 level.

c) Assessment parameters

Catch composition. The age compositions of catches in 1961-79 were the same as those used in the previous assessment (SCR Doc. 80/VI/87) except that removals in 1979 were adjusted to reflect the final reported nominal catch in that year. The 1980 age composition used in the current assessment was estimated from length and age data collected by Canadian observers on board of vessels involved in the silver hake fishery. Some discrepancies were noted between age composition data presented by USSR and those used in the assessment.

Natural mortality. No new estimates of natural mortality were available, and it was agreed that $M = 0.40$ be used in this assessment in order to maintain consistency with assessments since 1977.

Weight-at-age. Average weight-at-age data for 1980 were calculated from length-weight data collected on Canadian research vessel surveys. Weight-at-age values used for the projections and for the yield-per-recruit calculations are averages of 1977-80 values (below). The yield-per-recruit analysis indicated $F_{0.1} = 0.447$ with a yield of 0.062 kg per recruit.

| Age (years) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean weight (g) | 53 | 138 | 199 | 260 | 322 | 389 | 495 | 674 | 829 | 825 |

Partial recruitment. Starting F-values for ages 2 to 6 were weighted to population numbers, regressed against effort and adjusted to give the best fit. Partial recruitment values were obtained by averaging F-values over the years 1977 to 1979. The resultant values used in the present assessment are different from those used in the previous assessment (SCR Doc. 80/VI/87).

| Age (years) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| P. recruitment (previous) | 0.035 | 0.50 | 1.00 | 0.70 | 0.60 | 0.60 | 0.50 | 0.50 | 0.45 | 0.40 |
| " (present) | 0.04 | 0.44 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Recruitment. Reliable recruitment estimates have been difficult to derive for this stock. Research vessel data indicate that recent recruitment has been poor. However, the reliability of the research vessel data is questionable, and a more extensive analysis is required. For this assessment, the recruitment estimate was taken as the average of the sizes of the 1974-79 year-classes at age 1, which is 1.4 billion recruits. This is higher than the value of 1.0 billion fish used in the previous assessment.

d) Catch projections

The Committee considered three options that had been generated in respect of the 1982 catch at $F_{0.1}$: the first option predicted a 1982 catch of 68,400 tons, assuming that the $F_{0.1}$ catch is 73,000 tons in 1981; the second predicted a 1982 catch of 66,000 tons, assuming that the 1981 TAC of 80,000 tons will be taken; and the third predicted a 1982 catch of 70,000 tons, assuming that the catch in 1981 will be equal to the average catch/TAC ratio for 1974-79 (0.82). A fourth option, which assumed that the 1981 catch will be equal to the average for the 1977-80 period, predicted 1982 catch of 75,000 tons. The Committee considered this to be the most realistic option, and therefore advises a 1982 TAC of 75,000 tons.

9. American plaice in Division 3M

This stock has been regulated since 1974 with nominal catches during 1973-80 in the range of 1,000-2,000 tons. The TAC has been 2,000 tons for each gear except in 1978 when it was increased to 4,000 tons on the basis of relatively high catch rates in USSR research vessel surveys in 1977. However the TAC was reduced to 2,000 tons for 1979 to 1981. There is no new information on this stock, the catches from which are mainly by-catches in the cod and possibly the redfish fisheries. Hence, STACFIS advises that the TAC should remain at 2,000 tons for 1982.

10. American plaice in Divisions 3L, 3N and 3O (SCR Doc. 81/VI/55, 61; SCS Doc. 81/VI/13)

a) Fishery trends

Nominal catches up to 94,000 tons annually have been reported from this stock. However, the catch has not exceeded 53,000 tons since 1973, as indicated below:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | 60 | 60 | 60 | 47 | 47 | 47 | 47 | 47 | 55 |
| Catch (000 tons) | 53 | 46 | 43 | 52 | 44 | 50 | 49 | 49[1] | |

[1] Provisional data.

b) Abundance

Canadian research vessel surveys indicate relatively stable conditions since 1977, especially with regard to the recruiting year-classes (ages 5 and 6). USSR survey data (SCS Doc. 81/VI/13) indicate a somewhat similar trend, based on the overall numbers caught per set in Div. 3LNO, with an increase in abundance in Div. 3L being offset by a decline in Div. 3N. However, catch rates of Canadian otter trawlers have continued to increase from 0.41 tons per hour fished in 1977 to 0.50 tons per hour in 1979 and to 0.58 tons per hour in 1980.

c) Assessment parameters

Catch composition. Age compositions and mean weight-at-age data were derived from Canadian commercial sampling during 1980. Information from Div. 3L and 3N only was used in the assessment.

Partial recruitment. Values for 1980 and for projections to 1982 were derived from average F-values for 1977-79 from a preliminary virtual population analysis (VPA), as follows:

| Age (years) | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Partial recruitment | 0.04 | 0.15 | 0.30 | 0.40 | 0.60 | 0.75 | 0.80 | 1.00 | 1.00 | 1.00 | 1.00 |

Fishing mortality. A fishing mortality of 0.3 for fully-recruited age-groups (ages 13 and older) in 1980 was used to initiate the virtual population analysis. This value was the most reasonable estimate for 1980 as indicated by the regressions of biomass (ages 8-19) from VPA on catch-per-unit-effort, weighted F (ages 8-18) on directed fishing effort, and population numbers (ages 8-19) from VPA on abundance (numbers from research vessel surveys).

Recruitment. The number of 6-year-old American plaice assumed to be recruited to the fishery in

Div. 3LN in 1981 and 1982 was taken as the geometric mean of the numbers of age-6 fish in the population matrix for 1976-79 (268 million).

Estimation of $F_{0.1}$. The $F_{0.1}$ value of 0.264 was calculated from a Thompson-Bell yield-per-recruit analysis, using a partial recruitment vector derived from averaging fishing mortality at age for 1965-79 and average weights at age for the same period. Natural mortality was assumed to be 0.20.

d) Assessment results

Projection for Div. 3LN from the 1980 population structure with F = 0.30 for fully-recruited age-groups indicated that the removal of the 1981 TAC (48,000 tons in Div. 3LN) would result in a fishing mortality of 0.286, which is slightly higher than $F_{0.1}$ (0.264). Projection to 1982 with recruitment of 268 million fish at age 6 implies a catch of 48,000 tons at $F_{0.1}$. For Div. 30, catches have averaged about 6,000 tons during 1974-80. STACFIS therefore advises a continuation of the TAC of 55,000 tons for Div. 3LNO in 1982.

e) Discards

The discarding of small American plaice, based on observations on board of Canadian trawlers in 1980, continues to be significant (SCR Doc. 81/VI/55), with discard rates of 8.1% by weight and 20.2% by number. Although these rates are slightly less than in 1978 and 1979, they still indicate that substantial quantities of undersized fish are being discarded, possibly as much as 3,600 tons (15.3 million fish). These discards were not taken into account in estimating the removals at age for use in the assessment.

11. Witch flounder in Divisions 3N and 30

a) Fishery trends

Nominal catches increased from 4,700 tons in 1969 to a high of 15,000 tons in 1971 and declined to a level of about 3,000 tons in 1978-80. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 10 | 10 | 10 | 10 | 10 | 7 | 7 | 5 |
| Catch (000 tons) | 7 | 8 | 6 | 6 | 6 | 3 | 3 | 3[1] | |

[1] Provisional data.

b) Assessment

Previous assessments have indicated that the commercial stock of witch flounder in this area is located in deep water along the southwest slope of Grand Bank. A general production model analysis presented at the June 1980 Meeting indicated an equilibrium catch at 2/3 $F_{MSY}$ of 4,000-5,000 tons. Also, age composition data presented at that meeting indicated that the average fishing mortality was near $F_{0.1}$ when catches were in the range of 5,000-6,000 tons, thus resulting in the advice that the TAC for 1981 should not exceed 5,000 tons. No new data were available at this meeting, but, in view of the apparent stability of recent catch levels, STACFIS advises that the TAC of 5,000 tons should remain in effect for 1982.

12. Yellowtail flounder in Divisions 3L, 3N and 30 (SCR Doc. 81/VI/54)

a) Fishery trends

The nominal catch peaked at 39,000 tons in 1972, declined to 8,000 tons in 1976 and increased to 19,000 tons in 1979. The decline to 12,000 tons in 1980 was due to labor problems in the offshore component of the fishing industry. Recent catches and TACs are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | 50 | 40 | 35 | 9 | 12 | 15 | 18 | 18 | 21 |
| Catch (000 tons) | 33 | 24 | 23 | 8 | 12 | 16 | 19 | 12[1] | |

[1] Provisional data.

b) Abundance

The catch rates of Canada (Nfld) otter trawlers have increased markedly since 1976 and is now at the high level observed in the early 1970's. Canadian research vessel survey data for 1980 showed a slight increase in abundance over 1979.

c) Assessment parameters

Catch composition. Length and age compositions and mean weight-at-age data were derived from Canadian commercial sampling in 1980. Quarterly age-length keys and monthly catches were used to estimate the numbers caught by age-group.

Partial recruitment. These values, calculated from average F-values of the VPA using the catch matrix for 1976-79, are as follows:

| Age (years) | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|
| Partial recruitment | 0.15 | 0.53 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Terminal F. This value for 1980 was estimated from the regression of population numbers (age 7 and older) from VPA on abundance of the age 7+ (numbers) in research vessel surveys for the 1971-79 period, and resulted in F = 0.30.

Recruitment. The geometric mean of population numbers at age 5 from the VPA for 1968-79, with terminal F = 0.30, was used as the estimate of recruitment (81.8 million fish) at age 5 for the projections to 1982.

d) Assessment results

The average fishing mortality on fully-recruited age-groups in 1980 was estimated to be 0.30, which is lower than in the preceding years. If the TAC of 21,000 tons is fully utilized in 1981, it will generate an F of 0.47 which is also lower than $F_{0.1}$ (0.518). However, it must be pointed out that 57% of the projected catch for 1982 will be generated by the recruitment of age 5 fish in 1980 and 1981. On the assumption that the 1981 TAC will be taken and that recruitment at age 5 in 1980 and 1981 will be as indicated above, STACFIS advises that a TAC of 23,000 tons in 1982 corresponds to fishing at the $F_{0.1}$ level.

13. Greenland halibut in Subareas 0 and 1

a) Fishery trends

Nominal catches peaked at 25,000 tons in 1975 and have been less than 20,000 tons since then. Provisional data for 1980 indicate a catch of 8,200 tons, of which 1,700 tons were taken in Subarea 0 and the remainder in Subarea 1, mainly in Div. 1A. There is some indication that the reported catches for 1977-79 may have been overestimated (SCR Doc. 80/VI/72). Recent TACs and catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | - | - | 20 | 20 | 20 | 25 | 25 | 25 |
| Catch (000 tons) | 10 | 14 | 25 | 16 | 13 | 12 | 19 | 8[1] | |

[1] Provisional data

b) Assessment

No new information was available for this stock, the status of which has not been assessed since 1978, when a virtual population analysis indicated a possible annual yield of 35,000 tons. However, due to some uncertainty about the data, a lower (precautionary) TAC of 25,000 tons was advised for 1979 and maintained for 1980 and 1981. Lacking sufficient data for an up-to-date assessment, STACFIS again advises that the TAC of 25,000 tons should be maintained for 1982.

14. Greenland halibut in Subarea 2 and Divisions 3K and 3L (SCR Doc. 81/VI/64)

a) Fishery trends

Nominal catches ranged from 25,000-30,000 tons during 1971-76, increased to 39,000 tons in 1978 and declined to about 32,000 tons in 1980. Despite the decline in overall catch after 1978, catches in the Canada (Nfld) inshore gillnet fishery, particularly in Div. 3KL, increased steadily from 7,000 tons in 1976 to 27,000 tons in 1980. Reduced total catches since 1978 were the result of reduced allocations to the offshore otter-trawl fleets. Recent TACs and catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 40 | 40 | 30 | 30 | 30 | 30 | 35 | 55 |
| Catch (000 tons) | 29 | 27 | 29 | 25 | 32 | 39 | 34 | 32[1] | |

[1] Provisional data

b) Biomass surveys

Stratified-random trawl surveys in Div. 2J since 1977 and in Div. 3K and 3L since 1978 have indicated that the minimum trawlable biomass in these divisions appears to be in excess of 200,000 tons. Although no new data are available for Div. 2G and 2H, the results of a survey by German Democratic Republic in late 1978 indicated a minimum trawlable biomass in excess of 100,000 tons for these two divisions. It was noted that there has been essentially no fishery in these divisions during the past two years and that this estimate may therefore be low.

c) Assessment parameters

Catch composition. Catch-at-age data for 1975-80 were used to determine levels of fishing mortality and stock size over that period. Mean weight-at-age data were derived by applying a new length-weight relationship from 1980 survey data to the weighted length-at-age data from the commercial catches in 1975-80. These weights-at-age were used to compute population biomass and catch biomass for the projections.

Terminal F. An estimate of terminal fishing mortality for 1980 was difficult to determine, because reliable catch-per-unit effort data were not available for this fishery. However, an estimate of F for fully recruited year-classes ($F_T$ = 0.20) was derived by calculating the mortality of age 6+ fish between the November 1979 and November 1980 surveys.

Partial recruitment. These values were obtained by taking the average fishing mortality at age for 1976-78, when the pattern appeared to be stable. The partial recruitment curve was clearly dome-shaped, with age 10 being the only fully-recruited age-group.

| Age (years) | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean weight (g) | 609 | 760 | 955 | 1192 | 1580 | 2209 | 2699 | 3371 | 3884 | 4563 | 5918 | 7144 |
| Part. recruit. | 0.021 | 0.108 | 0.329 | 0.690 | 0.876 | 1.000 | 0.912 | 0.699 | 0.696 | 0.389 | 0.275 | 0.144 |

Recruitment. For use in the projections, recruitment at age 5 was taken as the geometric mean of recruitment in 1975-79 (144 million fish), as the time series of survey data is too short to provide any realistic estimate. A Thompson-Bell yield-per-recruit curve was calculated, using average weights at age for 1975-79 and partial recruitment factors at age for 1976-78, as above. $F_{0.1}$ was consequently estimated to be 0.343.

d) Assessment results

Under assumptions that $F_T$ = 0.20 in 1980 and that the TAC of 55,000 tons will be fully utilized in 1971, projection for 1982 indicates a yield of 71,000 tons at $F_{0.1}$ = 0.343. However, it was shown that an error in $F_T$ of ±0.05 would change the advice for 1982 by projecting yields of 54,000 and 96,000 tons. Due to this extreme senitivity in $F_T$, the Committee concluded that the method of calculating $F_T$ was not reliable, considering the large variance associated with abundance indices from research vessel surveys. With a significant shift in fishing pattern from offshore trawling to highly selective gillnet fishing in recent years, the Committee was also concerned that the average partial recruitment pattern may not accurately represent the present situation. Although the available data indicated that this stock is in a healthy condition, it was agreed that a recommendation to increase the TAC for 1982 based on this assessment was not advisable in view of the uncertainty about the two parameters. However, because the fishery has essentially been confined to Div. 2J+3KL and all commercial and research data pertain to these divisions, it was agreed that the assessment relates to Div. 2J+3KL. STACFIS therefore advises that the TAC for 1982 should remain at 55,000 tons, noting that this TAC should apply only to Div. 2J+3KL. Any increase in the TAC beyond 55,000 tons should be related to removals from Div. 2GH.

15. Roundnose grenadier in Subareas 0 and 1

a) Fishery trends

Nominal catches have fluctuated between 2,000 and 12,000 tons during 1971-79. The TAC has remained at 8,000 tons since 1977. Recent TACs and catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | - | 10 | 14 | 8 | 8 | 8 | 8 | 8 |
| Catch (000 tons) | 5 | 12 | 5 | 9 | 3 | 6 | 7 | 2[1] | |

[1] Provisional data.

b) Assessment

The assessments since 1976 have consistently indicated a TAC of 8,000 tons. It was noted that there was no directed fishery for roundnose grenadier in recent years and the TAC's were not fully utilized. Because of the lack of new data, STACFIS advises that the TAC for 1982 should remain at 8,000 tons.

16. Roundnose grenadier in Subareas 2 and 3 (SCR Doc. 81/VI/60)

a) Fishery trends

Except for a catch of 75,000 tons in 1971, nominal catches were in the range of 12,000-28,000 tons during 1967-78 but decreased to 8,000 tons in 1979 and to 2,000 tons in 1980. Recent catches and TACS are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 32 | 32 | 32 | 35 | 35 | 35 | 30 | 27 |
| Catch (000 tons) | 18 | 28 | 27 | 21 | 15 | 21 | 8 | 2[1] | |

[1] Provisional data

b) Assessment

The Committee reviewed an updated general production model analysis for the 1967-79 period and an analytical assessment based on data for 1972-78. Concern was expressed about the very low correlation coefficient ($r = 0.38$) from the regression of catch-per-unit-effort on effort, and the possible lack of a significant difference of the slope from zero, rendering the general production model inapplicable for the present data base. Regressions of biomass from cohort analysis on catch-per-unit-effort gave consistently negative slopes for all terminal F-values examined again indicating the problems associated with the catch-per-unit-effort data. Problems also exist in projecting the results of the cohort analysis ahead 4 years to 1982. It was agreed that the data on catch rates were very unreliable, a possible result of the historical practice of not specifiying the actual effort associated with the fishery directed toward roundnose grenadier. USSR scientists pointed out that the low catches in 1979 and 1980 were due to restrictions on bycatches of Greenland halibut and do not reflect a change in the status of the stock. It was noted that the average catch for the 1967-78 period was 26,000 tons. In view of the lack of adequate data on which to base an assessment, STACFIS advises that the TAC for 1982 should remain at 27,000 tons.

17. Wolffish in Subarea 1

a) Fishery trends

The nominal catches reported include two species: striped wolffish (*Anarhichas lupus*) and spotted wolffish (*A. minor*). Total catches since 1957 have been in the range of 3,000-6,000 tons. The reported catch for 1979 was 16,000 tons, but there is some indication that the officially-reported catches in 1977-79 may have been over-estimated. Recent TACs and catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | - | - | - | - | - | - | - | - |
| Catch (000 tons) | 5 | 6 | 6 | 6 | 6 | 6 | 16 | 5[1] | |

[1] Provisional data.

b) Breakdown by species

The fishery carried out by small Greenlandic vessels is mainly a directed longline fishery on spotted wolffish. Wolffish catches by trawlers are by-catches in fisheries directed for cod and redfish, and the striped wolffish dominates in number but in terms of weight the difference in the catches of the two species is much smaller. On the basis of two samples from Greenland trawlers and data presented by E. Smidt (*NAFO Sci. Coun. Studies* No. 1, pages 35-39), the first attempt to breakdown the Greenlandic catches (tons) into species resulted in the following:

| | Spotted wolffish | Striped wolffish | Total catch |
|---|---|---|---|
| Trawlers | 524 | 472 | 996 |
| Small vessels | 2,760 | 145 | 2,905 |
| Total | 3,284 | 617 | 3,901 |

c) General remarks

It is not possible to carry out a detailed assessment of wolffishes until more biological data become available. However, taking into account the available statistics, the description of the fishery presented by E. Smidt (*NAFO Sci. Coun. Studies* No. 1, pages 35-40), and the discussion at the June 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, pages 85-86), STACFIS agreed that a catch level of 5,000-6,000 tons seems to be reasonable.

18. Argentine in Divisions 4V, 4W and 4X (SCR Doc. 81/VI/71)

a) Fishery trends

The peak catch in recent years was 17,000 tons in 1974, after which nominal catches declined to a level of 2,000-3,000 tons. Recent TACs and catches are as follows:

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| TAC (000 tons) | - | 25 | 25 | 25 | 20 | 20 | 20 | 20 | 20 |
| Catch (000 tons) | 1 | 17 | 15 | 7 | 2 | 2 | 3 | 2[1] | |

[1] Provisional data.

b) Assessment

The fishery is carried out seaward of the Small Mesh Gear Line in an area removed from the major concentrations. Trends in abundance from Canadian surveys and Japanese catch-per-unit-effort data indicate that the stock is stable. STACFIS therefore sees no reason to change the existing TAC level of 20,000 tons, which is the estimated MSY level for argentine in Div. 4VWX.

19. Capelin in Subareas 2 and 3

The Committee noted the request of Canada to consider whether the analysis of capelin stocks carried out at the February 1981 Meeting (see Part A, this volume) are sufficient to provide advice on management of these stocks in 1982. Considering the critical importance of recruitment to the exploitable stocks and the current inability to adequately predict recruitment, STACFIS advises that it is more appropriate to consider the status of capelin stocks at a meeting early in 1982, when data from the 1981 fishery and research surveys will be available.

20. Shrimp in Subareas 0 and 1

The Committee noted the request of Canada and European Economic Community for advice on management of the shrimp stocks in 1982. However, considering the substantial contribution of shrimp recruitment to annual yields and the current inability to accurately predict recruitment, STACFIS advises that it is more appropriate to assess the shrimp stocks and advise on conservation measures for 1982 at a mid-term meeting in early 1982, when data from the 1981 fishery and research surveys will be available.

21. Squid-*Illex* in Subareas 3 and 4

a) Management regime

There being no significant new information on which a forecast of 1982 abundance might be based, STACFIS continues to support the management regime proposed at the February 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, pages 39-40), and therefore advises that the TAC for 1982 should be maintained at 150,000 tons, subject to adjustment on the basis of any significant new information forthcoming from the 1981 fishery. The Committee recognizes that this regime implies substantial loss of yield in years of high squid abundance and also notes that information available on predation by squid on fish species implies a potential loss of yield for other fisheries in years of high squid abundance. It was further noted that early season surveys on juvenile abundance and distribution may in future allow provision of short-term advice for mangement 3 to 4 months before the commencement of the fishery.

b) Commencement date for the fishery

The Committee noted that some evidence indicates early season cannibalism as a major source of mortality with a serious impact on yield-per-recruit, and advises that further examination of the biological basis for the 1 July commencement data is warranted. However, the information presently available is not considered sufficient to recommend a change in the commencement date for the 1982 fishery.

## III. COORDINATION OF SQUID RESEARCH (Annex 1)

1. Introduction

STACFIS noted that the *ad hoc* Working Group on Squid Research met at the Bedford Institute of Oceanography during 3-6 June 1981, with Mr T. W. Rowell as Convener, to review currently available information on squid biology and distribution and the preliminary results of the NAFO coordinated research surveys in early 1981, for the purpose of determining the spawning distribution and early life history, biology and distribution of *Illex illecebrosus* in the Northwest Atlantic (*NAFO Sci. Coun. Rep.*, 1979-80, pages 70 and 130). The full report of the Working Group, as approved by STACFIS, is given in Annex 1. A summary of the report follows.

2. Distribution and Biology

a) Preliminary results of 1981 coordinated surveys

Five research cruises were conducted between November 1980 and May 1981. Most of the effort was expended in the area between the southern slopes of the Scotian Shelf and Grand Bank and the Gulf Stream in Subareas 3 and 4. Areas along the edge of the Scotian Shelf were surveyed as were the off-shelf waters of Subareas 5 and 6 seaward to the Gulf Stream. Larvae and juvenile *Illex* were caught in Shelf, Slope, Gulf Stream and Sargasso Sea waters, but the largest numbers were found in Slope Water at 100 m. Temperatures in the areas of capture were generally above 10°C but ranged as high as 20°C. The larval samples require further treatment and identification before the larval distribution of *Illex illecebrosus* can be fully evaluated.

b) Trends in abundance and fishery characteristics

The nominal catch of *Illex* in Subareas 3 and 4 was about 70,000 tons in 1980, less than half of the TAC of 150,000 tons and only 45% of the peak catch of 153,000 tons in 1979. Commercial catches declined in all fisheries except the inshore fishery around St. Pierre. Unfavorable market conditions and reduced fishing effort were the contributing factors in the inshore Newfoundland fishery, whereas reduced quota allocations were partly responsible for the decline in offshore catches in Subareas 3 and 4 during 1980. Commercial catch rates in Subareas 3 and 4 and research survey catch rates in Subareas 3 to 6 mostly indicated greatly reduced abundance. The similarity of trends in abundance for the region from Newfoundland to Cape Hatteras suggest the existence of one stock in the entire area or that the cause of the changes in abundance has affected all stocks in a similar manner.

c) Patterns of distribution and migration (and environmental influences)

As noted in (a) above, the greatest concentrations of larval and juvenile stages of *Illex* were found at 100 m in the warm Slope Water near the northern border of the Gulf Stream. In Subarea 4, the distribution patterns of adults and late-stage juveniles, as well as the bottom-trawl catch rates from both commercial fisheries and research surveys, appeared to be related to water temperatures, the largest catches being made at temperatures from 6 to 12°C. In Subarea 3, the fishery around St. Pierre was delayed about one month in 1980, due to the delay in elevation of the temperature above 7°C. This delay and the observation of low inshore catches of squid along the south coast of Newfoundland in 1980, in contrast with 1979, may have been related to lower temperature conditions in 1980 than in 1979. On both the Scotian Shelf and Grand Bank, the time of occurrence and abundance of *Illex* appears related to the development of high bottom temperatures from the incursion of warm Slope Water. There is some evidence of a positive correlation between January mean sea surface temperatures south of Newfoundland and subsequent squid abundance in inshore Newfoundland waters. A similar relationship was suggested for the Scotian Shelf.

Tagging studies, including one in which a squid travelled 1,260 miles from Newfoundland to Maryland in 107 days, generally indicate a late season southwesterly movement.

d) Biological characteristics

Reported mean mantle lengths of adult *Illex* in Subareas 3 and 4 were generally lower in 1980 than in 1979, and growth parameters in 1980 were more similar to those for 1978 than 1979. Length distributions for 1980 in Subarea 3 were unimodal, whereas three modes were evident in research survey data in Subarea 4. Length frequency data in Subareas 5 and 6 for 1975-79 showed wide distributions in summer and autumn, indicating very protracted or possibly near year-round spawning. The significance of summer spawning in Subareas 5 and 6 was found to vary greatly from year to year, with length frequency data indicating that up to 86% of the *Illex* may result from summer spawning in some years. In general, sexual maturity of males in Subareas 3 and 4 was less advanced on a given date in 1980 than in 1979. New laboratory observations indicated the importance of temperature on the embryonic development of *Illex*. A study on the potential impact of *Illex* as a predator of the cod, capelin and herring stocks in Subareas 2 and 3, based on correlation analysis, failed to show a negative relationship between squid abundance and year-class strength of the prey species except for the capelin stock in Subarea 2 and Div. 3K. The implications of cannibalism were examined, with very high instantaneous mortality rates indicated. Cannibalism was identified as the major source of mortality, and it was suggested that yield-per-recruit would be increased by fishing *Illex* more heavily early in the period of residence on the continental shelf.

3. Coordination of Squid Research for 1982

Preliminary results of the 1981 research surveys were reviewed, but, due to time constraints and the need for further analysis of some data, it was not possible to fully evaluate the current program or to develop a program for 1982. STACFIS endorsed the conclusions and the requirements for future research, given in Annex 1, and

recommends

*that the Working Group on Squid Research should meet for two days during the September 1981 Meeting to carry out a more complete review of the results of the 1981 surveys and to develop a program for 1982.*

## IV. GEAR AND SELECTIVITY

1. Silver Hake Mesh Selection Studies

A joint USSR-Canada study, using 60-mm and 90-mm mesh codends, was conducted for silver hake on the Scotian Shelf by two USSR commercial trawlers during 18-28 July 1980. Only 31 paired comparative sets were made in an area slightly apart from the area of the main commercial operations, and hence the conditions of the Council's recommendation on this subject were not met. Discrepancies among Canadian and USSR observers on the quantities caught indicated serious doubt about the validity of the results. The Committee suggested that an attempt should be made to resolve the discrepancies in the data, but, nevertheless, indicated that the small amount of data and the experimental conditions precluded reaching any definitive conclusions. STACFIS accordingly

recommends

*that further selection studies on silver hake under commercial conditions should be undertaken as soon as possible so that sufficient data will be available to describe accurately the selectivity of*

2. Other Selection Studies

The Committee noted that the mesh selection studies on Greenland halibut, initiated in 1979 (SCR Doc. 80/VI/69) have not been continued, and therefore reiterates its previous recommendation that such studies should be continued, using a range of mesh sizes including the current minimum mesh size in effect (130 mm).

The Committee welcomed the report of a Cuban selection study on redfish in Div. 3M (SCR Doc. 81/VI/44), noting that the results were utilized in the mesh assessments described in Section VI below.

## V. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Redfish Ageing and Validation Studies

Comparative ageing of the same redfish specimens has been initiated by exchange of material between Canadian and Federal Republic of Germany scientists. The first comparison of age determinations from scales and otoliths showed a wider range of ages per cm length group in the Canadian otolith interpretations. The scale readings by Federal Republic of Germany scientists were within the same ranges but showed less variation, due partly to the fact that only about 50% of the scale readings were recorded as reliable, whereas the otolith readings were recorded for the whole sample. A conclusive analysis is not yet possible because of the limited amount of material examined to date. The Committee agreed that the comparative studies should be continued, using more comprehensive material, especially for larger redfish. The exchange sample will be provided by Federal Republic of Germany.

2. Roundnose Grenadier Ageing Studies

The Committee was informed that the ageing studies on roundnose grenadier between scientists of Federal Republic of Germany and German Democratic Republic have not yet been initiated.

3. Progress Report on Shrimp Ageing Workshop (SCS Doc. 81/VI/14)

In accordance with the recommendation from the November 1980 Meeting (*NAFO Sci. Coun. Rep.*, 1979-80, page 158), an ageing workshop on shrimp (*Pandalus borealis*) was convened by Mr J. Frechette at Quebec City, Canada, during 11-14 May 1981, to conduct an in-depth analysis of shrimp samples with a view to developing criteria for the ageing of shrimp. Statistical methods were used to divide size compositions into age-groups on the assumption that modal classes correspond to age-groups. This use of size compositions to age shrimp implies an optimum sampling strategy which must take into account the different parameters influencing the representation of age-groups. However, caution was advised regarding the proposed minimum requirement for 500 shrimp per sample and the measurement of carapace length to 0.1 mm. A statistical approach should be used to study further the matter of standardized sampling procedures.

Concerning the utilization of age-group separation for estimating age-class strength and hence recruitment, it was pointed out that selectivity and availability problems associated with the younger age-groups do not necessarily exclude the possibility of predicting recruitment. It was noted that a more comprehensive report on the ageing workshop will be presented at a later meeting. As time was insufficient to cover all aspects of ageing shrimp, STACFIS

recommends

*that two days should be added to the next meeting at which the shrimp stocks will be reviewed to further consider some aspects of ageing techniques and management implications.*

4. Other Ageing Studies

The Committee noted that there was no new information available on age determination of squid or other species.

## VI. MESH ASSESSMENTS

1. Mesh Assessment of Redfish in Division 3M (SCR Doc. 81/VI/44, 52)

An attempt was made to determine the mesh size at which the maximum yield-per-recruit might be obtained, using the Beverton and Holt mesh assessment model. It was noted that the selection factors given by Valdes and Fraxedas (SCR Doc. 81/VI/44) fall within the range given by Holden (*ICES Coop. Res. Rep.*, Ser. A, No. 25, 1971) and presented in table 3 of SCR Doc. 81/VI/52. The mean of these values for polyamide is 2.90, which was used as the selection factor.

The growth parameters used were the same as those employed in calculating the yield curves presented in SCR Doc. 81/VI/52, with parameters for male and female combined as follows:

$W_\infty = 1070$ g    $t_o = 0.17$ yr
$L_\infty = 42$ cm    $t_r = 6.00$ yr
$K = 0.094$

An estimate of the total mortality coefficient of 0.1, based on age-groups 16 years and older, was obtained from the age composition of three samples from Canadian catches in the third and fourth quarters of 1980. As the estimate of total mortality (Z) was the same as the value normally used for natural mortality (M = 0.10), a series of runs was made for F = 0.05, 0.10. Maximum yield-per-recruit was obtained at the following mesh sizes (to nearest 10 mm):

| | Mesh size (nearest 10 mm) for F | | |
|---|---|---|---|
| M | 0.05 | 0.10 | 0.20 |
| 0.05 | 100 | 110 | 110 |
| 0.10 | 70 | 80 | 90 |

Given the variability of the results and the uncertainty concerning the level of fishing mortality (F), the Committee concluded that it was not possible at this time to advise on the mesh size which would give the maximum yield-per-recruit for this stock.

2. Mesh Assessment of Cod in Division 3M (SCR Doc. 81/II/2)

The Committee noted that, at present growth rates, increases in yield-per-recruit of cod are indicated with mesh sizes up to 6 inches (152 mm) in manila codends. Calculations indicated that losses in yield in 1982 would be in the order of 10-35%, if a change in mesh size were applied in 1982, but would be marginal thereafter. Gains in yield would occur after about 1990. An increase in mesh size would result in an increase in spawning stock.

An assessment of losses and gains for an increase in mesh size from 120 to 130 mm in the cod fishery of the central Labrador area was reviewed (SCR Doc. 81/VI/58). The results indicated that the losses and gains would be about the same order of magnitude as those calculated for the cod stock in Div. 3M, with about the same time period before the first long-term gains would occur. The Committee noted that the above mesh assessment results apply only to the otter-trawl fishery, whereas other gears, such as gillnets and longlines with different selectivities, also exploit the cod stock in Div. 3M.

The Committee recognizes that significant by-catches of redfish may occur in the directed fishery for cod, and there is the potential for significant by-catches of cod in the redfish fishery at shallower depths. However, it was concluded that the present data base is not sufficient to provide advice on the impact of changes in mesh size on the cod and redfish fisheries in Div. 3M. The Committee was informed that USSR selectivity studies on cod and redfish were completed in June and that the results of these studies may be available at the September 1981 Meeting. STACFIS therefore

recommends

*that the deficiencies in the data base be clearly defined at the September 1981 Meeting, so that the necessary data can be obtained to carry out a complete evaluation of the impact of changes in mesh size on the interacting fisheries for cod and redfish on Flemish Cap.*

3. Mesh Size Equivalents

The use of equivalents was reviewed by an ICES/ICNAF Working Group in 1971 (*ICES Coop. Res. Rep.*, Ser. A, No. 25). The selectivity results were found to be extremely variable, and it was concluded that there are many factors (e.g. meshing and catch size) which contribute more to the variability than selectivity differences between materials. Consequently, the selectivity differences between materials can be ignored.

## VII. REVIEW OF SCIENTIFIC PAPERS

1. Redfish Speciation and Stock Delineation (SCR Doc. 81/VI/57, 70, 80)

Three papers on this general subject were considered. The paper on speciation (SCR Doc. 81/VI/70) attempts to show, from vertebral numbers sampled from different depths and areas, that redfish previously considered to be *Sebastes mentella* are composed of two groups, *S. mentella* and *S. fasciatus*. Discussion centered around the apparent change in vertebral numbers from north to south and whether this was a cline typical of that found in meristic studies on many other species. SCR Doc. 81/VI/57 attempts to redefine the stocks of redfish around the edge of Grand Bank, with the suggestion of a stock in Div. 3L and one in Div. 3NO, based on growth differences. The question arose as to whether the samples collected were from sufficient depths to contain the older age-groups in Div. 3L and 3N, as these older age-groups would influence growth differences between the different areas which might bias the conclusions. In SCR Doc. 81/VI/80, a review of data on anal fin ray counts by depth and division suggested the possibility of redefining stocks. The data indicate a north to south cline, as found in the data on vertebral numbers, although not as clear.

2. Atlantic Saury (SCR Doc. 81/VI/56)

USSR studies from research cruises during October-November 1980 in Subarea 4 indicated that Atlantic saury were distributed in the near-surface layer in temperatures of 9.4 to 14.8°C. The biomass, in an area of approximately 19,000 square miles, was estimated to be about 85,000 tons, and it was suggested that the migrating concentrations were large enough for a successful fishery.

3. Length Measurements of Roundnose Grenadier (SCR Doc. 81/VI/20)

This paper deals with the problem of length measurements of roundnose grenadier, indicating that the pre-anal length is different in males and females of the same total length. Also, inaccuracies apparently occur in measuring pre-anal length because of distortion caused by varying fullness of the stomachs. The Committee noted that these problems were discussed by STACREC at the June 1980 Meeting (*NAFO Sci. Coun. Rep.*, 1979-80, pages 66 and 94) and that the anal-fin length was recommended as the more appropriate partial length measurement.

4. Eggs of Roundnose Grenadier (SCR Doc. 81/VI/75)

Little is known about reproduction and early ontogony of this species. The celled structure of the membrane appears to be sufficiently different from that of the eggs of other species of grenadiers to be useful as a distinguishing character for egg identification.

5. Young Argentine on the Scotian Shelf (SCR Doc. 81/VI/75)

Catches of 0-group argentine are reported for the first time, specimens being caught in six Canadian ichthyoplankton surveys on the Scotian Shelf and in a joint Canada-USSR survey during September-November 1980. The observations are consistent with spawning in March-April, with growth in length of 6.7 cm by October. Vertical migration studies in October indicate that juveniles stay close to the bottom during daylight, migrate off the bottom at sunset, spend the hours of darkness in the upper layers and return to the bottom at sunrise.

## VIII. ACKNOWLEDGEMENTS

The Chairman expressed his thanks to Mr T. Rowell who convened the Working Group on Squid Research, to Mr J. Fréchette for is preliminary report of the Workshop on Ageing Shrimp, to those scientists who assisted by preparing the initial draft reports on the various matters under consideration, to all participants for their cooperation during the course of the meeting, and to the Secretariat for their support.

# ANNEX 1. REPORT OF *AD HOC* WORKING GROUP ON SQUID RESEARCH

Convener: T. W. Rowell

The Working Group met at the Bedford Institute of Oceanography, Dartmouth, Canada, during 3-6 June 1981, to review currently available information on squid biology and distribution and the preliminary results of the coordinated research surveys conducted in late 1980 and 1981 for the purpose of determining the spawning distribution and early life history of *Illex illecebrosus* in the Northwest Atlantic (*NAFO Sci. Coun. Rep.*, 1979-80, pages 70 and 130). Scientists participated from Canada, Cuba, European Economic Community (France), Japan, Portugal, USSR and USA. The results of the reviews are presented below.

## I. DISTRIBUTION AND ABUNDANCE

1. Preliminary Results of 1980/81 Coordinated Surveys

Five research vessel cruises conducted in late 1980 and early 1981 were related to the coordinated survey program.

a) RV *Argus*, 1 November-1 December 1980 (SCR Doc. 81/VI/39)

Two bottom trawl sets and 40 Engel midwater trawl (EMT-400) sets during 1-15 November in Subarea 4, extending from the edge of the Scotian Shelf seaward to the Sargasso Sea, resulted in the capture at 50-100 m of eight *Illex* (larvae and early juveniles) which have not been identified beyond the genus level. During 16 November-1 December, 10 bottom trawl sets in Subarea 4 and 36 EMT sets in Subareas 3 and 4 resulted in the capture of 144 adult *Illex illecebrosus* on LaHave Bank and Basin, four on Sable Island Bank and four on Grand Bank, the average mantle length of these being 206 mm. Nine adults (mean length of 230 mm) were taken in EMT sets close to the continental shelf in Shelf Water.

b) RV *A. T. Cameron*, 24 January-16 February 1981 (SCR Doc. 81/VI/39)

Twelve bottom trawl sets at the edge of the Scotian Shelf and 78 EMT-400 sets in transects extending from the edge of the shelf to the Sargasso Sea resulted in the capture of one juvenile *Illex illecebrosus* (60 mm in length) in Shelf Water at 100 m where the temperature was 7.2°C.

c) RV *Gadus Atlantica*, 20 February-11 March 1981 (SCR Doc. 81/VI/23)

This survey, which extended from the northern edge of Slope Water south of St. Pierre Bank and Grand Bank southward to the Gulf Stream, resulted in the capture of 8,275 juvenile *Illex illecebrosus* in 45 EMT-80 sets, the catch rate being 183.9 animals per set. Catches were made throughout the 24-hour period but more frequently during dusk and darkness. Two exceptionally large catches (3,462 in darkness and 2,546 in daylight) were made at 100 m near the northern boundary of the Gulf Stream. Catches in the upper 300 m occurred at stations where the temperature was higher than 10°C and salinity higher than 35°/°°. No catches were made in water clearly identified as Gulf Stream water. The specimens taken in the EMT sets were 10-30 mm in length. The Bongo net samples have not yet been examined for squid larvae.

d) RV *Atlant*, 15-19 February 1981

This survey, intended to parallel the February surveys of the *A. T. Cameron* and *Gadus Atlantica* in Subareas 3 and 4, was conducted in Subareas 5 and 6. A preliminary XBT transect extended from Georges Bank seaward to the Sargasso Sea. A narrow and deep warm-core eddy was identified close to the northern edge of the Gulf Stream and nine stations were sampled with an EMT-80. Eleven juvenile *Illex* (45-65 mm in length) were taken in the periphery of the eddy and three larvae (3.0-6.2 mm) were caught in the southern extreme of the transect where water temperatures were close to 20°C.

e) RV *Atlant*, 3 March-4 May 1981 (SCR Doc. 81/VI/41)

A total of 99 stations were occupied on 8 transects running perpendicular to the Scotian Shelf. The transects were 50 miles apart and the stations usually at 50 mile intervals, but the intervals were reduced to 10-25 miles when the water masses required better definition. *Illex* juveniles (10-150 mm manille length) were caught at 69 stations in depths of 50-500 m. Maximum abundance occurred in a zone 50-70 miles wide near the edge of the Gulf Stream. Eleven stations, occupied in a warm-core eddy, resulted in small numbers of *Illex* being caught in the periphery and six within the core. Abundance appeared to be highest at 50-100 m, somewhat lower at 200-300 m, and lowest at 500 m. However, catches at 300 m were generally higher than those at 200 m. The size distributions indicated increased size of juveniles along the transects from the

Gulf Stream to the Scotian Shelf, but there was no significant change in size distributions along lines connecting stations in a southwest-northeast direction.

## 2. Fishery and Abundance Trends

### a) Fishery trends

Nominal catches of *Illex* in Subareas 2 to 4 increased rapidly from an annual average of 4,500 tons in 1970-74 to 153,000 tons in 1979 (Table 1). Preliminary data for 1980 indicate significant declines for both Subareas 3 and 4, the overall catch of 70,000 tons being 55% lower than in 1979.

The inshore catch at Newfoundland was only 32,400 tons in 1980, a 61% decrease from 1979. Market conditions and reduced fishing effort were noted as contributing factors in this decline (SCR Doc. 81/VI/27). While the French inshore catch around St. Pierre and Miquelon remained at about the same level in 1980 (1880 tons) as in 1979 (1846 tons), the offshore fishery by France in Subdivision 3Ps and Div. 4W yielded 600 tons in 1980, a descrease of 77% from 1979 (SCR Doc. 81/VI/37). The Canadian catch in Subarea 4 was only about 2,300 tons in 1980, a 65% decrease from the previous year, and the distant-water fleet caught 32,000 tons in 1980, a 50% decrease from 1979. A reduction in quota allocations in 1980 was partly responsible for the decline in catch by the fleet (SCR Doc. 81/VI/35).

Table 1. Nominal catches by subarea and TACs (tons) for squid-*Illex*, 1972-80.

| Year | SA 2 | SA 3 | SA 4 | Total | TAC |
|---|---|---|---|---|---|
| 1972 | - | 26 | 1,842 | 1,868 | - |
| 1973 | 2 | 620 | 9,255 | 9,877 | - |
| 1974 | 31 | 17 | 389 | 437 | - |
| 1975 | - | 3,751 | 13,993 | 17,744 | 25,000[1] |
| 1976 | - | 11,257 | 30,510 | 41,767 | 25,000[1] |
| 1977 | 6 | 32,748 | 50,726 | 83,480 | 25,000[1] |
| 1978 | - | 40,697 | 51,987 | 92,684 | 100,000 |
| 1979 | - | 81,820 | 71,279 | 153,099 | 120,000 |
| 1980[2] | 1 | 34,701 | 34,825 | 69,527 | 150,000 |

[1] Countries without specific allocations could each take up to 3,000 tons.

[2] Catch statistics are provisional.

### b) Fishing power estimates

Estimates of fishing power coefficients were made for Japanese vessels (SCR Doc. 81/VI/31) and for the entire distant-water fleet engaged in the squid fishery in Subarea 4 (SCR Doc. 81/VI/35). For the Japanese fleet, no significant differences were noted for vessels of 1000, 1500 and 2000 GRT, but the catch-per-unit effort (CPUE) for 3000 GRT vessels was about twice that of the smaller ones. For the overall distant-water fleet, mean catch rates in 1980 varied greatly among vessel classes and by month. The CPUE data for August and September, during which 61% of the total *Illex* catch was taken, were considered as the most representative of the differences in fishing power. Allowing a factor of 1.0 for 150-499 GRT vessels, the factors for the other classes were 0.5 for 500-999 GRT, 3.7 for 1000-1999 GRT and 6.8 for 2000+ GRT vessels. Both studies indicated that the fishing power of vessels greater than 2000 GRT was considerably higher than that for smaller vessels.

### c) Catch rates in 1980

The French inshore catch in Subdiv. 3Ps did not decline in 1980 and the catch rate was 37.7 tons per dory compared with 36.9 tons per dory in 1979, although in 1980 the fishery was delayed by about one month due to the late arrival of squid to the inshore area (SCR Doc. 81/VI/37). However, in the offshore areas of Subdiv. 3Ps and Div. 4W, the catch rate in the French fishery was only 5.5 tons per day in 1980 compared with 17.0 tons per day in 1979 (SCR Doc. 80/II/12), indicating a 68% decline in abundance. In Subarea 4 during August and September 1980, the catch rates of the distant-water fleet were 15 and 13 tons per day respectively, whereas in July and September 1979 the catch rates were 24 and 22 tons per day respectively (SCR Doc. 81/VI/35), implying a 40% reduction in biomass from 1979 to 1980 in the area permitted for the distant-water fleet. The catch rates for the Japanese fleet by month and division in Subarea 4 were also considerably lower in 1980 than in the preceding two years, about one-half to one-third of the values in 1979 and one-half to two-thirds of the values in 1978 (SCR Doc. 81/VI/30).

d) Abundance indices

Various abundance indices for squid *Illex* in Subareas 3 to 6, based on stratified-random trawl surveys and commercial catch rates, are listed in Table 2., together with sources of the information. In addition to these two classes of indices, relative abundance indices from other sources were considered and compared (Table 3). The methods were classified into three categories: stratified-random trawl surveys, areal expansion of commercial fishery catch rates, and other indices of abundance.

Table 2. Abundance indices for *Illex illecebrosus* in Subareas 3 to 6, determined from stratified random trawl surveys and commercial catch rates.

| Country | Area | Time | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canada[1] | 4VWX | July | 9.6 | 40.7 | 14.4 | 14.4 | 25.1 | 52.5 | 337.9 | 80.8 | 30.9 | 152.2 | 26.6 | SCR 81/34 |
| USA[1] | 5X+6 | Sep-Nov | 3.4 | 1.9 | 3.5 | 1.3 | 0.3 | 12.4 | 28.7 | 15.8 | 28.4 | 32.1 | 17.0 | SCR 81/33 |
| France[2] | 3Ps | Jun-Oct | (inshore) | | | | | | | | | 36.9 | 37.7 | SCR 81/37 |
| France[3] | 3Ps+4W | Aug-Oct | (offshore) | | | | | | | | | 17.0 | 5.5 | SCR 81/37 |
| International[3] | SA 4 | Jul-Sep | | | | | | | | | | 23.0 | 14.0 | SCR 81/35 |

[1] Mean number per tow. [2] Tons per dory. [3] Tons per day.

Table 3. Relative abundance indices for *Illex illecebrosus* in Subareas 3 to 6, based on (A) stratified random trawl surveys, (B) areal expansion of commercial fishery data, and (C) qualitative index of inshore abundance.

| Country | Area | Time period | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Canada | 4VWX | July | 0.36 | 1.53 | 0.54 | 0.54 | 0.94 | 1.97 | 12.70 | 3.04 | 1.16 | 5.68 | 1.00 | SCR 81/34 |
| USA | 5Z+6 | Sep-Nov | 0.20 | 0.11 | 0.21 | 0.08 | 0.02 | 0.73 | 1.69 | 0.93 | 1.67 | 1.89 | 1.00 | SCR 81/33 |
| B. Japan[1] | 4VWX | Sep | - | - | - | - | - | - | - | - | 3.28 | 6.21 | 1.00 | SCR 81/31 |
| C. Canada[2] | 3 | | 1 | 2 | 1 | 2 | 1 | 4 | 4 | 5 | 4 | 5 | 4 | SCR 81/25 |
| Canada[3] | 3 | | | | | | | | | | 1.88 | 2.19 | 1.00 | SCR 81/28 |

[1] Based on abundance indices in the 90-140 fathom depth zone.
[2] Subjective indices; see text for explanation.
[3] Based on survey catches of percent trawling time with squid catches of 60%, 70% and 32% in 1978, 1979 and 1980, respectively.

i) Stratified-random surveys

Canadian surveys carried out on the Grand Bank since 1948 were examined by area and time in SCR Doc. 81/VI/28 to determine the best set of survey data that might provide the best indication of *Illex* abundance in inshore Newfoundland waters later in the year. Survey catches on the southwest slope of Grand Bank during 8-30 June were selected for this purpose. The relative estimates of abundance from these surveys in 1978, 1979 and 1980 expressed as percentages of total trawling time during which squid were caught, were 60%, 70% and 32% respectively. These have been transformed in Table 3, with the 1980 value represented by a factor of 1.0.

During a French bottom-trawl survey on the Scotian Shelf (Div. 4VWX) in September 1980 (SCR Doc. 81/VI/38), 75 hauls were made randomly in 22 strata at depths of 90-365 m. All sets were made during daylight when squid were assumed to be concentrated near the bottom. Estimates of minimum trawlable biomass, by the areal expansion method assuming that all squid in the path of the trawl are caught, were 108,700 tons (481 million individuals) for depths of 50-100 fathoms (92-183 m) and 45,000 tons (184 million individuals) for depths of 100-200 fathoms (183-366 m). The total biomass estimate of 153,700 tons is compared with other estimates in Table 4. The mean catch per 30-min tow over the entire survey was 384 squid. This compares with Canadian estimates, made in the same area and in the same manner from July surveys during 1970-80, of 10 to 338 individuals per 30-min tow (SCR Doc. 81/VI/34).

Squid catch rates from annual Canadian bottom-trawl surveys on the Scotian Shelf in July, adjusted for diurnal effects as the surveys were conducted during day and night (SCR Doc. 81/VI/34), indicated a sharp decline (82%) in abundance from 1979 to 1980 (Table 2). Biomass estimates from these survey data for 1970-79 were previously presented in SCR Doc. 80/II/17, but this time series was not updated to 1980. However, the corrected catch rates from SCR Doc. 81/VI/34 were related to past estimates of biomass and a biomass estimate of 15,700 tons was calculated for 1980 (Table 4).

Squid catch rates (stratified mean catch per tow in numbers) from USA autumn bottom-trawl surveys in Subareas 5 and 6 indicate a general increase in abundance after the mid-1970's and a sharp decline (47%) from 1979 to 1980 (Table 2).

Table 4. Summary of biomass estimates (000 tons) for *Illex illecebrosus* in Div. 4VWX.

| Country | Time period | Survey area | 1978 | 1979 | 1980 | 1981 | Comments |
|---|---|---|---|---|---|---|---|
| Canada | July | (see text) | 19.0 | 147.6 | 15.7 | - | Stratified random trawl survey |
| Japan | Sep | 4,766 mi$^2$ | 233.0 | 667.0 | 69.0 | - | Areal expansion, fishery catch rates |
| France | Sep | 19,867 mi$^2$ | - | - | 153.4 | - | Stratified random trawl survey |
| USSR | Aug | 71,014 mi$^2$ | | | | 580-1917 | Areal expansion, March-May off-shelf juvenile survey extrapolated to August on-shelf adult abundance |

ii) Areal expansion of commercial catch rates

Estimates of *Illex* biomass along the edge of the Scotian Shelf from the Japanese squid fishery in September for 1978, 1979 and 1980 were presented in SCR Doc. 81/VI/31. Fishing effort was standardized for all vessels and gear types and CPUE values were calculated by 10-fath depth zones within 30' x 30' unit areas. These were expanded over the total area of the southeastern edge of the Scotian Shelf according to the following assumptions: the average distance between the wing tips of the trawl used by 2000 GRT vessels was 26 m, the towing speed was constant at 3.5 knots, and all squid in the path of the trawl were caught. Using only the catches during daylight, biomass estimates of 233,000 tons, 667,000 tons and 69,000 tons were calculated for 1978, 1979 and 1980 respectively (Table 4). As for other estimates, the biomass increased in 1979 and decreased sharply in 1980. Since about 90% of the fishing effort was expended in fishing at 90-140 fath (165-256 m), the estimates for this depth zone are used in Table 3 to estimate the relative indices of abundance from the Japanese fishery. These relative indices indicate a decrease in abundance of 84% from 1979 to 1980 in the surveyed area.

iii) Other indices of abundance

Qualitative estimates of squid abundance in Newfoundland waters have been made since 1948 (SCR Doc. 81/VI/28). These estimates are based on collating reports from such sources as newspaper articles, fisheries reports and field observations. The abundance levels were assigned numerical values ranging from 1 (very scarce) to 5 (very abundant). These indices for 1970-80 (SCR Doc. 81/VI/28) are given in Table 3. During 27 March-4 May 1981, a USSR survey for *Illex* covered an area of 71,014 mi$^2$ in the offshore waters of Div. 4VWX (SCR Doc. 81/VI/43). Abundance estimates for the surveyed area from the Scotian Shelf to the northern edge of the Gulf Stream), calculated by methods of horizontal and vertical interpolation (SCR Doc. 80/II/36) were in the range of 5.2 billion to 17.0 billion animals. These juvenile squid ranged in length from 10 to 150 mm but were generally less than 60 mm. The authors extrapolated this March-May estimate of offshore abundance of juveniles to later abundance on the Scotian Shelf during the period of recruitment, by assuming that all of the juveniles in the surveyed area would migrate to the Scotian Shelf, that mortality would not exceed 50% from the time of the survey and time of recruitment, and that the average weight of squid would be about 225 g (230 mm mantle length, from SCR Doc. 81/VI/38) at the time of recruitment. The biomass in August 1981 is forecasted to be in the range of 585,000-1,917,000 tons (Table 4). It was noted that the major limitation to this forecast lay in the assumptions of migration only to the Scotian Shelf and of 50% mortality between survey and recruitment times. It was also noted that squid upon recruitment to the fishery are smaller in length and weight than the values used in calculating the biomass estimate and that cannibalism (SCR Doc. 81/VI/40) might increase the early season mortality factor well beyond the suggested level of 50%. However, it was recognized that such off-shelf indices of juvenile abundance may in the future provide a valuble means of short-term prediction of later on-shelf abundance and availability to the fishery.

iv) General considerations

It was recognized that there are many factors which affect the accuracy of abundance indices. Squid tend to be more dispersed throughout the water column at night and are less vulnerable to the bottom trawl. Consequently, the catch rates from day and night operations during bottom-trawl surveys must be adjusted for diurnal effects for use in calculation of biomass estimates, although such adjustments are not critical for the calculation of relative catch rates if the relative proportion of day and night sets does not change from year to year. Biomass estimates from bottom trawling may be too low when squid are off the bottom as during the night, during dark days or during the day when the height of the trawl does not reach the height of the squid concentrations. Moreover, data from bottom trawl surveys may not reflect consistent year-to-year trends in squid abundance if different weather conditions (e.g. different numbers of misty or cloudy days), result in different vertical distribution patterns.

Considering all of the information available, however, the similarity in trends of abundance for the area from Newfoundland to Cape Hattaras (Table 3) suggest that one stock exists in the entire area or that the cause of the changes in abundance has affected all stocks in a similar way.

3. Patterns of Distribution and Migration (and Environmental Influence)

a) Oceanic distribution of larval and early juveniles

Surveys conducted from February to May 1981 in Subareas 3 and 4 indicated that the distribution of small juveniles was closely related to the physical properties of the water masses (SCR Doc. 81/VI/23, 41). Greatest catches occurred at 100 m in warm Slope Water near the northern boundary of the Gulf Stream. Catches also occurred at greater depths dominated by North Atlantic Central Water, as indicated by lower temperatures and stable salinity values of about 35°/₀₀, and there were some small catches within and on the oceanic side of the Gulf Stream.

b) Distribution of adults and large juveniles

i) Subarea 4

From commercial fishery data, concentrations of squid appeared to be small on the southern part of the Scotian Shelf during July to November 1980, due apparently to lower-than-normal temperature conditions (SCR Doc. 81/VI/30). Differences in bottom-trawl survey catch rates seemed to be associated with bottom temperature, but the largest catches occurred during daylight, indicating diel vertical migration (SCR Doc. 81/VI/31, 34).

The French bottom-trawl survey and the Japanese commercial data indicate that the largest catches near the edge of the Scotian Shelf in September 1980 were associated with incursions of 6-12°C Slope Water onto the Shelf (SCR Doc. 81/VI/38). In the French survey, maximum catches were made where bottom temperatures ranged from 7.5 to 9.5°C. High sea-surface temperatures outside the Shelf Water in March (1977-81) may be associated with early immigration onto the Scotian Shelf in some years (SCR Doc. 81/VI/32).

ii) Subarea 3

It was noted that the delay of approximately one month in the commencement of the fishery around St Pierre in 1980 may have been related to the delay in elevation of the temperature about 7°C (SCR Doc. 81/VI/37). This delay and the observation of low squid abundance inshore along the south coast of Newfoundland in 1980 compared with the situation in 1979 (SCR Doc. 81/VI/27) may have been due to lower temperature conditions in 1980 than in 1979. Although squid were unusually scarce along the south coast of Newfoundland, they were distributed around St. Pierre and Miquelon and in all other areas of insular Newfoundland.

The time of occurrence of squid on the slope of Grand Bank in May-June appears to be related to the time of development of high bottom temperatures due to incursions of warm Slope Water (SCR Doc. 81/VI/28). There also appears to be a positive correlation between January mean sea-surface temperatures off the continental slope south of Newfoundland and squid abundance in inshore Newfoundland waters later in the year. This relationship, together with the temperature-related occurrence of squid on the southern Grand Bank in June may provide an indication of July-November levels of squid abundance in inshore waters. The presence of unusually high numbers of icebergs drifting south of latitude 48°N during May-June in some years may be associated with conditions which are unfavorable for inshore squid migration.

c) Migration

Based on a tag return, the longest distance of travel yet reported for a short-finned squid, from northeastern Newfoundland to a point off the coast of Maryland, was 1260 miles (minimum) in 107 days (SCR Doc. 81/VI/24). A return from inshore tagging at Nova Scotia indicated that the squid travelled in a southwesterly direction along the coast a minimum distance of 300 miles in 70 days (SCR Doc. 81/VI/36). Three other tag recoveries reported inshore at Nova Scotia also indicated movement in a southwesterly direction. As previously reported (SCR Doc. 80/II/33), overall tagging observations tend to support a generally northeastward movement of squid early in the commercial fishing season and a southwestward movement late in the season. It was recognized that such long distance tag recaptures may in future provide valuable insight on migration, stock identity and the location of spawning sites.

## II. BIOLOGICAL CHARACTERISTICS

### 1. Sex composition, growth and maturation

Juvenile *Illex*, caught during Canadian surveys in February-March 1980 extending from the Grand Bank southward to the Gulf Stream (SCR Doc. 81/VI/23), ranged in length from 10 to 30 mm. The sex ratio was 50:50 and the length distribution from each set was unimodal. The length-weight relationships have a lower exponent than is the case for adults:

Male: $W = 0.08\ L^{2.13}$        Female: $W = 0.07\ L^{2.24}$

The adult short-finned squid, taken by midwater trawl in the November survey off the Scotian Shelf (SCR Doc. 81/VI/39), with a mean mantle length of 230 mm were larger than those taken by bottom trawl on the shelf (206 mm), and most of the specimens were in maturity stages 2 and 3 except for one mature female (stage 4). Mean mantle lengths of squid in the Japanese commercial fishery (bottom and off-bottom trawls) in Subarea 4 were on the average lower in 1980 than in 1979, the reported values for 1980 being 186 mm in July, 212 mm in August, 222 mm in September, 232 mm in October and 226 mm in November (SCR Doc. 81/VI/30). Canadian sampling of catches of the international fleet on the Scotian Shelf from late April to November 1980 indicated increases in mantle length from 136 mm to 229 mm for males and 133 mm to 249 mm for females. Growth parameters for 1980 were more similar to those of 1978 than of 1979.

Three modes were identified in the length distribution of short-finned squid from a French research survey in September 1980 at depths of 50-200 m (SCR Doc. 81/VI/38). The dominant mode (80% of the specimens) consisted of maturing animals, with mean lengths of male and female being 215 mm and 226 mm respectively. The next largest mode was comprised mainly of immature animals with mean length of about 165 mm. The third mode (2% of the specimens) consisted of immature squid of 80-130 mm in length. The length-weight relationship for these samples were as follows:

Male: $W = 0.00993\ L^{3.322}$        Female: $W = 0.01478\ L^{3.082}$

Length frequencies from the Canadian survey on the Scotian Shelf in July showed rather wide distributions (SCR Doc. 81/VI/34), suggesting limited summer spawning or divergent growth rates. The mean lengths seemed to be positively correlated with bottom temperature. Inshore sampling of squid at various locations in Nova Scotia showed divergent patterns of length (SCR Doc. 81/VI/36), the pattern in those samples from the South Shore being relatively consistent from week to week and with offshore samples, whereas sample lengths from the Chedabucto Bay area fluctuated greatly from week to week, implying that different sizes of squid were moving into and out of the area.

Length frequencies from USA bottom-trawl surveys in Subareas 5 and 6 during 1973-79 show wide distributions (30-350 mm mantle length) in summer and autumn (SCR Doc. 81/VI/33). This wide range in size is attributed to greatly protracted and possibly year-round spawning.

In Subarea 3, samples from the French fishery during 21 July-15 October 1980 indicated growth rates of 12 mm and 16 mm per month for males and females respectively (SCR Doc. 81/VI/37). These growth rates are very similar to those for 1979, but the average sizes were smaller in 1980. The size distributions were unimodal, and the sex ratio was dominated by males until mid-September about a month later than in 1979, presumably due to slower increase in water temperature in 1980.

From inshore commercial sampling in Subarea 3 and Div. 4R in 1980 (SCR Doc. 81/VI/27), the percentage of males began to decline early in the season (mid-August). In general, the sexual maturity of males on a given date was less advanced in 1980 than in 1979. One mature female was found inshore on the west coast of Newfoundland in September (SCR Doc. 81/VI/26). Such early maturation, also evidenced for six mature females captured in summer between 1968 and 1978, is possibly related to high water temperatures. The maturity stages assigned to these specimens, based on the nidamental gland length/ mantle length index, corresponded with descriptions of maturity based on visual examination, indicating that the index of maturity proposed for captive females seem to be applicable to specimens from the wild population (Amaratunga and Durward, *ICNAF Sel. Papers*, No. 5: 37-42).

2. Fecundity, Spawning and Larval Development

A fecundity estimate of 36,288 ova was obtained for a mature female caught in September 1980 on the west coast of Newfoundland (SCR 81/VI/26). This specimen represents the first record of a mature female taken so far north and in inshore waters. The fecundity estimate is much lower than that reported for capative animals (400,000 ova) but is close to estimates reported previously for mature females from the wild population.

Data collected during 1973-79 in Subareas 5 and 6 provide evidence of summer spawning of *Illex* (SCR Doc. 81/VI/33). Although fully mature females were rarely observed in any season, mature males were apparently present in each season. Autumn samples contained the highest proportion of mature individuals in most years, indicating the predominance of winter spawning. Significant number of squid were found to be mature during the spring and summer, indicating that some spawning also occurs in these seasons. The importance of summer spawning appears to vary from year to year, but the length frequencies indicate that up to 86% of the squid in the Cape Hattaras area in the autumn of some years may be the result of summer spawning. Although the percentages of mature animals are lower for the more northerly regions of Subareas 5 and 6, they still indicate to a lesser degree that some summer spawning may occur in some years in the Georges Bank and southern New England areas.

Laboratory observations on the embryonic development of *Illex illecebrosus*, based on both artificially and naturally fertilized eggs, are described and the major stages illustrated in SCR Doc. 81/VI/29. It was noted that the basic pattern of development resembles that of *Todarodes pacificus*. The observations indicated that the gelatinous egg mass appears to have important functions related to the avoidance of polyspermy and to chorionic expansion during later developmental stages. Among the factors appearing to be important for normal embryonic development, temperature conditions play a significant role. The observations indicate that fertilization can occur at temperatures as low as 7°C, but normal development required minimum temperatures in the range of 10-30°C. The development time was also temperature-dependent, 11 to 8 days at temperatures from 13 to 21°C.

3. Food and Feeding

An analysis of correlations between squid abundance (estimated from catch and subjective abundance indices) and the abundance of age-group 0 and age groups 0 and 1 combined (estimated by virtual population techniques) of cod, capelin and herring stocks indicated no evidence that squid predation is a major factor in determining finfish recruitment (SCR Doc. 81/VI/25). The total food consumption by squid in 1979 was estimated to be about 4 million tons. Although the food consumption by squid in a year of high squid abundance must be very large, the analysis failed to demonstrate a negative association between squid abundance and year-class strength of finfish prey, with the exception of capelin in Subarea 2 and Div. 3K.

Data in SCR Doc. 81/VI/41 indicated that young squid (50-150 mm) fed mainly on euphausiids, shrimp, amphipods and other crustaceans. Stomach contents of small squid (10-40 mm) contained only unidentified remnants and fat globules. Stomach analyses of squid (150-260 mm) sampled inshore at Nova Scotia (SCR Doc. 81/VI/31) indicated that about 90% of animals had empty stomachs and caeca, but fish was the dominant class of prey in those stomachs containing some food.

4. Mortality

The implications of cannibalism as a source of natural mortality were investigated from reported data on the frequency of occurrence of squid in stomachs, the proportions of empty stomachs and the efficiency of food conversion to growth (SCR Doc. 81/VI/40). The available information indicated that cannibalism is the major source of mortality from June to the end of the season, but squid is not a major food item in small animals. To what extent squid cannabilize on prey as large as the predator was not known, but generally the prey were much smaller. The instantaneous mortality rate due to cannibalism was estimated to be about 0.3 per 2-week period. This is much larger than previously reported estimates of natural mortality. The presence of high proportions of squid in the stomachs of larger squid throughout the period of their occurrence on the Scotian Shelf implies that small squid are available as food throughout the summer and autumn. This observation supports the hypothesis of protracted spawning.

5. Yield-per-recruit Analysis

A yield-per-recruit analysis attempted to quantify the major sources of mortality in the squid stock (SCR Doc. 81/VI/40). Cannibalism was identified as the largest source of mortality, and it was suggested that total mortality during the whole season on the Scotian Shelf may be as high as 10.0. Such high mortality is not seen in the commercial catch-rate data for the past four years, but this discrepancy may be due to fishing practices of the commercial fleet in seeking the highest concentrations or to continuous recruitment. Under the assumptions used in the model, with high natural mortality, the analysis indicated that the yield-per-recruit would be increased by fishing intensely early in the period of residence of squid on the shelf. For the simulated data, $F_{0.1}$ was greater than 1.0 per 2-week period. The target exploitation rate of 0.4 for squid, proposed by STACREC (*ICNAF Redbook*, 1978, page 32), is equivalent to F = 0.2 per 2-week period.

## III. CONCLUSIONS

1. The total catch of squid in Subareas 3 and 4 in 1980 was considerably lower than in 1979.

2. Estimates indicate that the biomass in 1980 was much lower than in 1979 and probably of the same order as in 1978 or during 1971-75.

3. As previously noted (SCS Doc. 80/II/1), biomass estimates of recruited squid stocks do not provide a basis for projection of future stock levels.

4. While considerable new knowledge has been developed regarding the life-cycle, distribution, and possible migration patterns, it is still not possible to relate off-shelf larval and juvenile abundance to later on-shelf and inshore abundance. It is noted that, with greater understanding of the off-shelf to on-shelf migration patterns and of the range of mortality coefficients acting between larval and juvenile stages and recruited adults, it may be possible in future to predict biomass abundance prior to the fishery.

5. The existence of a relationship between squid distribution and water temperature and a positive correlation between squid abundance estimates (e.g. catch rates) and water temperature has been demonstrated.

6. Parallel changes in abundance indices throughout the species range and information on the off-shelf distribution and size characteristics of larval and juvenile squid appear to support the possibility of a single stock or stock complex with still unknown spawning areas.

7. Considerable information has been collected concerning the general distribution and related abiotic factors for early juvenile *Illex* in the off-shelf areas of Subareas 4 and 3, south of the Grand Bank. Subareas 5 and 6, which appear important to fuller understanding of the biology distribution and life-history of *Illex*, have not been adequately studied.

8. A yield-per-recruit model, considered by the Working Group, indicated that an earlier fishing season may be appropriate, and it is suggested that the date for commencement of the fishery be re-examined.

## IV. FUTURE RESEARCH REQUIREMENTS

1. The Working Group noted the progress being made in understanding the life history, distribution and migration of *Illex*, and urged that national and cooperative research efforts continue to focus on elucidation of the spawning, larval and early juvenile stages as a basis for future stock predictions.

2. The Working Group noted that studies to date have provided only limited information on larval distribution and no significant information on spawning distribution, and recommends that future studies be directed at these stages of the life cycle.

3. The Working Group noted that cooperative studies on the spawning, larval and early juvenile stages have been concentrated on the more northern areas of distribution in Subareas 3 and 4. It is recommended that increased effort be applied to studies in Subareas 5 and 6.

4. The Working Group noted that continued success of inshore tagging experiments and again suggested that future research be directed toward the development of offshore tagging techniques, since offshore tagging is considered to have greater potential for determining migratory patterns.

5. The Working Group noted that hydrological processes appear to be of fundamental importance in determining the transport and distribution of larval and early juvenile *Illex* in the Gulf Stream/Slope Water interface area, and recommends that increased emphasis be placed on studies which will increase understanding of these processes.

6. The Working Group suggests that special studies be conducted to estimate mortality coefficients for squid migrating onto the shelf and to determine the catchability and selectivity of research gear.

7. The Working Group notes the value of bottom-trawl surveys for provision of indices of squid abundance, and recommends that such surveys be continued and that procedures be standardized and coefficients be developed for comparison between gears.

8. The Working Group notes the importance of feeding studies to the understanding predator/prey relationships and the dynamics of squid populations and recommends that they be continued.

## V. COORDINATION OF SQUID RESEARCH FOR 1982

Preliminary results of the 1981 coordinated research on squid were reviewed, but insufficient time and the need for further analysis of some data prevented a complete evaluation of the current program, and consequently it was not possible to develop specific plans for cooperative research and surveys in 1982. The conclusions and future research requirements presented in the two preceding sections reflect the consensus of the Working Group regarding the desirability of continuing the cooperative studies and indicate those areas of research which should be emphasized. The Working Group therefore

recommends

*that a more complete review of the results of the 1981 surveys and the development of a research program for 1982 should be undertaken at the September 1981 Meeting, noting that two days would be appropriate for this purpose.*

# APPENDIX II. REPORT OF STANDING COMMITTEE ON RESEARCH COORDINATION (STACREC)

Chairman: V. A. Rikhter    Rapporteurs: Various

The Committee met a Dartmouth, Nova Scotia, Canada, during 16-18 June 1981, to consider and report on matters referred to it by the Scientific Council (see Part E, this volume). Scientisits attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, France and the Commission of the European Communities), Japan, Portugal, Spain, USSR and USA.

In considering the various sections of the agenda, the Chairman appointed Dr R. W. Trites to lead the discussion on matters dealing with Environmental Studies and Dr. W. G. Doubleday for matters dealing with Biological Surveys. The Assistant Executive Secretary and several participants including the discussion leaders contributed to the preparation of the initial drafts of this report.

## I. STATISTICS AND SAMPLING

1. CWP Activities Relevant to NAFO Statistical Matters (SCS Doc. 81/VI/3, 11)

   a) Tenth Session of CWP

      The Assistant Executive Secretary briefly reviewed the Report of the Tenth Session, which was held at Madrid, Spain, during 22-29 July 1980 (SCS Doc. 81/VI/3). Attending on behalf of NAFO were the Assistant Executive Secretary (V. M. Hodder) and Canadian nominees (W. G. Doubleday and D. Tilley). Dr Doubleday was elected Chairman of the Session. The CWP considered a wide range of statistical matters, some of which are directly relevant to the work of the Scientific Council (SCS Doc. 81/VI/11). It was noted that STACREC had dealt with two of the CWP recommendations at its September 1980 Meeting, namely, the list of standard abbreviations for countries, and the future structure of the CWP (*NAFO Sci. Coun. Rep.* 1979-80, page 127). With reference to other CWP recommendations, STACREC reaffirmed previous commitments regarding (i) the international standard statistical classification of fishing gear, (ii) the use of 3-alpha species identifiers, (iii) use of standardized STATLANT forms and notes for collecting fishery statistics, and (iv) the allocation of catches by nationality. STACREC also welcomed the effort of FAO in compiling an up-to-date list of conversion factors (to convert landings to nominal catches), and endorsed the CWP recommendation that FAO establish a computerized data base of national conversion factors and provide for regular updating at 3-year intervals. Dr. Doubleday observed, from recent Canadian studies, that the factors for converting gutted fish to whole weight were quite reliable but that the factors for converting fillets to whole weight were highly variable.

   b) Eleventh Session of CWP

      STACREC noted that the 11th Session will be held at Luxembourg during 21-28 July 1982 at the invitation of EUROSTAT and that plans for this Session are already in progress through consultations between member agencies. Noting that the names of NAFO representatives were required at least 6 months in advance of this Session, it was proposed that two of the representatives should be the Assistant Executive Secretary and the Chairman of STACREC, and that the country which nominates the third representative should be decided by the Scientific Council following the election of officers.

2. Fishery Statistics

   a) STATLANT 21A reports

      These reports, with a 15 April deadline, consist of provisional nominal catch statistics by species and division and are supposed to provide the Secretariat with reasonably complete annual statistics well in advance of the June Meeting, so that they can be compiled and documented for that meeting. At the start of this June 1981 Meeting, despite the clearly designated deadline, STATLANT 21A reports for several countries were still outstanding. However, most of these became available during the meeting, and consequently the provisional nominal catches for 1980 could be compiled before the end of the meeting (SCS Doc. 80/VI/15).

   b) STATLANT 21B reports

      These reports, with a 30 June deadline, containing detailed nominal catch and effort data broken down by gear, tonnage class, main species, division and month, are used as the final statistics for publication in the Statistical Bulletin.

      i) Statistical Bulletin, Vol. 28 for 1978. This volume should have been published in December 1979 but was not issued until the autumn of 1980, nearly a year behind schedule. The major problems were the difficulty in obtaining STATLANT 21B reports from some countries, despite repeated requests, and the complication of sorting out national statistics and those accruing from joint venture operations to avoid the possibility of double-counting or under-counting.

ii) Statistical Bulletin, Vol. 29 for 1979. The publication of this volume has also been significantly delayed for the same reasons given above. However, it was noted that all 1979 data are now in hand and that the volume will probably be ready for distribution in August 1980. In connection with this first NAFO issue of the Statistical Bulletin, the Assistant Executive Secretary noted some minor changes in format, in accordance with previous recommendations of STACREC, the most significant being a new Table 5 to replace Table 5 and 6 of the ICNAF Statistical Bulletin, and use of the standard abbreviations for countries, with those for EEC member states prefixed by the letter E for convenience in listing them as a group.

iii) STATLANT 21B reports for 1980 (deadline 30 June 1981). It was noted that about half of these reports have already been received by the Secretariat and that the early receipt of the remainder could result in publication of *Statistical Bulletin* Vol. 30 before the end of 1981.

c) Response difficulties

The problems encountered by the Secretariat in acquiring and documenting fishery statistics have persistently been discussed in the scientific meetings of ICNAF and NAFO. Usually more than half of the STATLANT 21A and 21B reports are received close to the designated deadlines, but the lack of response for several months by one or two countries seriously hampers the work of the Secretariat. The responsibility lies with the national statistical offices, and it was recognized that the problem would not be reduced by changing the deadlines.

d) Historical Catches for 1970-79 (SCS Doc. 81/VI/10)

As requested at the June 1980 Meeting, the preparation of a summary document giving 10-year tabulations of catches of selected species by stock area and country has been continued.

3. Sampling Data

a) Processing of length samples (SCS Doc. 81/VI/16)

In accordance with previously adopted requirements for the reporting of length frequencies and age-length keys separately on the new sampling forms (CFS-1 and CFS-2), the Secretariat has modified its procedure for processing the more detailed data. In view of the large volume of data involved, progress has been rather slow, but all available length-frequency data received for 1979 have been computerized, and provisional lists of the samples are given in SCS Doc. 81/VI/16. The Committee noted that a large volume of sampling data for 1979 collected through the Scientific Observer Program had been reported to the Secretariat by Canada (Newfoundland), and that similar data collected by observers of Canada (Maritimes) are expected to be reported in the near future. Noting that the national lists of sampling data indicate incomplete or no coverage of the fishery in some cases, STACREC urged scientists to check their national lists and to submit all non-reported data to the Secretariat as soon as possible, to facilitate the production of Sampling Yearbook, Vol. 24 for 1979.

b) Age-length keys

Except for data reported by Canada (Newfoundland) both nationally and through the Scientific Observer Program, very few age-length keys for 1979 have been reported on sampling form CFS-2. Preparation for the computerization of these data have only just begun, mainly because the bulk of the data were received only recently.

c) Sampling Yearbook, Vol. 23 for 1978

STACREC was informed that the data base for this volume lacked the USA data for Subarea 5 and 6 until recently, but that these data are now in hand and the Yearbook will be issued in 3-4 months.

d) Greenland halibut data

STACREC noted that the Secretariat had received USSR length compositions and age-length keys for the 1969-76 period by division for Subareas 0 and 1, but that there was no information as to when similar data for Subareas 2 and 3 could be expected.

4. List of Fishing Vessels for 1980

STACREC noted that the Secretariat had requested member countries, through a circular letter issued in January 1981, to submit their 1980 lists of fishing vessels by 15 May 1981. Since only about half of the reports have been received to date (SCS Doc. 81/VI/17), STACREC urged that the outstanding lists should be forwarded to the Secretariat as soon as possible, for inclusion in the first NAFO issue of this publication.

5. Tagging Activities in 1980 (SCS Doc. 81/VI/6)

Tagging activities in the Northwest Atlantic during 1980, as reported to the Secretariat, were reviewed and the usefulness of the information was discussed. It was agreed that the program should be continued.

## II. BIOLOGICAL SURVEYS

1. Review of Survey Activity in 1980

The Committee noted that the following documents contained material relevant to biological surveys in 1980 and earlier years: SCR 80/IX/115, 116, 120, 130, 132, 133, 134, 137, 143, 146, 150, 151, 152, 153; SCR 80/XI/169; SCR 81/II/5, 9, 10, 11, 12, 13, 14, 15; SCR 81/VI/22, 28, 32, 34, 38, 39, 47, 51, 53, 54, 56, 59, 61, 63, 66, 68, 69, 71, 73, 76, 77; SCS 81/VI/12, 13, 18. Since many of these documents contained the results of investigations previously considered by STACFIS, only those documents containing new information relevant to the agenda of STACREC were discussed. Such information, supplemented by additional details provided by the participants, enabled the compilation of the list of surveys carried out in the NAFO area in 1980 (Table 1).

Changes in the level of survey activities were highlighted by participating scientists. Canada (M) increased survey activity on swordfish in Subareas 3 to 6, on scallops in Div. 4T, and combined acoustic and trawl surveys on pollock, redfish and herring in Div. 4X. For Canada (N), there were no major changes except for a Greenland halibut cruise which was carried out in Subarea 2 and Div. 3K, and a food and feeding survey on the Grand Bank. The Federal Republic of Germany increased survey activity on cod and redfish in Subarea 1 and in ICES Subarea XIV (East Greenland) as compared to recent years, and continued the time series of stratified random groundfish surveys in Div. 2J. France continued stratified-random groundfish surveys and undertook cod tagging and surveys for scallops in Subdiv. 3Ps. A new stratified-random survey for squid in Div. 4VWX was carried out. Survey activity by Denmark in 1980 included a new marine mammals survey (whales) but there were no other major changes in relation to 1979 survey activities. The USA carried out a new survey for clams and a new ichthyoplankton survey in Div. 4X. USSR carried out new saury surveys in Div. 4VWX.

Table 1. Inventory of biological surveys conducted in the NAFO Area during 1980.

| Sub-area | Div. | Country | Months | Type of survey | No. of sets |
|---|---|---|---|---|---|
| A. | Stratified-random surveys | | | | |
| 2 | J | CAN-N | 10 | Groundfish | 53 |
| | | " | 11-12 | " | 63 |
| | | DEU | 10-11 | " | 68 |
| 3 | K | CAN-N | 10 | Groundfish | 78 |
| | | " | 11-12 | " | 81 |
| | L | CAN-N | 4-5 | " | 107 |
| | | " | 5-6 | " | 77 |
| | | " | 10 | " | 8 |
| | | " | 11-12 | " | 8 |
| | M | CAN-N | 1 | " | 132 |
| | N | CAN-N | 4-5 | " | 82 |
| | O | CAN-N | 4 | " | 61 |
| | Pn | CAN-N | 3-4 | " | 7 |
| | Ps | CAN-N | 3-4 | " | 83 |
| | | FRA | 3 | " | 40 |
| | | " | 10 | " | 106 |
| 4 | RST | CAN-N | 1-2 | Groundfish | 133 |
| | | " | 9 | " | 48 |
| | T | CAN-M | 9 | " | 74 |
| | VWX | CAN-M | 3 | " | 114 |
| | | " | 7 | " | 140 |
| | | " | 9-10 | " | 145 |
| | | FRA | 9 | Squid | 75 |
| | | USSR | 9-10 | Groundfish | 100 |
| | W | USSR | 12 | " | 20 |
| | X | USA | 5 | " | 37 |
| | | " | 10-11 | " | 28 |
| 5 | YZ | USA | 4-5 | Groundfish | 198 |
| | | " | 7-8 | " | 160 |
| | | " | 10-11 | " | 204 |
| | Ze | USSR | 9-10 | " | 53 |
| | Z | POL | 2 | " | 22 |
| 6 | ABC | USA | 3-4 | Groundfish | 153 |
| | | " | 7-8 | " | 160 |
| | | " | 10-11 | " | 204 |
| B. | Other Surveys | | | | |
| 1 | A | GRL | 2,6 | Shrimp (commercial) | 43 |
| | | " | 7-9 | Shrimp and groundfish | 17 |
| | | " | 8 | Shrimp (photo) | 5 |
| | | " | 7,9 | Plankton | 17 |
| | B | CAN-N | 8 | Salmon | - |
| | | GRL | 1-5,7 | Shrimp (commercial) | 149 |
| | | " | 8 | Shrimp and groundfish | 14 |
| | | " | 8 | Shrimp (photo) | 15 |
| | | " | 7 | Plankton | 11 |
| | B-F | DEU | 6-7 | Groundfish | 71 |
| | | " | 11-12 | " | 50 |
| | C | GRL | 2-3,8 | Shrimp and groundfish | 9 |
| | | " | 4-5 | Shrimp (commercial) | 41 |
| | | " | 4 | Plankton | 6 |
| | C-F | DEU | 4-5 | Groundfish | 45 |
| | D | GRL | 3-4,9,12 | Shrimp and groundfish | 15 |
| | | " | 4,8 | Shrimp (commercial) | 5 |
| | | " | 7 | Plankton | 6 |
| | | " | 8-11 | Salmon | 125 |
| | D-E | GRL | 7 | Cod (acoustics) | - |
| | E | GRL | 4 | Shrimp and groundfish | 3 |
| | | " | 8 | Shrimp (commercial) | 1 |
| | E-F | DEU | 9-10 | Groundfish | 8 |
| | F | DEU | 8-10 | " | 30 |
| 2 | G | CAN-N | 9-10 | G. halibut, tagging | 6 |
| | GHJ | " | 8 | Salmon and Arctic char | - |
| | GH | USSR | 8-11 | Capelin, groundfish | 240[1] |
| | | " | 8-11 | G. halibut selectivity | 32 |
| | H | CAN-N | 7-8 | Shrimp | 117 |
| | | " | 9-10 | G. halibut, tagging | 57 |

Table 1. (Continued)

| Sub-area | Div. | Country | Months | Type of survey | No. of sets |
|---|---|---|---|---|---|
| | J | CAN-N | 7-8 | Shrimp | 87 |
| | | " | 9-10 | G. halibut, tagging | 36 |
| | | " | 10-11 | Capelin | - |
| | | " | 11-12 | Squid | - |
| | | FRA | 2 | Cod | 20 |
| | | USSR | 8-11 | Groundfish | ...[1] |
| | | " | 10 | Redfish, G. halibut | 42[2] |
| 3 | K | CAN-N | 3 | Cod, tagging | 107 |
| | | " | 6-7 | Salmon | - |
| | | " | 6-7 | G. halibut, tagging | 111 |
| | | " | 9-10 | " " | 4 |
| | | " | 10-11 | Herring, capelin | - |
| | | " | 11-12 | Squid | - |
| | | FRA | 2 | Cod | 22 |
| | | USSR | 8-11 | Groundfish | ...[1] |
| | | " | 10 | Redfish, G. halibut | ...[2] |
| | KLNO | USSR | 4-8 | Groundfish | 305 |
| | L | CAN-N | 1 | Groundfish, feeding | 27 |
| | | " | 2-3 | Capelin | - |
| | | " | 3 | Fish ecosystem studies | - |
| | | " | 3 | Cod, tagging | 32 |
| | | " | 3-5 | Crab | - |
| | | " | 4-5 | Groundfish (deepwater) | 66 |
| | | " | 5-6 | Herring, capelin | - |
| | | " | 7-11 | Crab | - |
| | | " | 9-10 | G. halibut, tagging | 4 |
| | | " | 10 | Cod, tagging | 46 |
| | | " | 10-11 | Capelin | - |
| | | " | 11-12 | Squid | - |
| | | FRA | 2 | Cod | 22 |
| | LNO | CAN-M | 8-9 | Swordfish | - |
| | | CAN-N | 6-7 | Capelin | - |
| | | USSR | 5-6 | Capelin (acoustic) | - |
| | M | CAN-N | 4-6 | Fish ecosystem studies | - |
| | | USSR | 3,5,6,8 | Ichthyoplankton | 515 |
| | N | CAN-N | 1,5-6 | Fish ecosystem studies | - |
| | | " | 4-5 | Groundfish (deepwater) | 44 |
| | | " | 5-6 | Salmon | - |
| | | " | 6 | Squid | 47 |
| | O | CAN-N | 4-5 | Groundfish (deepwater) | 23 |
| | | " | 6 | Squid | 131 |
| | P | CAN-N | 5 | Pollution survey | - |
| | Pn | " | 6 | Squid | 43 |
| | Ps | " | 2 | Cod tagging | 27 |
| | | " | 1-3 | Herring | - |
| | | " | 5-6 | Herring, capelin | - |
| | | " | 8-12 | Herring | - |
| | | FRA | 10 | Cod tagging | 18 |
| | | " | 11 | Scallops | 116 |
| 4 | R | CAN-N | 4-5 | Herring | - |
| | | " | 7 | Scallops | - |
| | RST | CAN-N | 2 | Shrimp | 57 |
| | | " | 6 | Juvenile flatfish | 83 |
| | | " | 7-8 | Shrimp, redfish | 185 |
| | | " | 8 | Groundfish (acoustics) | - |
| | | " | 11 | Shrimp | 21 |
| | T | CAN-M | 4-5 | Scallops | 135 |
| | | " | 5 | Herring (larvae,migration) | - |
| | | " | 5-6 | Cod migration | 22 |

| Sub-area | Div. | Country | Months | Type of survey | No. of sets |
|---|---|---|---|---|---|
| | | " | 6-7 | Mackerel (eggs) | 207 |
| | | " | 7,9 | Scallops | 79 |
| | | " | 9-11 | Herring (larvae,juveniles) | 51 |
| | | " | 11-12 | Cod migration | - |
| | Vn | CAN-N | 3 | Squid | 21 |
| | V | CAN-M | 1 | Herring migration | - |
| | | " | 9-10 | Cod migration | - |
| | VWX | CAN-M | 2 | Ichthyoplankton | 118 |
| | | " | 5-7 | " | 378 |
| | | " | 11-12 | " | 100 |
| | | " | 7 | Comparative fishing | 138 |
| | | " | 8 | Squid | 41 |
| | | " | 9 | Swordfish | 7 |
| | | " | 10-11 | IYGPT gear test | 49 |
| | | USSR | 8-10 | Ichthyoplankton | 378 |
| | W | CAN-M | 1 | Trawl gear tests | 10 |
| | | " | 6 | Pollock migration | - |
| | | " | 9 | Silver hake patch study | 211 |
| | | " | 11-12 | Redfish (acoustics) | - |
| | | USSR | 8-9 | Ichthyoplankton | 264 |
| | WX | CAN-M | 9 | Lobster (offshore) | 68 |
| | | " | 9-10 | Crab | 82 |
| | X | CAN-M | 3 | Herring larvae, zooplank. | 238 |
| | | " | 6 | Scallops | 100 |
| | | " | 7 | Herring migration | - |
| | | " | 8 | Herring larvae, zooplank. | 160 |
| | | " | 8 | Herring (acoustics) | - |
| | | " | 8 | Scallops | 74 |
| | | " | 10 | Redfish, pollock | 17 |
| | | " | 10 | Scallops | 26 |
| | | " | 11 | Herring larvae, zooplank. | 131 |
| | | USA | 4 | Ichthyoplankton | 10 |
| | | " | 9 | Clams | 23 |
| | | " | 10 | Ichthyoplankton | 4 |
| | | " | 12 | " | 4 |
| 5 | YZ | USA | 6 | Ichthyoplankton | 77 |
| | | " | 9-10 | " | 92 |
| | Z | CAN-M | 5-7 | Scallops | 372 |
| | | " | 9-10 | Swordfish | 7 |
| | | USA | 2 | Clams | 16 |
| | | " | 2-4 | Ichthyoplankton | 76 |
| | | " | 4 | Yellowtail flounder | 42 |
| | | " | 5 | Red crab | 25 |
| | | " | 6 | Scallops | 84 |
| | | " | 6-8 | Ichthyoplankton | 194 |
| | | " | 9 | Clams | 22 |
| | | " | 12 | Ichthyoplankton | 64 |
| | | USSR | 4-5 | MARMAP | 156[3] |
| | | " | 7-8 | " | 156[4] |
| | | POL | 2-3 | " | 156[5] |
| 6 | ABC | CAN-M | 8 | Swordfish | 9 |
| | | USA | 2-4 | Ichthyoplankton | 72 |
| | | " | 5-6 | " | 72 |
| | | " | 5-6 | Scallops | 293 |
| | | " | 9-10 | Ichthyoplankton | 72 |
| | | " | 10-12 | " | 70 |
| | | USSR | 4-5 | MARMAP | ...[3] |
| | | " | 7-8 | " | ...[4] |
| | | POL | 2-3 | " | ...[5] |

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

## 2. Survey Plans for 1981

Survey plans for 1981 and early 1982 are listed in Table 2. Attention was drawn to changes in 1981 plans from those carried out in 1980. Canada (M) will increase survey activity on silver hake in Div. 4VWX, on argentine in Div. 4VWX and Subarea 5, a new 0-group gadoid survey in Div. 4WX and several new invertebrate cruises. Canada (N) has plans for a new fall stratified-random groundfish survey on the Grand Bank, comparative trawling experiments between *A. T. Cameron* and the new research vessel *W. Templeman* when the latter becomes available, combination of two groundfish surveys in Div. 2J and 3KL into one survey to cover both shallow and deep strata, a groundfish survey in Div. 2GH using lines or transects, and a new juvenile flatfish survey on Grand Bank. Denmark has carried out a new aerial survey for marine mammals in 1981. There are no major changes for the Federal Republic of

Germany, except that the groundfish surveys in Subarea 1 will be conducted according to the stratified-random survey design, and a special cruise in the Northeast Atlantic is planned for calibration of standard survey trawls including those used in the NAFO area. French groundfish surveys in Janary-February 1981 in the Gulf of St. Lawrence (Div. 4R) and off Labrador (Div. 2J+3KL) used stratified-random survey designs for the first time. Japan plans a major survey in Subareas 3-6 from January to March 1982, using a 2,500 GRT research vessel, the objectives being observations on squid distribution and abundance (larvae, juveniles and adults) and collection of oceanographic data. There are no major changes in the USA research vessel program. It was noted that the USSR had already carried out a new juvenile squid survey in early 1981.

Table 2. Biological surveys planned for the NAFO Area in 1981 and early 1982.

| Country | Area | Type of survey | Dates |
|---|---|---|---|
| A. Surveys planned for 1981 | | | |
| CAN-M | 4RST | Seals (aerial survey) | Jan |
| | 4T | Groundfish | Sep 3-Oct 2 |
| | | Mackerel (eggs) | Jun 15-26 |
| | | Queen crab | May 4-Jun 5 |
| | | " " | Oct |
| | | Scallops | May 11-22 |
| | | " | Jun 1-13 |
| | | " | Jul |
| | 4V | Cod migration | Apr 27-May 8 |
| | 4VW | 0-group gadoid survey | May 11-22 |
| | | Shrimp | Oct 5-16 |
| | 4VWX | Groundfish | Feb 23-Mar 20 |
| | | " | Jul 2-24 |
| | | " | Oct 5-30 |
| | | Silver hake (adult) | Sep 14-Oct 2 |
| | | " " ( " ) | Nov 16-Dec 11 |
| | | Mackerel (eggs) | Feb |
| | | Multi-species studies | Feb |
| | | Comparative fishing | Jul 2-24 |
| | | Red crab | Jul,Oct |
| | | Shrimp | Mar 30-Apr 10 |
| | | " | Aug 31-Sep 11 |
| | | Squid | Jun 1-12 |
| | | " | Aug 17-28 |
| | | Disease and parasites | Apr 21-24 |
| | | " " " | Nov 16-27 |
| | | Hydroacoustics | Nov 2-13 |
| | | Ichthyoplankton | Jan 19-Feb 20 |
| | | " | Mar 23-Apr 16 |
| | | " | Jun 15-26 |
| | | " | Nov 2-13 |
| | 4W | Silver hake (juvenile) | Jan 5-16 |
| | | Herring | Jan 19-Feb 27 |
| | | Cod migration | Sep 8-18 |
| | 4X | Herring (larvae) | Mar 2-20 |
| | | " ( " ) | Jul 27-Aug 14 |
| | | " ( " ) | Nov 9-27 |
| | | " (juveniles) | Jun 29-Jul 10 |
| | | " (adults) | Jul 13-24 |
| | | Lobster-Jonah crab (offshore) | Jul,Sep |
| | | Lobster (offshore) | Jul,Aug,Oct |
| | | Scallops | Jun 15-27 |
| | 4 | IYGPT gear trials | Apr 21-24 |
| | 4VWX-5Z | Argentine | Sep 21-Oct 2 |
| | 4X,5Z | Scallops | Jul 27-Aug 21 |
| | 5Z | Lobster (offshore) | Jun 1-12 |
| CAN-N | 2GH | Salmon and Arctic char | Aug 3-31 |
| | | Groundfish (random) | Oct 23-Nov 11 |
| | 2GHJ | Cod sampling and tagging | Jul 15-Sep 15 |
| | | Capelin survey | Sep 30-Oct 21 |
| | 2HJ+3K | Squid survey | Nov 26-Dec 11 |
| | 2J+3K | Groundfish (strat. random) | Nov. 13-Dec 14 |
| | 2+3K | Shrimp survey | Jul 1-30 |
| | 2+3 | Seals | Apr 15-29 |
| | 3K | Salmon tagging | May 25-Jun 19 |
| | | Herring | Sep 28-Oct 21 |
| | 3KL | Capelin survey | Sep 2-21 |
| | 3L | Cod (food and feeding) | Apr 1-8 |
| | | Crab tagging | Mar 23-Apr 15 |
| | | " survey | May 5-19 |
| | | " " | Jul 24-29 |
| | | " " | Sep 4-9 |
| | | " " | Sep 25-30 |
| | | " " | Nov 9-14 |
| | | Shrimp survey | Apr 21-May 1 |
| | | Herring survey | May 11-27 |
| | 3LMNO | Fisheries ecosystems | Apr 23-May 11 |
| | 3LNO | Groundfish (strat. random) | Apr 2-May 29 |
| | | Capelin and sand lance | Jun 3-29 |
| | | Groundfish (deepwater) | Sep 10-28 |
| | | Groundfish (strat. random) | Sep 1-Nov 20 |
| | 3LPs | Capelin | Jun 16-Jul 14 |
| | 3M | Fisheries ecosystems | May 13-Jun 1 |
| | | " " | Jun 23-Jul 10 |
| | 3NO | Juvenile flatfishes | Aug 13-31 |
| | 3NOP | Squid survey | Jun 4-23 |
| | | " tagging | Jul 21-27 |
| | 3Ps | Herring survey | Jun 24-Jul 3 |
| | | " " | Aug 11-31 |
| | | " " | Sep 4-21 |
| | | " " | Oct 23-Nov 3 |
| | | " " | Nov 26-Dec 11 |
| | | Juvenile flatfish | Oct 5-19 |
| | 4R | Herring survey | Apr 13-May 5 |
| | | Scallops | Jun 1-11 |
| | | " | Jul 20-Aug 7 |
| | | Herring | Nov 10-27 |
| | 4RS | Capelin acoustics | Apr 27-May 29 |
| | 4RST | Shrimp-redfish survey | Jul 14-Aug 24 |
| | | Groundfish acoustics | Aug 26-Sep 8 |
| CAN-Q | 4S | Salmon and eels | Jul 6-16 |
| | | Herring survey | Jul-Aug |
| | | Capelin survey | Oct 5-16 |
| | | Queen crab studies | May,Oct |
| | | Capelin survey | May 18-29 |
| | | Herring juveniles | Aug |
| | | Eel migrations | Sep 26-Oct 2 |
| | | Herring survey | Oct 19-Nov 6 |
| GRL | 0+1 | Marine mammals (aerial) | Apr |
| | 1A | Plankton | Jul-Nov |
| | 1AB | Groundfish and shrimp | Jul-Nov |
| | | Shrimp (photo) | Jul-Aug |
| | 1B | Shrimp (commercial) | Jan-Nov |
| | 1BD | Plankton | Jul |
| | 1CDE | Groundfish and shrimp | Jan-Dec |
| | 1CDEF | Cod (commercial) | Jan-May |
| | 1 | Whales (sightings) | Jul-Sep |
| FRA | 2J+3KL | Cod (strat. random) | Jan 8-Mar 3 |
| | 3P+4R | " ( " " ) | |
| | 3Ps | Groundfish (strat. random) | Mar 5-Apr 1 |
| | | " ( " " ) | Oct 5-Nov 1 |
| | | Scallops | Nov 1-10 |
| | 4VWX | Squid (strat. random) | Aug 22-Sep 22 |
| DEU | 1C-1F | Groundfish | Feb 22-Apr 2 |
| | | " (strat. random) | Nov 9-Dec 18 |
| | 2GHJ | " ( " " ) | Nov 7-Dec 18 |
| | E. Grl. | Groundfish | Feb 22-Apr 2 |
| | | " (strat. random) | Jun 23-Jul 24 |
| | | " ( " " ) | Nov 9-Dec 18 |
| | NE Atl. | Calibration of trawls (including standard survey trawl used in NAFO Area) | Aug 8-Sep 9 |
| USSR | 3K | Groundfish | Jun-Jul |
| | 3KLNO | " | Aug-Sep |
| | 3LNO | Capelin (acoustics) | May-Jun,Nov |
| | 3M | Ichthyoplankton | Apr-May |
| | 4VWX | Silver hake, ichthyoplankton | Aug-Oct |
| | 4+5 | Squid-*Illex*, ichthyoplankton | Feb-Mar |

Table 2. (Continued)

| Country | Area | Type of survey | Dates |
|---|---|---|---|
| USA | 4X | Groundfish survey | May 4-15 |
| | | " " | Nov 2-18 |
| | 5YZ | " " | Jan 5-23 |
| | | " " | Apr 6-May 15 |
| | | " " | Jul 7-24 |
| | | " " | Oct 5-Nov 13 |
| | 5Z | Gear test (bottom trawl) | Jun 29-Jul 2 |
| | | " " ( " " ) | Nov 2-13 |
| | | " " ( " " ) | Dec 7-18 |
| | 5Z+6 | Clam assessment | Aug 3-Sep 11 |
| | | Scallop assessment | Jun 9-Jul 2 |
| | 4-6 | Ichthyoplankton | Feb 17-Mar 26 |
| | | " | Mar 17-Apr 12 |
| | | " | May 20-Jun 26 |
| | | " | Sep 21-30 |
| | | " | Nov 16-Dec 22 |
| | 6ABC | Groundfish survey | Jan 5-23 |
| | | " " | Mar 17-Apr 17 |
| | | " " | Jun 22-Jul 24 |
| | | " " | Sep 16-Oct 16 |

B. Surveys in early 1982

| Country | Area | Type of survey | Dates |
|---|---|---|---|
| CAN-M | 4VWX | Ichthyoplankton | Jan 5-Mar 26 |
| | | Hydroacoustics | Feb 15-26 |
| | | Parasites and diseases | Mar 1-5 |
| | | Groundfish | Mar 1-26 |
| | 4WX | Squid (larvae and juveniles) | Feb 2-26 |
| | 4W | Herring | Jan 5-29 |
| | 4X | Herring (larvae) | Mar 8-26 |
| | 4VWX+5Z | Mackerel (offshore) | Jan 5-29 |
| CAN-N | 2J+3KL | Cod tagging | Mar 12-31 |
| | 3L | Herring | Mar 16-31 |
| | 3LNO | Groundfish | Jan 5-Mar 25 |
| | 3M | Groundfish (strat. random) | Jan 28-Feb 16 |
| | 3Ps | Juvenile flatfish | Jan 18-Feb 3 |
| | | Herring | Jan 5-Feb 16 |
| | | " | Feb 9-26 |
| | 3+4VW | Squid survey | Feb 18-Mar 10 |
| | 4RST | Capelin and herring | Jan 7-26 |
| CAN-Q | 4T | Herring (larvae, juveniles) | Feb-Mar |
| JPN | 3-6 | Squid (larvae to adults) | Jan 16-Mar 5 |
| USA | 4X+5+6 | Groundfish survey | Mar 9-May 7 |
| | | " " | Jun 15-Jul 16 |
| | 5Z | Gear tests (bottom trawl) | Jan 4-29 |
| | 5Z+6 | Scallop assessment | Jul 14-Aug 5 |
| | | Clam assessment | Jul 27-Sep 7 |
| | 4-6 | Ichthyoplankton | Feb 16-Mar 25 |
| | | " | May 17-Jun 11 |

3. Review of Draft Manual on Groundfish Surveys in NAFO Area

As recommended by the Scientific Council at the September 1980 Meeting, a revised draft of the survey manual was circulated to members of the Scientific Council. This draft incorporated comments received on the 1980 draft. Historical information on USSR and German Democratic Republic surveys will be included in the final draft. New material on "Coordination of Joint International Surveys", provided by Mr. R. Wells, was presented and approved for inclusion in the manual. Dr Messtorff provided a detailed diagram of the sediment sampler used by Federal Republic of Germany, and it was agreed that this diagram should also be included.

It was noted that the 1975 draft international standard for drawings of fishing nets had not been published by ISO due to inaccuracies in the diagrams. This standard is very relevant to fishing gears used in bottom trawl surveys, and STACREC therefore

recommends

*that the NAFO Secretariat write to ISO requesting that the international standard for specification of fishing nets be expedited.*

In the absence of an agreed ISO standard, it was agreed that the 1975 draft should be included in the manual. Subject to final editing and the above modifications, STACREC

recommends

*that STACPUB consider the publication of the Manual on Groundfish Surveys in one of the Scientific Council's publication series.*

4. Other Matters

The Committee noted that existing time series of groundfish surveys with fixed stations have not been calibrated with more recently introduced stratified-random surveys. It was also noted that biomass estimates from surveys are highly dependent on catchability coefficients. STACREC therefore

recommends

a) *that calibration of fixed-station and stratified-random surveys should be carried out, beginning with USSR groundfish surveys in Div. 3M; and*

b) *that reports of biomass estimates from surveys should include the catchability coefficients used in calculating these estimates.*

There was further discussion of research vessel trawl performance. The United States is routinely monitoring head rope height during surveys using a third wire. More emphasis is being put on gear testing now and in the forseeable future. This program complements research planned by Federal Republic of Germany mentioned above. Attention was also drawn to the effect of variable trawl performance on research vessel catches at a trawl survey workshop held in Canada in 1980. STACREC considered such studies to be extremely valuable in improving survey methods.

## III. ENVIRONMENTAL STUDIES

### 1. MEDS Progress Report for 1980

Highlights of the information in the progress report for 1980 (SCR Doc. 81/VI/82) are given below.

a) Inventory of reported data collections in 1980

The Committee noted that MEDS had identified 28 cruises from 6 countries totalling upwards of 7,000 stations for which data had not yet reached MEDS. The list identifying the cruises is presented in table 1 of SCR Doc. 81/VI/82. The information was extracted from cruise reports, NAFO documents and personal communications; no inventory forms were received this year. The representative of MEDS suggested that national representatives could send the required cruise information to MEDS in any convenient form as an alternative to compiling all of the information on the inventory form. Federal Republic of Germany supplied information about the 5 cruises noted in table 1. The Denmark (G) representative noted that the cruises described in NAFO SCS Doc. 81/VI/12 were absent from table 1 of SCR Doc. 81/VI/82.

b) Data received and processed for 1980

An inventory of oceanographic data received and processed for 1980 is given in table 2 of SCR Doc. 81/VI/82. Fifty-six cruises were reported, comprising approximately 6,000 stations. Only data from Canada and the USSR was received. A large portion of these data had not yet been fully processed. The French data sent through IGOSS messages did not reach MEDS. It was agreed that national representatives should try to improve the speed of data submission to MEDS and that MEDS should attempt to deal with these data more quickly as well.

c) Historical data acquisition

MEDS noted that, of the 3,000 stations identified as outstanding from 1979 in last year's report (SCR Doc. 80/IX/149), only approximately 150 were received. Approximately 3,000 stations were received from data collections prior to 1979.

The Committee was informed of a new cruise information management system under development by MEDS. Plans are underway to review all of the ICNAF and NAFO documents for cruise information for input to this system. The MEDS representative suggested that by the time of the June 1982 Meeting he should be in a better position to assess the extent of MEDS data holdings in comparison with historical data collections.

d) IGOSS messages

MEDS reported receiving approximately 1,200 BATHY and TESAC messages from 72 ships in 1980. Messages from ships transmitting information from the area of the Flemish Cap were compiled into a single document (SCR Doc. 81/VI/83). MEDS noted that there are still difficulties associated with messages reaching it, and it was agreed that information about the dates, areas and number of messages transmitted be sent directly to MEDS by the originator. In this way, MEDS will be able to identify any losses and possibly pinpoint the major deficiencies in the system.

### 2. Environmental Conditions in the NAFO Area in 1980

The Committee noted that MEDS has again provided a summary of environmental conditions from the available data. Other reports presented at the meeting are also relevant and are summarized here.

a) Subarea 0 (SCR Doc. 81/VI/79)

Work reported by the USSR noted that the geostrophic flows in this subarea were consistent with the usually observed patterns along the Baffin Island coastline south of Davis Strait.

b) Subarea 1 (SCR Doc. 81/VI/50, SCS Doc. 81/VI/12)

Work by Denmark and Federal Republic of Germany showed that water temperatures were slightly above normal but not by an exceptional degree. This was reflected in limited amounts of cold water evident along the Fylla Bank section and relatively light ice conditions in 1980. A suggestion was made of a positive correlation between the mean temperature in the uppermost 40 m on the Fylla Bank section and cod recruitment. This was based on a non-continuous data record going back to the 1880's.

c) Subarea 2 (SCR Doc. 81/VI/19, 51, 78, 79)

USSR and Federal Republic of Germany surveys showed that the surface water was slightly warmer and saltier than in previous years. This correlation between temperature and salinity has been noted in past years as well. In the waters of the Labrador Current, it was noted that temperatures were cooler than in 1979 and approached long-term mean values. A great deal of small-scale spatial variability was noted. This was reflected in local streams and reversals along some of the sections sampled. It was noted that the volume transport in the more northerly areas were slightly lower than usual.

d) Subarea 3 (SCR Doc. 81/VI/19, 45, 79, 82; SCS Doc. 81/VI/13, 18)

Investigations by the USSR, France, and Canada indicated slightly cooler and fresher surface water compared to previous years. Calculations of mean conditions by both the USSR and Canada indicate that water temperatures are approaching the mean values after a couple of years of above normal conditions. Analyses of the dynamic topography show complex patterns of small size. Volume transports in this area appear to be lower than the mean.

e) Subarea 4 (SCR Doc. 81/VI/38, 82)

Bottom temperatures were sampled all along the Scotian Shelf in conjunction with the squid program. It was noted that warm Slope Water intruded onto the shelf in the Emerald Basin region and this was associated with high catches of squid.

f) Subarea 5 and 6

There were no available documents from which environmental summaries could be made for this area.

3. National Representatives

The Committee was informed of only one change in the national representatives: H. Hatanaka replaces F. Nagasaki as the representative for Japan but the mailing address remains the same. The updated list is as follows: Canada (J. R. Keeley), Cuba (J. Gomez), Denmark (P. Kanneworff), France (G. Stanislas), Federal Republic of Germany (D. Kohnke), German Democratic Republic (B. Schreiber), Japan (H. Hatanaka), Norway (R. Leinebo), Poland (S. Grimm), USSR (V. Ponomarenko), UK (P. Edwards) and USA (R. Ochinero).

The Committee noted that MEDS expressed its willingness to accept submissions in any form from which the data could be reasonably extracted. In this way, they hope to assist the acceleration of data submissions. It was noted by some representatives that much of the delay in both data submission and processing was the result of manpower problems. MEDS encouraged all countries to try to improve on promptness of data submission and MEDS would also try to improve its processing time.

It was noted that MEDS produces a number of reports of particular interest to NAFO and it was suggested that future annual reports to NAFO by MEDS should include a listing of these.

4. Other Relevant Papers (SCR Doc. 80/IX/121, 136; 81/VI/28, 34, 41, 42, 45, 50, 78)

The Committee briefly reviewed available papers analysing environmental conditions for years other than 1980. A number of these relate to conditions over several years. The Chairman noted that they were appropriate for the upcoming September 1981 Symposium on "Environmental Conditions in the Northwest Atlantic during the 1970-79 Decade", and urged that the authors be encouraged to present them at the Symposium. Other papers containing information on environmental conditions observed in early 1981 were reviewed (SCR Doc. 81/VI/41, 45).

5. Other Matters

The MEDS representative noted that the review of environmental conditions for the previous year is based on only a portion of the data taken during the period. He noted that a much better review would be possible if the report was delayed until the September meeting of the Council, since both information in research documents printed at the June meeting plus additional data in MEDS could be incorporated. The Committee noted that June is the preferred time from the point of view of participants present (both biologists and physical oceanographers) as well as use of environmental information for other aspects of the spring meeting. It was agreed that, for the present, the review of the environmental conditions should continue to be prepared in June. However, greater efforts should be made to improve on speed of data submission to MEDS and its subsequent processing and reporting.

## IV. OTHER MATTERS

1. Request by the Fisheries Commission for Review of Gear Definitions Relevant to NAFO Fishery Regulations

In accordance with a request by the Fisheries Commission (FC Doc. 81/IV/3, revised), the terms and definitions for trawling gears were discussed. After due consideration, the Committee agreed that the definitions given in Annex 1 are the most appropriate and that a supplementary illustration showing the various trawl components would aid comprehension of the definitions.

2. Acknowledgements

The Chairman expressed appreciation to Dr R. W. Trites and Dr W. G. Doubleday for presiding over the sessions dealing with environmental studies and biological surveys, and to Mr P. J. G. Carrothers for his contribution on gear definitions. He thanked the rapporteurs and all participants for their co-operation during the meeting, and the Secretariat for their usual efficient work.

## ANNEX 1. DEFINITION FOR THE VARIOUS COMPONENTS OF A TRAWL

The following definitions, supplemented by a labelled illustration, are considered to be appropriate for the various components of a trawl:

1. Topside component is (a) in a 2-seam trawl that portion of the net between the two seams or rib-lines and nearest the sea surface while the trawl is in tow, and (b) in a 4-seam trawl that portion of the net between those two seams or rib-lines which are nearest to the sea surface while the trawl is in tow.

2. Bottomside component is (a) in a 2-seam trawl that portion of the net between the two seams and nearest the sea bed while the trawl is in tow, and (b) in a 4-seam trawl that portion of the net opposite the topside component and between those two seams which are nearest the sea bed while the trawl is in tow.

3. Side components, in a 4-seam trawl, are those two other portions between the respective pairs of side seams while the trawl is in tow.

4. Square is that part of the topside component which is connected aft to the belly and forward (a) to the beam in a beam trawl and (b) to the headline or headrope in any other trawl net.

5. Bellies are panels of trawl netting (a) in a trawl with a square, starting from the square on the topside and from the lower wings on the bottom side and extending aft to the belly extension, lengthener or codend whichever comes first; or (b) in a trawl with no square, starting from the wings and extending aft to the belly extension, lengthener or codend whichever comes first.

6. Belly extension is a tapered piece of netting sometimes attached to the after end of the belly so that the effective length of the belly is extended. It is usually characterized by smaller mesh and heavier twine (sometimes double yarn) than in the bellies.

7. Codend lengthener is netting, untapered at least in the net plan, sometimes inserted between the belly or belly extension and the codend to increase catch capacity. It is usually characterized by larger mesh and lighter twine (sometimes single yarn) than in the codend but equal or heavier twine and equal or smaller mesh than in the belly or belly extension.

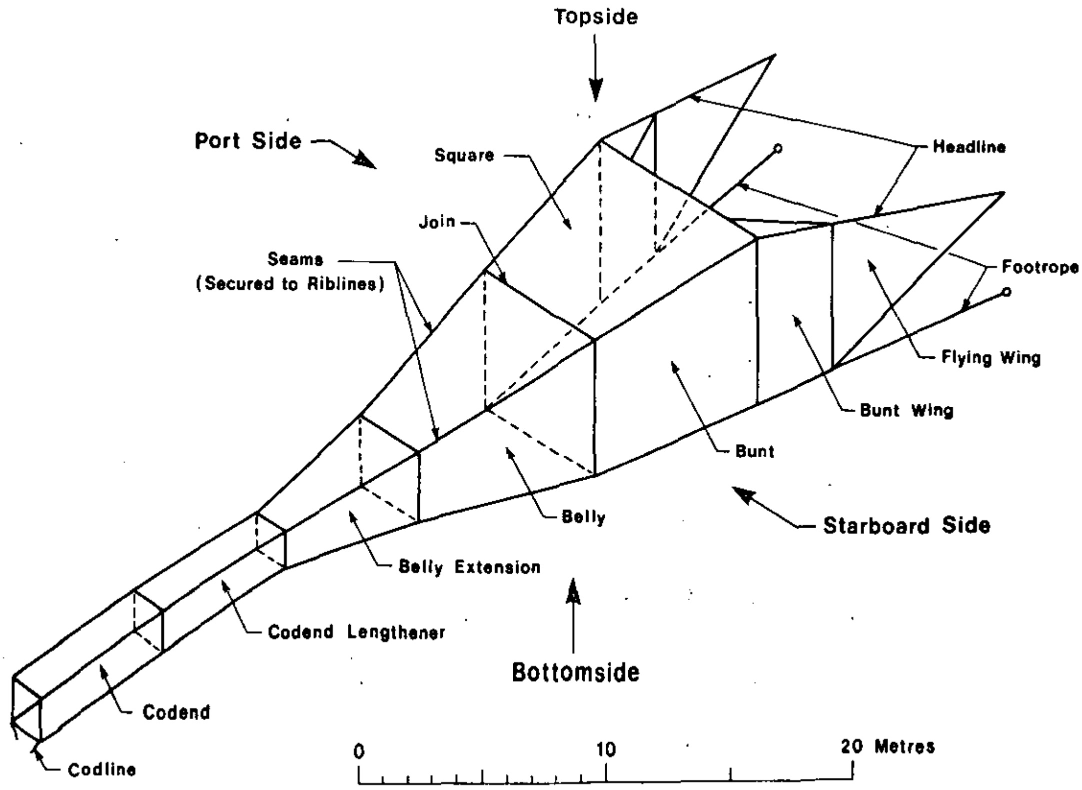
8. Codend is the after portion of the trawl net, untapered at least in the net plan, with mesh usually of the smallest allowable size, attached to the after end of the bellies (or belly extension or lengthener, if present), secured to form a bag by means of a cod-line or codend clip reaved through the after or terminal meshes (or rings attached thereto) to retain the catch until released on board the trawler.

   The topside of the codend, in a 2-seam trawl, is that half of the perimeter of the codend which is nearest the sea surface, and the bottomside of the codend is that half of the perimeter which is nearest the sea bed while the trawl is in tow.

9. Chafing gear or chafers are attachments to the trawl net designed to protect the codend: (a) topside chafing gear or topside chafer is an attachment affixed to the topside of the codend in a 2-seam trawl or to the topside and sides of the codend in a 4-seam trawl, and (b) bottom chafing gear or bottom chafer is an attachment to the bottomside only of the codend.

10. Panel, in the case of midwater trawls, refers to the total area of netting, irrespective of mesh size, between each pair of adjacent seams of the trawl forward of the codend (e.g. top panel, bottom panel, side panel). The term panel, as applied to bottom trawls, usually refers to each discrete piece of netting tailored for the trawl, i.e. each section of netting between successive transverse joins and between adjacent longitudinal seams.

(See overleaf for illustration)




**Atlantic IIA Standard Groundfish Survey Trawl (4 - seam)**

# APPENDIX III. REPORT OF STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

Chairman: R. G. Halliday

Rapporteur: V. M. Hodder

The Committee met at Dartmouth, Nova Scotia, Canada, in three sessions during 10-18 June 1981, to consider and report on matters referred to it by the Scientific Council (see Part E, this volume). The members in attendance were R. G. Halliday (Chairman), J. Messtorff (EEC), J. P. Minet (EEC), A. T. Pinhorn (Canada), V. A. Rikhter (USSR), and H. Hatanaka (Japan) was appointed to replace A. Paciorkowski (Poland) who was not present. The Chairman of the Scientific Council (R. H. Letaconnoux) also attended the sessions. The Assistant Executive Secretary was appointed rapporteur.

1. Review of Scientific Council Publications, 1980/81

The Committee noted that the Secretariat had issued several scientific publications since the June 1980 Meeting of the Council, as follows:

a) Journal of Northwest Atlantic Fishery Science

Following the proposal of STACPUB at the September 1980 Meeting, three cover designs were prepared and circulated to STACPUB members, whose various choices, when evaluated, resulted in the selection of the yellow and black design used for Vol. 1. This volume, containing 10 scientific papers (111 pages), was printed in December 1980 and distributed in January 1981. The Editor reported that six papers had been accepted to date for Vol. 2.

b) NAFO Scientific Council Reports, 1979-80

In accordance with the proposal of STACPUB that the reports of the Scientific Council be published on a calendar year basis, the 1979-80 issue (189 pages) was finalized in December 1980 and distributed in January 1981. This volume contains the reports of Scientific Council meetings held in March, May-June and November 1979, and in February, June, September and November 1980. Also included are the agenda, list of recommendations, list of summary and research documents, and list of participants for the various meetings held during 1979 and 1980.

c) NAFO Scientific Council Studies, No. 1

The first issue of this series, containing 11 edited, scientific contributions (101 pages) which initially appeared as research documents, was printed in March and distributed in April 1981.

d) Provisional Index and List of Titles, 1979-80

Continuing the procedure followed during the last few years of the ICNAF regime, the provisional index and list of titles of Scientific Council meeting documents for 1979 and 1980 was prepared and distributed in March 1981. The intent is that a provisional index will be prepared annually and that the information will be compiled and published in a single volume at 5-year intervals.

e) NAFO Statistical Bulletin, Vol. 29 for 1979

Publication of this first NAFO issue is anticipated during July-August 1981. The 8-month delay is due to late reporting and verification of 1979 fishery statistics. The Committee noted that the final issue of ICNAF Statistical Bulletin (Vol. 28 for 1978) was published in November 1980.

2. Consideration of Need for Special Issues of Studies

It was recognized that the special sessions to be held at the September 1981 Meeting would probably produce a substantial amount of material suitable for publication. It was agreed that STACPUB should meet toward the end of the September 1981 Meeting to recommend on how the material should be handled in the Journal and/or Studies issues.

It was agreed that the Manual for Groundfish Surveys, approved by the Scientific Council, should be published in a special issue of Studies. The title should appear on the front cover and the spine.

3. Coordination of Research Information for the NAFO Area

The Committee noted that, on the basis of the research documents available to date in 1981, there is a substantial amount of research information relevant to the NAFO Convention Area being generated which is not directly available to the Scientific Council. Success in attracting general material, particularly through the use of special sessions, should be evaluated by STACPUB at the end of the September 1981 Meeting to determine what steps might be required to encourage such contributions. It was agreed that this agenda item should be addressed each year to continually monitor progress. Meanwhile STACPUB

recommends

*that countries producing analyses of general biological, ecological and methodological interest be encouraged to submit these to the Scientific Council.*

4. Proposed Ichthyoplankton Identification Manual

This matter was initially considered at the September 1980 Meeting and discussed further at the present meeting. STACPUB

recommends

*that the Scientific Council establish a working group of ichthyoplankton systematic experts at the September 1981 Meeting to review the state of knowledge on ichthyoplankton identification and to recommend whether the production of an ichthyoplankton identification manual for the Northwest Atlantic at this time is a practical and worthwhile venture.*

If the answer is affirmative, the working group should propose mechanisms for production of such a manual. In preparation for a meeting of the working group, the Secretariat is asked to obtain (a) a Northwest Atlantic species list, (b) an index and examples of ICES plankton identification sheets, and (c) copies of manuals available and in use in the laboratories of member countries, and to make these available to participants at the proposed meeting of the working group.

5. Publication and Editorial Policy

a) Editorial board for the Journal

Names submitted to STACPUB as prospective associate editors were reviewed and approved lists were drawn up in each of the four subject areas - biological oceanography, vertebrate fisheries biology, invertebrate fisheries biology and bio-mathematics. The Chairman of STACPUB and the Editor will solicit acceptance from the nominees and report on the results at the September Meeting. A statement on the structure and function of the Editorial Board (Annex 1) was agreed.

The Secretariat is asked to investigate the possibility for, and the implications of, paying miscellaneous costs (postage, telephone, etc.) of editors, not covered by national governments, and to report on this to the September 1981 meeting.

b) Terms of reference for Journal editors

A set of terms of reference for editors were drawn up and approved (Annex 2).

c) Fate of rejected Journal papers

It was noted that papers submitted directly to the Journal have not gone through the STACPUB selection process for Studies. Hence, those papers not suitable for the Journal could not be considered for Studies without substantial delay. It was agreed to give the Editor authority to consider these papers for Studies. All such cases are, however, to be reported to STACPUB annually.

d) Upgrading of Journal reprints

A preliminary report on ways of folding and stitching reprints rather than stapling, as is present practice, and associated costs was received from the Secretariat. However, it was decided to allow more time for investigation of alternatives which may be of lower cost, and decision was deferred to the September 1981 Meeting. The Secretariat was requested to provide a detailed report at that time which documented, to the extent possible, present costs and income from sales associated with the Journal as well as potential incremental costs.

6. Documents for Possible Publication

The members of STACPUB reviewed the research documents presented to the November 1980 and the February and June 1981 Meetings of the Scientific Council and requested the Secretariat to invite the authors of the following documents to submit suitably revised manuscripts for possible publication in one of the Scientific Council series: SCR Doc. 80/IX/159, 160, 166, 168, 170; 81/II/7+8; 81/VI/22, 28, 29, 40, 46, 47, 70+80, 75, 76, 78. The Committee noted that 3 papers selected at the June 1980 Meeting were also expected for the next issue of Studies.

7. Acknowledgements

The Chairman thanked the Committee members for their interest and cooperation and expressed his appreciation for the support rendered by the Secretariat.

## ANNEX 1. STRUCTURE AND FUNCTION OF THE EDITORIAL BOARD

The Editorial Board for the Journal of Northwest Atlantic Fishery Science shall consist of an Editor and Associate Editors, none of whom will be remunerated. The editors are appointed by the Scientific Council on the recommendation of STACPUB. The Editor will be responsible to STACPUB for implementation of Scientific Council publications policy. The Associate Editors are selected from established scientists in the four fields of biological oceanography, vertebrate fisheries biology, invertebrate fisheries biology and bio-mathematics. The editors need not be members of the Scientific Council.

## ANNEX 2. TERMS OF REFERENCE FOR JOURNAL EDITORS

Appointments to the Editorial Board will be subject to annual review by STACPUB, but there are no restrictions on term of appointment. Associate Editors are responsible for recommending to the Editor acceptance or rejection of papers based on their scientific quality in relation to Journal standards. Papers recommended for acceptance are to be submitted to the Editor edited with regard to language usage, format and style as set out by the Editor. It is the responsibility of the Associate Editors to select appropriate referees when these are required and to conduct all necessary communication with the referees and with authors regarding revisions to the content or form of manuscripts until such time as the Associate Editor can decide on the suitability of the manuscript for publication. The Editor has over-riding authority on all decisions regarding acceptance of manuscripts and in resolving disagreements between Associate Editors. Associate Editors can propose manuscripts for inclusion in the Journal and are expected to encourage submission of manuscripts suitable for publication in the Journal.

# PART C

## REPORT OF SCIENTIFIC COUNCIL

Annual Meeting, September 1981

CONTENTS

# REPORT OF SCIENTIFIC COUNCIL

Annual Meeting, September 1981

Chairman: R. H. Letaconnoux Rapporteur: V. M. Hodder

The Scientific Council and its Standing Committees on Fishery Science and on Publications met at Halifax during 8-11 September and at Dartmouth, Nova Scotia, Canada, during 12-18 September 1981 to consider and report on the various matters listed in the Agenda (see Part E, this volume). Representatives attended from Canada, Cuba, European Economic Community (Denmark, Federal Republic of Germany, and France), German Democratic Republic, Japan, Poland, Portugal and Union of Soviet Socialist Republics (USSR), and observers were present from Spain and United States of America (USA) (Part E, this volume). The participants included several scientists who were invited to present papers at the Special Session on Remote-Sensing Methods and their Possible Application to Fisheries Science on 14 September and at the Symposium on Environmental Conditions in the Northwest Atlantic during the 1970-79 Decade on 15-16 September.

The reports of the Standing Committees, as adopted by the Council at this meeting, are given in Appendix I (STACFIS) and Appendix II (STACPUB). Summaries of these reports and other matters considered by the Council are given below.

## I. FISHERY SCIENCE (APP. I)

### 1. Special Session on Remote-Sensing Methods

The Council noted that the Special Session took place on 14 September 1981, with R. W. Trites (Canada) as Convener. The purpose of the Session was to focus on remote-sensing applications relevant to fisheries research. It also noted the significant advances in and potential utility of such remote-sensing techniques and endorsed the recommendations of STACFIS on these matters.

### 2. Symposium on Environmental Conditions in the Northwest Atlantic during the 1970-79 Decade

The Council noted that the Symposium was held on 15-16 September 1981, with E. J. Sandeman (Canada) as Convener. The Council reiterates the concern of STACFIS relating to the difficulty of maintaining time series of ocean climate data and the shrinking efforts being devoted to the collection of such data. It was pointed out that the application of remote-sensing techniques might alleviate the problem to some degree, particularly in achieving broad spacial coverage. The Council therefore supported the request of STACFIS that NAFO should consider fisheries requirements for remote-sensing and ensure that these requirements are communicated to those responsible for specifying satellite remote-sensing systems in the future.

The Council also noted the concern of STACFIS that there was no clear focus for discussing environmental matters on a regular basis within its present structure, and agreed to the establishment of a subcommittee within the framework of STACFIS to consider and discuss matters relevant to remote sensing and environmental research on a regular basis. It was unanimously agreed that R. W. Trites (Canada) be appointed Chairman of the Subcommittee and that the first meeting (1 day) be held immediately in advance of the regular STACFIS Meeting in June 1982.

### 3. Georges Bank-Gulf of Maine Larval Herring Program

The Council noted that the Task Force on the Larval Herring Program, with M. D. Grosslein (USA) as Convener had met on 14-15 September 1981, to consider further progress on herring studies as outlined in recommendations from the September 1980 Meeting. Several documents and working papers covering a variety of subjects were reviewed on the biology of herring. The Council welcomed the continuing progress made by the Task Force in evaluating and analyzing the voluminous quantity of data relevant to the larval herring program and agreed that the Task Force should pursue its original objectives and attempt to conclude its analysis of the data. To achieve this purpose, it was agreed that the Task Force should meet again at the June 1982 Meeting.

### 4. Flemish Cap Project

The Council noted that the Working Group had met on 12 September 1981, with J. T. Anderson (Canada) as Convener, and reviewed the results of recent research on a variety of aspects related to environmental influences on the production and survival of cod and redfish larvae and juveniles. The Council endorsed the recommendations of STACFIS that the newly-compiled time series of temperature and salinity data be examined to determine their potential interaction with cod recruitment on Flemish Cap. The Council noted that there were no specific proposals for investigations on Flemish Cap in 1982 and strongly endorsed the recommendations of STACFIS that a reappraisal of the aims of the Flemish Cap project is urgently needed, if future research is to achieve the desired results.

5. Coordination of Squid Research

The Council noted that the *ad hoc* Working Group on Squid Research, with T. W. Rowell (Canada) as Convener, met on 9-10 September 1981 to review further information on squid research in 1981 and to plan for continuation of coordinated research in 1982. The Council strongly endorsed the continuation of the research program for 1982, as outlined in Annex 1 of Appendix I. The Council agreed that four days will be allotted for a special session on "Squid Biology and Distribution", to review all available information accruing from national and coordinated research programs and to plan for coordinated squid research in 1983. This meeting should be convened by T. W. Rowell in the week preceding the June 1982 Meeting of the Scientific Council.

6. Other Matters

The Council endorsed the recommendation of STACFIS that the agenda item relating to mesh size requirements for the interacting fisheries on cod and redfish in Div. 3M be deferred to the June 1982 Meeting, due to inadequate representation at the present meeting of experts involved in selectivity studies.

## II. PUBLICATIONS (APP. II)

1. Review of Scientific Publications

The Council noted that the first NAFO issue of *Statistical Bulletin* (Vol. 29) was ready for distribution, that Vol. 2 of the *Journal of Northwest Atlantic Fishery Science* would be published in October 1981, and that the NAFO Manual on Groundfish Surveys (*Scientific Council Studies*, No. 2) would be published in December 1981.

2. Editorial Board for the Journal

The Council adopted the recommendation of STACPUB regarding the establishment of the Editorial Board, consisting of Mr. V. M. Hodder as Editor, with Dr. W. G. Doubleday, Mr. A. Lee, Mr. E. J. Sandeman and Dr. W. Templeman as Associate Editors.

3. Journal Reprints

The Council adopted the recommendation of STACPUB concerning the upgrading of Journal reprints and requested the Executive Secretary to use Volume 2 as a pilot study.

4. Distribution and Promotion of the Journal

The Council, although noting the importance of promoting the widest possible distribution of the Journal, agreed that an efficient distribution policy was required, involving free distribution to fishery scientists and institutes of Contracting Parties of NAFO and partial cost recovery through subscription fees for certain other user sectors of the scientific community. The Council therefore endorsed the guidelines proposed by STACPUB (see Appendix II, Section 5) and requested the Executive Secretary to take appropriate action on this matter.

In order to solicit subscribers to the Journal, the Council also requested the Executive Secretary to investigate the possibilities of advertising the Journal widely by calling on the goodwill of various organizations and abstracting services to include announcements in their publications.

5. Other Matters

The Council endorsed the proposals of STACPUB regarding (a) the possible publication of various papers presented to this meeting as research documents, (b) the development and publication of regional ichthyoplankton manuals, (c) the revision of the NAFO List of Species Items by changing the scientific name of roundnose grenadier from *Macrourus rupestris* to *Coryphaenoides rupestris*, and (d) investigation by the Executive Secretary of the potential benefits of utilizing microfiche or microfilm for storage, retrieval and distribution of meeting documents and publications.

## III. RULES OF PROCEDURE

1. Proposal to Amend Rule 3.1 Regarding Election of Officers

The Council unanimously agreed to defer this item for consideration at the June 1982 Meeting.

2. Proposal to Amend Rule 4.1 Regarding Distribution of Draft Provisional Agenda 100 Days Before the Opening Date of a Meeting (SCS Doc. 81/IX/25)

The Council noted that the adoption of such a rule would create difficulties, as the time between the

June Meeting and the Annual Meeting in September is usually less than 100 days. It was unanimously agreed that the proposal was unacceptable.

## IV. FUTURE SCIENTIFIC MEETINGS

1. Mid-term Meeting for Shrimp and Seal Assessments

The Council noted that STACFIS had not been able to provide scientific advice for management in 1981 of the shrimp stocks in Subareas 0 and 1, and it was therefore agreed to meet at NAFO headquarters, Dartmouth, Nova Scotia, Canada, during 20-26 November 1981 for this purpose, allowing the first two days for the Shrimp Ageing Workshop to finish its work. The Council noted the EEC request for advice on the shrimp stock off East Greenland and agreed to undertake this assessment at the November Meeting. The Council was informed that a request had not yet been received for advice on the status of the harp and hooded seal stocks, but agreed to deal with this matter during 23-26 November if a request is received from the coastal states involved.

2. Mid-term Meeting for Assessment of Cod and Capelin

The Council noted its earlier decision to meet in February 1982 should it be necessary to provide further advice on the cod stocks in Div. 3M and 3NO and the capelin stocks in Subareas 2 and 3. However, management measures established for 1982 by the Fisheries Commission at this Annual Meeting eliminates the necessity of a mid-term meeting in February 1982. The relevant assessments will be carried out at the June 1982 Meeting.

3. Meeting of *ad hoc* Working Group on Herring Tagging

The Council noted that STACFIS had set up an *ad hoc* Working Group on Herring Tagging, which will meet during 12-14 January 1982, with W. T. Stobo (Canada) as Convener, to coordinate the analysis of the large volume of tagging data preparatory to its consideration by the Task Force on Larval Herring at the June 1982 Meeting.

4. Regular Meeting in June 1982

The Regular Meeting of the Scientific Council, together with its Standing Committees, Subcommittees and Working Groups will be held at NAFO Headquarters, Dartmouth, Nova Scotia, Canada, during 2-18 June 1982, the first 4 days being allocated for a special session on "Squid Biology and Distribution". It was agreed that the dates may be extended, should it be considered necessary when the provisional agenda and timetable for this meeting are being drafted.

## V. OTHER MATTERS

1. Provisional Report of the June 1981 Meeting

The Council received and formally approved, after minor editorial amendment, the report of its meeting at Dartmouth, Nova Scotia, Canada, during 3-19 June 1981 (Part B, this volume).

## VI. OFFICERS FOR 1982-83

1. Election of Officers

The Council confirmed, as a result of a telegraphic vote requested by the Chairman following the lack of a quorum at the June 1981 Meeting, the election of the following officers to serve until the 1983 Annual Meeting.

a) Scientific Council

R. Wells (Canada) - Chairman
V. A. Rikhter (USSR) - Vice-chairman

b) Standing Committees

J. P. Minet (EEC) - Chairman of STACFIS
T. K. Pitt (Canada) - Chairman of STACREC
V. A. Rikhter (USSR) - *Ex officio* Chairman of STACPUB

c) Executive Committee

The four officers noted above and the Executive Secretary constitute the Executive Committee.

2. Members of Publications Committee

The Council confirmed the following appointments of the Standing Committee of Publications:

V. A. Rikhter (Chairman)
R. G. Halliday (Canada)
H. Hatanaka (Japan)
J. Messtorff (EEC)
J. P. Minet (EEC)
A. T. Pinhorn (Canada)
Executive Secretary (*ex officio*)

3. Subcommittees and Working Groups

The Council noted the appointment by the relevant Standing Committees of the following conveners:

STACFIS - Subcommittee on Environmental Reasearch (R. W. Trites)
- Task Force on Larval Herring Program ( M. D. Grosslein)
- *Ad hoc* Working Group on Flemish Cap Project ( J. T. Anderson)
- *Ad hoc* Working Group on Squid Research (T. W. Rowell)

STACPUB - *Ad hoc* Working Group on Ichthyoplankton Manuals (D. F. Markle)

## VII. ADJOURNMENT

The Chairman referred to his concluding remarks on the work of the Scientific Council, made at the closing of the June 1981 Meeting (see Part B, this volume), and hoped that the incoming officers would note some improvement in the situation during the next two years. He expressed his appreciation to the Director of the Bedford Institute of Oceanography for making meeting rooms available, to the outgoing Chairmen of the Standing Committees and Conveners of Working Groups for their excellent cooperation and support since the Inaugural Meeting of the Scientific Council in March 1979, noting that he chaired nine meetings of the Council during the period. He also thanked the Executive Secretary and his staff for their efficiency in rendering invaluable services both during and between meetings.

Mr. Sv. Aa. Horsted, on behalf of all members of the Council, expressed appreciation for the excellent guidance rendered by the Chairmen of the Council and its Committees during the last two years. The meeting adjourned at 1200 hours on 18 September 1981.

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

Chairman: G. H. Winters

Rapporteurs: Various

The Committee met at Halifax on 11 September and at Dartmouth, Nova Scotia, Canada, on 17-18 September 1981 to consider and report on various matters referred to it by the Scientific Council (see Part E, this volume), relating specifically to the Special Session on Remote Sensing Methods, the Symposium on Environmental Conditions during 1970-79, the Task Force on the Georges Bank-Gulf of Maine Larval Herring Program, the Working Group on the Flemish Cap Project, and the Working Group on Squid Research, all of which met at different times during 10-16 September 1981. The conveners of the various groups acted as rapporteurs in summarizing the results of the discussions at their respective sessions. Scientists attended from Canada, Cuba, EEC (Denmark, Federal Republic of Germany, and France), German Democratic Republic, Japan, Poland, Portugal, Spain, USA and USSR.

## I. SPECIAL SESSION ON REMOTE-SENSING METHODS AND THEIR POSSIBLE APPLICATION TO FISHERIES SCIENCE

### 1. Introduction

The Special Session, convened by R. W. Trites (Canada), was held at the Bedford Institute of Oceanography on 14 September 1981 during which 12 contributed papers were presented and discussed. To ensure that the major aspects of remote-sensing application to fisheries science were not overlooked, 5 of the 12 contributions were presented in response to invitations by the convener. The purpose of the session was to focus on remote-sensing methods relevant to fisheries research, thereby informing and bringing participants up to date on both the demonstrated and potential usefulness of such techniques in NAFO's particular fields of interest.

### 2. General Considerations

Although the Special Session was mainly an information exchange medium, subsequent informal discussions by interested participants led to the following proposal which were considered by STACFIS.

a) It was noted that the sea-surface thermal maps, showing the position of the Gulf Stream, fronts, eddies, shelf water, etc., are proving to be extremely useful in fisheries research applications, especially the squid research program. However, the present maps issued by the National Environmental Satellite Service are produced in near real-time, whereas a better interpretation can normally be made in hindsight, particularly when an area has been cloud-covered for a number of days. Special routine analyses should also be incorporated, such as distance offshore of shelf water-slope water and slope water-Gulf Stream boundaries at intervals of longitude, amount and time of shelf water entrainments, etc. STACFIS therefore

recommends

*that the Scientific Council encourage the appropriate agencies involved in remote-sensing technology relevant to sea-surface temperatures in the NAFO area to produce an improved product.*

b) Because of the evident value of recent satellite water-color data from CZCS for productivity and fisheries ecology studies, the archive of collected, but unanalyzed, data needs to be examined and requests made for additional data collection and analyses. Color coverage should be about as frequent as thermal infra-red data is at present, and it should include chlorophyll estimates as well as details of surface-structure not necessarily discernible in thermal products. STACFIS therefore

recommends

*that the Scientific Council encourage the analysis of available satellite water-color data for the NAFO area and alert NOAA/NESS (Nimbus NET group) about important geographical areas for which coverage is so far inadequate.*

c) In view of the importance of remote-sensing technology to fisheries science, it was noted that NAFO scientists should plan to be in a position to influence future satellite systems so that they will better serve fisheries requirements. Satellites have a limited number of systems that can be carried, and, unless requests are made clearly and firmly by fisheries interests, other groups are more likely to have their special needs met, which may be of little value to fisheries research. STACFIS noted that there is at present no agency within NAFO to accommodate and promote research on remote-sensing techniques, and strongly

recommends

*that the Scientific Council consider a restructuring of its committees to include a clear focus for research on remote-sensing relevant to fisheries science.*

d) Noting that the Special Session provided a good overview of remote-sensing techniques and data available, as well as a useful and concise summary of the application of remote-sensing data to fisheries research, STACFIS therefore

recommends

*that STACPUB consider for publication in the appropriate NAFO series the papers presented to the Special Session on Remote Sensing, subject to the completion, revision and editing of manuscripts, and the approval of the authors.*

3. Papers Presented

a) General overview of the nature and use of remote sensing data, by J. F. Gower, Institute of Ocean Sciences, Sidney, B.C., Canada. (SCR Doc. 81/IX/145)

b) Application of satellite infrared data to analysis of ocean frontal movements and water mass interactions off the northeastern United States, by J. Lockwood Chamberlin, Atlantic Environmental Group, National Marine Fisheries Service, Narragansett, R.I., USA. (SCR Doc. 81/IX/123)

c) Visual features of the Kuroshio eddies as seen in the infrared satellite images from NOAA-6, by K. Kitano, Hokkaido Regional Fisheries Research Laboratory, Yoichi-Machi, Hokkaido, Japan. (SCR Doc. 81/IX/121)

d) Remote sensing of surface water temperatures on the Great Lakes and off the Canadian Atlantic coast, by J. G. Irbe, R. K. Cross, and A. Saulesleja, Atmospheric Environment Service, Downsview, Ont., Canada. (SCR Doc. 81/IX/112)

e) Application of artificial satellites data for fisheries studies in Japan, by I. Yamanaka, Far Seas Fisheries Research Laboratory, 1000 Orido, Shimizu 424, Japan. (SCR Doc. 81/IX/109)

f) Satellite observation of phytoplankton distribution associated with large-scale oceanic circulation, by C. S. Yentsch, Bigelow Laboratory for Ocean Science, West Boothbay Harbor, Maine, USA. (SCR Doc. 81/IX/143)

g) On the possibility of observing natural chlorophyll *a* fluorescence from space, by J. F. R. Gower, Institute of Ocean Sciences, Sidney, B.C., Canada. (SCR Doc. 81/IX/131).

h) Water colour in inshore areas, by B. J. Topliss, Atlantic Geoscience Centre, Bedford Institute of Oceanography, Dartmouth, N.S., Canada. (SCR Doc. 81/IX/110)

i) Application of remote sensing techniques in oceanographic studies of the British Columbia salmon fishery, by G. A. Borstad, R. M. Brown and D. Truax, Seakem Oceanography Ltd., Sidney, B.C.; T. R. Mulligan, Pacific Biological Station, Nanaimo, B.C.; and J. F. R. Gower, Institute of Ocean Sciences, Sidney, B.C., Canada. (SCR Doc. 81/IX/132)

j) Application of a satellite-tracked fishing vessel transmitting terminal (FVTT) to fisheries management and science, by J. J. Murray and R. M. Hayes, U.S. Coast Guard Oceanographic Unit, Washington, D.C., USA. (SCR Doc. 81/IX/113)

k) An application of satellite and remote sensing to studies of surface circulation in NAFO Subareas 3 and 4, by R. W. Trites, D. J. Lawrence and C. K. Ross, Bedford Institute of Oceanography, Dartmouth, N.S., Canada. (SCR Doc. 81/IX/98)

l) Availability of remote-sensing data for the Northwest Atlantic, by Howard Edel, Ocean Science and Surveys, Ottawa, Ont., Canada. (SCR Doc. 81/IX/144).

## II. SYMPOSIUM ON ENVIRONMENTAL CONDITIONS IN THE NORTHWEST ATLANTIC DURING THE 1970-79 DECADE

1. Introduction

The Symposium, convened by E. J. Sandeman (Canada), was held at the Bedford Institute of Oceanography on 15-16 September 1981, during which 15 contributed papers were presented and discussed. Several of the papers were solicited by the convener in order to ensure that the major aspects of environmental conditions were adequately covered.

2. Observations on Trends

In the previous symposium on environmental conditions during the 1960-69 decade, it was noted that, following a climatic maximum in the 1950's, the eastern seaboard of North America had experienced a cooling trend which lasted through the decade of the 1960's. Following rather severe conditions in the early years of the 1970-79 decade, a trend to generally warmer conditions can be discerned. However, the decade of the 1970's clearly displayed some remarkable weather conditions. Ocean climate changes and their impacts on fisheries do not lend themselves to simple summarization, and, although there is evidence that long-term changes in indicators such as sea-surface temperature are coherent over space scales of a few thousand kilometers, it seems clear that the NAFO area cannot be described as a single regime.

In West Greenland waters (Subarea 1), the 1970's experienced a reversal of the cooling trend of the 1960's, with a return to warmer conditions in the surface and near-surface waters, which allowed the production of relatively successful year-classes of cod in 1973, 1975, 1977 and 1979. This followed a period of several years when water temperatures in the near-surface layers were too low for good survival of cod eggs and larvae.

In much of the Labrador-Newfoundland area (Subareas 2 and 3), the 1970-75 period was one of generally declining surface temperatures and salinities, the decadal low in temperature having been reached in the most northerly part of the region in 1972, whereas farther southward the cooling trend seems to have persisted at least until 1975. By 1978, surface temperatures appear to have increased to near-normal levels. However, the makeup of the annual temperature signal shows significant regional differences. For example, even though all parts of Subareas 3 and 4 may have experienced a downward trend in average annual sea-surface temperature from the mid-1950's to the mid-1960's, those for the April-July period on the Grand Bank tended to increase during the period, whereas there was a downward trend over all months in the western part of Subarea 4.

Due to the paucity of subsurface hydrographic data, little can be said about space and time variations at subsurface depths throughout Subareas 2, 3 and 4. Data for Station 27 off St. John's, Newfoundland, provide no basis for believing that the long-term trends in either temperature or salinity below the depth of convective winter overturn bear close similarity to the properties of the overlying surface layer.

Oceanographic conditions in Subareas 5 and 6 were characterized by the continuation of a warming trend that began in the late 1960's and peaked in the mid-1970's followed by a decrease in average temperatures. This pattern was observed in both sea-surface and bottom temperatures. The magnitude of the changes was quite large and could have significant effects on the distribution and abundance of fish and invertebrates in the southern part of the region. The trend was not strictly a coastal phenomenon, being also present offshore in Div. 6E although at a reduced magnitude. The significantly different character of the Gulf of Maine-Georges Bank area and the Browns Bank area in Subarea 4 may in part be due to offshore forces, since Gulf Stream eddies are capable of producing major changes in the properties of shelf water over a period of weeks or months. However, the data base (satellite imagery) is still too short to determine year-to-year variation in eddy numbers and location on decadal time scales.

3. General Considerations

Following the presentation of the papers, a general discussion ranged over a variety of topics both related and unrelated to the theme of the Symposium, with the following considerations receiving special attention:

a) The difficulty of maintaining time series of routine climate-monitoring programs, in the face of the quicker payoff derived from scientifically more attractive, process-oriented and site-specific research, was discussed and concern was expressed on the shrinking efforts being devoted to the former. It was noted that the application of remote-sensing techniques might alleviate the problem to some degree. Not only might remote-sensing help in achieving the broad spatial coverage required for the measuring of climate signals but also some of the higher-precision techniques might be applied to some of the site-specific research that is currently being carried out. It seems clear that NAFO should consider fisheries requirements for remote sensing and ensure that these requirements are communicated to those responsible for specifying satellite remote-sensing systems of the future, as recommended in the preceding section.

b) Although several NAFO coordinated research projects (Larval Herring Task Force, Flemish Cap Project, Squid Research Program) have brought the disciplines of oceanography and fisheries biology together, concern was expressed by several participants that, whereas under ICNAF the Environmental Subcommittee provided a forum for formally bringing together oceanographers and biologists on a regular basis to discuss environmental matters, there was no clear focus for these sorts of discussions within the present structure of the Scientific Council and papers dealing with environmental matters did not receive the consideration that possibly is warranted. STACFIS therefore

   recommends

   *that the Scientific Council consider the possibility of restructuring its committees to ensure that environmental matters are dealt with on a regular basis.*

It was noted that a focus on remote sensing is also required and that perhaps the same restructuring could fulfil this need.

c) STACFIS noted that papers presented to previous ICNAF-sponsored symposia on environmental conditions during the 1950-59 and 1960-69 decades were published in separate volumes of the ICNAF Special Publication series, and therefore

recommends

*that STACPUB consider for publication in the appropriate NAFO series the papers presented to the Symposium on Environmental Conditions during the 1970-79 Decade, subject to completion, revision and editing of manuscripts, and the approval of the authors.*

4. Papers Presented

a) Twentieth century marine climatic change in the Northwest Atlantic and Subarctic region, by M. J. Dunbar, Institute of Oceanography, McGill University, Montreal, Que., Canada. (SCR Doc. 81/IX/128).

b) Meteorological conditions in the decade 1970-79 and their impacts over the Northwest Atlantic, by A. Saulesleja and D. W. Phillips, Atmospheric Environment Service, Downsview, Ont., Canada. (SCR Doc. 81/IX/114)

c) Weather conditions and trends in the Maine-Virginia coastal and offshore area during 1970-79, by M. C. Ingham, Atlantic Oceanographic Group, National Marine Fisheries Service, Narragansett, R.I., USA. (SCR Doc. 81/IX/96)

d) Sea ice and iceberg conditions, 1970-79, by T. C. Wolford, Coast Guard Oceanographic Unit, Washington, D.C., USA. (SCR Doc. 81/IX/130)

e) A review of oceanographic conditions in Subareas 0 and 1 in the decade 1970-79, by Erik Buch, Institute of Physical Oceanography, Copenhagen, Denmark. (SCR Doc. 81/IX/102)

f) Overview of oceanographic conditions within NAFO Subareas 2, 3 and 4 for the 1970-79 decade, by R. W. Trites, Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, N.S., Canada. (SCR Doc. 81/IX/111)

g) Autumn temperature anomalies of the Labrador Current between 1969 and 1980, by M. Stein, Institut fur Seefischerei, Hamburg, Federal Republic of Germany. (SCR Doc. 81/IX/97)

h) Variability of oceanographic conditions in the Hamilton Bank area in the autumn period, by V. A. Borovkov, Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Murmansk, USSR. (SCR Doc. 81/VI/78)

i) Potential temperature and salinity anomalies in the 1970's along the Flemish Cap section, by J. R. Keeley, Marine Environmental Data Service, Ottawa, Ont., Canada. (SCR Doc. 81/IX/129)

j) Oceanographic conditions in Subareas 5 and 6 during 1970-79, by D. G. Mountain, National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, Mass., USA. (SCR Doc. 81/IX/108)

k) Year-to-year seasonal dynamics of water masses on the Nova Scotia and New England shelves from observations obtained at standard hydrographic sections, by I. K. Sigaev and A. B. Bendik, Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO), Kaliningrad, USSR. (SCR Doc. 81/IX/107)

l) Fisheries oceanography and the nature of carrying capacity for larval marine fishes, by S. A. Akenhead, Northwest Atlantic Fisheries Center, St. John's, Nfld., Canada. (SCR Doc. 81/IX/142)

m) Changes in the near-shore ecosystem of the Atlantic coast of Nova Scotia, 1968-1981, by B. B. Bernstein, Welsford Research Group, Halifax, N.S., and K. H. Mann, Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, N.S., Canada. (SCR Doc. 81/IX/134).

n) Some biological correlates of environmental conditions around Newfoundland in the decade 1970-79: harp seals, blue whales and fulmar petrels, by D. E. Sergeant, Arctic Biological Station, Ste. Anne de Bellevue, Que., Canada. (SCR Doc. 81/IX/135)

o) Fisheries oceanography on the Labrador Shelf, by W. H. Sutcliffe and R. H. Loucks, Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, N.S., Canada.

# III. GEORGES BANK-GULF OF MAINE LARVAL HERRING PROGRAM

## 1. Introduction

The Task Force on the Georges Bank-Gulf of Maine Larval Herring Program was convened by M. D. Grosslein (USA) at the Bedford Institute of Oceanography on 14-15 September 1981, with M. Sinclair (Canada) and G. T. Waring (USA) as rapporteurs. Eleven research documents and several working papers were reviewed, covering a variety of topics, including (i) stock identification and intermixing through studies on tagging, meristics and parasites, (ii) density-dependence of fecundity in spawning stocks, (iii) distribution and production of herring larvae in the southern Nova Scotia stock during 1972-80, and (iv) abundance of herring larvae on Georges Bank and in western Gulf of Maine in 1980.

## 2. Stock Identification and Intermixing

### a) Tagging studies

The status of herring tagging research in the Georges Bank-Gulf of Maine region was reviewed, with special emphasis on the International Herring Tagging Program (SCR Doc. 81/IX/133). It was noted that some progress had been made in meeting the three objectives of the program, particularly in relation to herring migrations, but that two of the objectives (stock resolution and herring mortality) had not been adequately met. Complete analysis of the data base, considered essential before initiating new tagging experiments, was reported to be behind schedule.

A detailed analysis of tagging operations relevant to the International Tagging Program, carried out by scientists of the Northeast Fisheries Center, Woods Hole, was reviewed (SCR Doc. 81/IX/122). A major conclusion of the study is that migration of the Jeffrey's Ledge spawning component seems to be more localized than that of the southwest Nova Scotia stock. Discussion centered on whether migrations and the degree of mixing between stocks during various phases of the life history varied between years.

A report on tagging experiments undertaken by scientists of the Maine Department of Marine Resources in 1980 was presented. Tagged juvenile and adult herring totalling 49,202 were released during 10 June-31 October at sites distributed along the coast from Cape Elizabeth to Pasamaquoddy Bay. Spawning herring (stage VI) were observed in fish schools sampled during 24 September- 1 October. Ages 2-4 herring were captured in weirs and stop-seines and ages 4-5 fish were obtained from purse seines. Tag returns (to 5 August 1981) varied from 0.4% to 16.2%. Low returns appeared to be related to extended holding of the fish within pockets of the commercial gear before tagging. The total number of tag returns was 2,492, for an overall recovery rate of 5.1%. Within 60 days of release, 824 tags were returned, the majority of these being from fish which did not move farther than 3.7 km before recapture. Longer-term recoveries indicated a southwesterly movement, especially from release sites in eastern Maine. During the autumn and winter of 1980/81, 68 tags were returned from areas off Gloucester, Maine, and Point Judith, Rhode Island. These tags were primarily from large herring, but some large fish also moved northeastward from release sites in eastern Maine, as indicated by 6 recoveries from Canadian waters. Work continued on experimental tagging of "brit" herring, seeding experiments in canneries, and tagging mortality estimates.

A brief report on Canadian tagging operations in Subarea 4 indicated that the tag returns have only recently been computerized and that analysis of the results should be completed by January 1982. It was therefore considered premature at this time to summarize conclusions concerning the herring populations in Subareas 4-6. In view of the disirability to evaluate all of the tagging data as soon as possible, STACFIS

recommends

*that an ad hoc Working Group be convened during 12-14 January 1982 to summarize all Canadian and USA tag releases and recoveries relevant to the herring stocks in Subareas 4, 5 and 6 and to review analyses related to movements of adults and juveniles, stock identification, and mortality rates.*

It was agreed that W. Stobo (Canada) should convene this Working Group meeting and coordinate the formats of data summaries and analyses so as to maximize possibilities for comparing and combining results of the various tagging studies.

### b) Meristic studies

An extensive analysis of meristic characteristics of herring stocks in the Gulf of Maine region was reviewed (SCR Doc. 81/IX/127). It was noted that some characters were better than others for stock identification purposes due to differences in the timing of ossification of the various characters normally used, pectoral fin-ray counts being considered to be the most appropriate. Specific conclusions concerning the mixing of stocks were not made at this stage but the method shows promise of helping to clarify stock structure and intermixing, particularly when comparison with complete analyses of the tagging data becomes possible. Further analysis of the meristic data and publication of the results were strongly encouraged.

The participants were reminded of a paper (by T. D. Iles) published in *ICNAF Redbook* 1970, Part 3, on vertebral numbers of Bay of Fundy herring. It was noted that this study revealed persistent differences in mean vertebral counts of 2-year-old herring between the New Brunswick side and the Nova Scotia side of the Bay of Fundy, fish in the latter area having the higher counts. It was hypothesized at that time that the juveniles on the Nova Scotia side of the Bay were from spawning in Nova Scotian waters and those on the New Brunswick side of the Bay were from spawning groups to the west. However, similar studies on the 1976 and 1977 year-classes of herring at age 2 showed an apparent reversal in the mean vertebral counts. This was hypothesized by T. D. Iles to have been due to a "vacuum" created in the Bay of Fundy stock by the reduction in the Georges Bank stock. There was some discussion of the problem of interpreting the significance of relatively small differences in vertebral averages based on large sample sizes.

c) Parasite studies

Studies by Canadian and USA scientists on the occurrence of parasites in herring were briefly reviewed. An evaluation of nematode (*Anisakis* sp.) occurrence in herring spawning populations of the Gulf of Maine region in 1963-69 based on unpublished USA data showed a steady increase in infection with age and a significant difference in infection between western Gulf of Maine and southwest Nova Scotia herring. It was noted that a recently initiated Canadian study involves the cataloging of parasites found in various size groups of herring (juveniles and adults) collected from Passamaquoddy Bay, Grand Manan, southwest Nova Scotia and Gulf of St. Lawrence (SCR Doc. 81/IX/124). A total of 330 fish have so far been examined, and the study is planned to continue until May 1984.

A prospectus for studies on parasites as biological tags in herring of the Gulf of Maine region was reviewed (SCR Doc. 81/IX/125). The study is focused on the quantitative estimation of the infestation levels in various ages and groups of herring throughout the year and their migration routes, and sampling is already in progress along the Maine coast and on Jeffrey's Ledge. It was suggested that parasite infestation should be measured for prespawning and spawning herring off southwest Nova Scotia, because tagging studies have shown this area to be one of mixing of southwest Nova Scotia and Gulf of Maine spawners, and that the winter-spring fisheries should also be sampled. Discussion of the plan centered on the benefits that could be derived from a coordinated USA-Canada effort and the desirability of good liaison between Canadian and USA scientists to promote the exchange of information and samples from critical areas and stock components.

d) General observations

It was noted that, in general, both meristic and parasite studies have the potential for providing quantitative estimates of stock intermixing if a number of biological conditions are met (and certain biological knowledge obtained). By contrast, the tagging approach has already confirmed intermixing in a qualitative way, but it is plagued by serious difficulties associated with estimation of fishing mortality and tag return rates in sufficiently small units of time and space for the provision of quantitative measures of mixing. Consequently, meristic and parasite methods should be examined for their potential with the completion of the requisite biological studies before large-scale intensive field sampling is undertaken.

3. Fecundity Studies

The Committee was informed of progress on studies of herring fecundity for the western Gulf of Maine and southwest Nova Scotia stocks. Density-dependent fecundity was noted for the western Gulf of Maine (and Georges Bank), but it was not evident in the data for southwest Nova Scotia due to the narrow range in stock size. Year-to-year variability in fecundity for the southwest Nova Scotia stock was considered sufficient to warrant further detailed study. It was suggested that the results of both studies should be documented.

4. Larval Herring and Related Studies

Progress continues on analyses of growth and mortality studies of herring larvae from the ICNAF series of data, and final revisions of two research documents presented at the September 1980 Meeting (SCR 80/IX/129 and SCR 80/IX/131) are in progress for publication. Analysis of biological and oceanographic data from the 1978 patch study is continuing at the Woods Hole Laboratory and further papers are planned for 1982. In addition, analysis of ichthyoplankton data and environmental indices (particularly wind) from the ICNAF series is planned for 1982. Meanwhile, available reports on recent studies on larval herring were reviewed.

a) Southwest Nova Scotia

A hypothesis relating persistence and size of discrete spawning stocks of herring to the location and size of specific larval retention areas was described (SCR Doc. 81/IX/126). Retention areas of the Georges Bank, Gulf of Maine, southwest Nova Scotia and Bay of Fundy region were shown to be associated with physical oceanographic characteristics thought to be most important for larval transport (tidal and residual circulation patterns, drift, stratification or vertical mixing). Larval herring surveys off southwest Nova Scotia confirmed that dispersal of larvae followed general circulation patterns in that area, and larval production was shown to be well correlated with spawning stock size. Vertical migration of larvae is thought to be involved in their retention in such areas, but empirical data are insufficient at present to provide the basis for testing specific hypotheses.

b) Western Gulf of Maine

Two studies on larval herring along the Maine coast were reviewed. Differential vertical movement of larvae under varying light conditions was shown to be a source of bias in the results of the 1961-66 spring larval herring surveys where depth of sampling was restricted to 20 m (SCR Doc. 81/IX/138). From the 1980-81 larval herring surveys, the characteristics (abundance and size) of the 1980 year-class appeared to be comparable to larval data collected on year-classes of 1974 and 1976, indicating that the harvest of the 1980 year-class at age 2 in 1982 may be comparable to those of the 1974 and 1976 year-classes, i.e. about 12,000-13,000 tons (SCR Doc. 81/IX/140).

c) Georges Bank

MARMAP ichthyoplankton surveys in 1980 and 1981 indicated that, for the fifth consecutive year, production of herring larvae was very poor or non-existent on Georges Bank (SCR Doc. 81/IX/115). A description of total ichthyoplankton abundance, diversity and spatial distribution patterns has been completed for the entire 1971-77 series of data from the ICNAF larval herring surveys (SCR Doc. 81/IX/136). Three faunal zones were defined and related to water mass types, and geographical displacements of the faunal groups were found to be consistent with patterns of mean residual flow and broad-scale incursions of slope water onto the southern part of the bank. A data report, upon which this faunal analysis was based, contains a summary of the 0.333 mm net catches of larvae (all species) for all cruises of the ICNAF series. This report may be obtained upon request from the Northeast Fisheries Center, Woods Hole (National Marine Fisheries Service, Reference Document 81-08, 446 p.).

Stomach contents and morphological condition of more than 7,000 herring larvae were summarized for samples collected during 15 surveys in the 1974-76 spawning seasons (SCR Doc. 81/IX/137). Feeding incidence and prey selectivity were examined in relation to availability of prey. Higher larval condition factors and occurrence of food in 1976 were associated with larger mean size of larvae and increased overwinter survival.

5. Coordination of Future Research on Herring

With the completion of the analysis and summarization of the ICNAF larval herring data series in the next year or two and the need for relating these results to other aspects of herring research, STACFIS considered that the time had come to broaden the scope of the Task Force to cover all phases of herring biology, and therefore proposed that a working group on herring biology be formed to coordinate all ongoing and future research on herring in the NAFO Area.

## IV. FLEMISH CAP PROJECT

1. Introduction

The *ad hoc* Working Group on the Flemish Cap Project was convened by J. T. Anderson (Canada) at the Bedford Institute of Oceanography on 12 September 1981. The convener pointed out the recommendation from the September 1980 Meeting "that high priority should be placed on the analysis of all existing biological and hydrographic data relevant to the objectives of the Flemish Cap Project, for consideration at the June 1981 Meeting" (*NAFO Sci. Coun. Rep.* 1979-80, page 124), noting that the meeting of the Working Group was subsequently deferred from June to September 1981.

2. Summary of Work Undertaken in 1981

Review of research work carried out on Flemish Cap in 1981 indicated a high level of research activity and the successful completion of three special projects. Five Canadian research cruises were carried out during January-August 1981, one involving a two-ship survey. It was noted that the results of a cruise in January were presented at the February 1981 Meeting (SCR Doc. 81/II/13). From the specialized sampling carried out during a two-ship survey in June-July, it is hoped to quantitatively describe the temporal and spatial variation that may occur when sampling the standard grid on Flemish Cap. Additional work included the successful deployment of a moored satellite-communicating thermistor chain and the exchange of plankton sampling gear with the USSR vessel *Gemma* for purposes of intercalibration. USSR research in 1981 included ichthyoplankton surveys during March-May and four hydrographic surveys, the results of which will be reported at the 1982 meeting of the Working Group.

3. Review of Recent Analyses

a) Hydrography

Geostrophic current patterns computed from USSR data obtained in the spring and summer of 1980 on Flemish Cap (SCR Doc. 81/VI/79) indicated the existence of non-stationary meanders which could remove a considerable portion of the ichthyoplankton from the bank with a consequent loss of cod larvae. Recently acquired Canadian data from a moored satellite-communicating thermistor chain on Flemish Cap during May-June 1981 showed seasonal warming only to depths less than 45 m.

As recommended at the September 1980 Meeting, a time series of March-September values of average temperature and salinity of the 0-20 m water layer for the 1955-80 period was presented (SCR Doc. 81/IX/120), but it was not known if these data represented good correlation with cod recruitment on Flemish Cap. STACFIS therefore

recommends

*that a study be undertaken to determine whether a relationship exists between cod recruitment and biomass on Flemish Cap and environmental indices based on temperature and salinity data available in the MEDS data base.*

STACFIS noted that MEDS had reported on oceanographic data transmitted from the Flemish Cap area in 1979-80 (SCR Doc. 81/VI/83). It was further noted that IGOSS transmission of data to MEDS had fallen to a low level during 1981. The Committee agreed that there was no continuing requirement for participants in the Flemish Cap Project to transmit messages through IGOSS on a mandatory basis, but that they should be continued on a voluntary basis in view of the usefulness of such messages for other programs.

b) Ichthyoplankton

Length frequency data from Canadian ichthyoplankton surveys (SCR 81/IX/116, 117) indicated that peak extrusion of redfish occurs in April. In 1978, 1979 and 1980, the abundance of larvae increased exponentially from mid-March to late April, followed by an exponential decrease to July. In contrast to distributions in 1978 and 1979, redfish larvae were found to be concentrated over the shallow area of Flemish Cap in 1980. Larval abundance in July decreased over the three years, the estimated level in 1980 being about 40% of that in 1978. Growth estimates were 0.14-0.15 mm per day for larvae taken in the 1979 and 1980 surveys. Examination of larval redfish otoliths showed the existence of pre-extrusion rings, but no significant difference in growth rate was observed between the 1979 and 1980 data.

c) Juvenile redfish

Catches of juvenile redfish in Canadian groundfish surveys on Flemish Cap were relatively large in 1979 and 1981 and low in 1978 and 1980 (SCR Doc. 81/IX/119). The largest concentrations occurred in the southwest quadrant at depths less than 330 m. The majority of these fish were aged by otoliths as 2-year-olds (<10 cm long), but their relative abundance did not correspond with abundance estimates from larval surveys. Data from these surveys indicated some evidence of redfish cannibalism.

Analysis of the contents of cod stomachs showed that juvenile redfish were most abundant in an arc around the western slope of Flemish Cap in depths less than 310 m (SCR Doc. 81/IX/118). Predation by cod on young redfish may have a significant effect on redfish recruitment. Consumption of small redfish was low in 1978 and 1980 and high in 1979 and 1981. This pattern corresponded with information from the larval fish surveys if the cod were feeding on 1-year-old fish but not to the information from juvenile surveys where most of the young were determined by otoliths to be age 2. In order to resolve this problem, one or more autumn surveys were considered necessary to obtain juveniles for ageing.

d) Adult fish

USSR investigations on cod biology (SCR Doc. 81/VI/76) indicated seasonal differences in feeding which resulted in a buildup of fat content in the winter, but no marked year-to-year changes due possibly to the isolation of the area and stability of the environment. It was stated that cannibalism was not prevalent in cod. Discussion of some Canadian data on cod maturity, growth and seasonal changes in components of its biology resulted in a request that further analysis be carried out and the work presented as a research document at a future meeting.

An analysis of juvenile cod (ages 1 and 2) abundance from USSR bottom trawl surveys in 1968-79 and mean water temperature in the 0-50 m layer on USSR hydrographic section 4-A indicated an inverse relationship between year-class strength and temperature, with a prediction that the 1980 year-class will be below the long-term mean level (SCR Doc. 81/VI/77). There was discussion on the strength of the correlation which was not indicated, and it was suggested that the analysis be extended to include other age-groups.

4. Cod Stock-Recruitment Relationship

It was difficult to evaluate a stock-recruitment relationship for cod on Flemish Cap because the larval surveys only commenced in 1978 and numbers of eggs and larvae were extremely low. Preliminary calculations indicated that about 30% of the estimated number of eggs spawned in 1979 were available to the ichthyoplankton survey. It was agreed that more sampling (ichthyoplankton and adults) during and after the spawning period would refine the estimation of egg and larval abundance and indicate whether the ichthyoplankton surveys can provide quantitative estimates of the spawning products.

5. Calibration of Sampling Techniques

No reports were available on intercalibration of ichthyoplankton and groundfish sampling techniques. It was noted that a comparison of Canadian and USSR plankton sampling gear was carried out on board of the *Gemma* in 1981 and that a report will be presented at the next meeting of the Working Group. Although data exist for estimates of groundfish abundance based on fixed-station and stratified-random surveys and a recommendation by STACREC at the June 1981 Meeting indicated that calibration of these data should be carried out (see Part B, this volume), work on this project has not yet been done.

6. Progress and Future Research

There were no specific proposals for investigations on Flemish Cap during 1982. However, it was noted that a USSR plan of activity in Div. 3M, taking into account the discussions at the present meeting would be formulated soon and forwarded to the Secretariat early in 1982.

Several points were discussed regarding the future of the Flemish Cap Project. These pertained to several areas of concern which are summarized as follows: (i) the almost complete absence of cod eggs and larvae in the Canadian ichthyoplankton surveys in 1979, 1980 and 1981; (ii) the low level of cod stock biomass and the uncertainty about studying recruitment mechanisms when the stock is at such a low level; (iii) difficulties in studying the larval phase of redfish by itself to determine the causes of fluctutions in year-class strength; (iv) the state of the oceanographic program following the curtailment of the moored current meter program in 1979; and (v) the fact that Flemish Cap is in international waters where fishing effort has been high and where regulation and monitoring of catch and effort is poor.

STACFIS noted that the original aim of the Flemish Cap Project was to study the causes and mechanisms controlling year-class strength of demersal fishes in the area. However, in view of the present low level of the cod spawning stock, the inability to accurately assess recruitment and biomass variations due to poor monitoring of catches and fishing effort, and the inability during current surveys to capture significant numbers of cod larvae, STACFIS agreed that the original aim of the Working Group was no longer achievable and accordingly

recommends

*that participants of the Flemish Cap Working Group initiate discussions with a view to redefining the project's objectives as soon as possible so that maximum coordination of 1982 surveys can be achieved.*

## V. COORDINATION OF SQUID RESEARCH

1. Introduction

As agreed at the June 1981 Meeting (Part B, this volume), the *ad hoc* Working Group on Squid Research was convened by T. W. Rowell (Canada) during 9-10 September 1981 to carry out a more complete review of the 1981 survey results and to develop a program for 1982. While national commitments to the 1982 research program were established at the meeting, very little additional information relevant to the 1981 surveys was available. The full report of the Working Group is given in Annex 1.

2. New Information on Squid Research in 1981

Further analysis of data from the February-March 1981 survey in oceanic waters south of Grand Bank (SCR Doc. 81/IX/104) indicated that the greatest concentrations of juvenile *Illex* were in Slope Water near the northern boundary of the Gulf Stream, suggesting that spawning probably occurs in the vicinity of the Gulf Stream rather than on the continental slopes. Distribution and abundance data from a bottom trawl survey of the Scotian Shelf in June 1981 (SCR Doc. 81/IX/100) indicated that squid were in the early immigration phase, with the highest catch rates along the southern part of the Shelf at bottom temperatures of 8-12°C, but a similar survey in August-early September 1981 indicated a sharp decline in squid abundance relative to that in 1980. Three size-groups were apparent, with the large maturing individuals predominating. Juvenile squid, observed mainly on the most southerly part of the Shelf, were interpreted as late arrivals to the area. An attempt to correlate squid abundance indices and bottom temperatures from Canadian bottom-trawl surveys on the Scotian Shelf in July of 1970-80 (SCR Doc. 81/IX/99) gave no clear relationship on a year-to-year basis, but the overall data indicated higher catch rates at 8-12°C.

3. Review of 1981 Program

Five hypotheses regarding the life cycle of *Illex*, developed at the September 1980 Meeting (*NAFO Sci. Coun. Rep.* 1979-80, pages 129-130) were reviewed in relation to the information provided to both the June 1981 and September 1981 Meetings. Although none were definitively rejected or accepted, it was possible to focus more clearly on the relative merits of the information available and possible implications for the hypotheses, as follows: migration of juveniles from the Gulf Stream to the continental shelf was found to be most prevalent at depths of 50-100 m; no adults were captured in any of the water masses sampled to 1,000 m (considered to be the maximum depth of the Gulf Stream), thus lessening the probability that spawning occurs in these waters; the capture of larvae and juveniles favors the hypothesis of spawning in the region of the Gulf Stream; the areas where larvae were captured and the long-distance tagging results favor a southern spawning area (Subareas 5 and 6) with northward transport of larvae and juveniles; information on temperature requirements for fertilization (>7°C), embryonic development (>10°C) and larval growth lessens the probability of spawning in areas near the continental shelf in winter, particularly in the northern part of the region.

4. Coordinated Research Program for 1982

From the review of coverage of the 1981 surveys, it was agreed that the 1982 program should continue to emphasize the broadest possible coverage of Subareas 3-6 from the edge of the continental shelf through the Gulf Stream into the Sargasso Sea (56° to 74°W), with extensive surveys in Subareas 5 and 6 as far south as Cape Hatteras. Research effort will be divided between broad coverage of the entire region and intensive surveys of the water masses in the vicinity of the Gulf Stream. Four vessels (two Canadian, one Japanese, one USSR) appear to be committed to the program, and, with increased gear capabilities, it will be possible to obtain greater depth coverage (to 1500 m) and sampling of discrete water masses and depth regimes. The survey design will differ from that of 1981 but the biological and hydrological sampling regimes will be similar (see Annex 1). Data collection formats and reporting procedures will not be standardized except as mutually agreed among participating scientists.

5. Future Meetings

STACFIS noted that considerable time would be required at the time of the Scientific Council Meeting in June 1982 to review all new information from the 1982 surveys, including outstanding data from the 1981 cooperative research program, and to plan a cooperative program for 1983. STACFIS therefore

recommends

*i) that a special 4-day session on squid biology and distribution be included in the scheduling of the June 1982 Meeting in order to review all available information from national programs and the cooperative research program;*

*ii) that planning for cooperative research in 1983 be undertaken at this meeting; and*

*iii) that participating countries ensure that scientists involved in the cooperative research program on squid be available to attend this meeting.*

## VI. OTHER MATTERS

1. Evaluation of Scientific Advice Provided for Management of Northwest Atlantic Cod Stocks

A paper entitled "Management of Canadian cod stocks" (SCR Doc. 81/IX/141), prepared for the Joint Session of the Fish Committees at the 1980 ICES Annual Meeting, was presented and discussed. It was noted that insufficient time had elapsed since the extension of fisheries jurisdiction in 1977 to draw conclusions about the effectiveness of scientific advice and management measures in the Canadian fisheries zone. Preliminary evidence indicated that catch rates and stock biomasses have increased for the cod stocks fished entirely within the 200-mile zone, whereas neighboring stocks on Flemish Cap and overlapping the 200-mile limit on Grand Bank remained at low levels of abundance.

2. Evaluation of the Impact of Changes in Mesh Size on the Interacting Fisheries for Cod and Redfish in Division 3M.

STACFIS noted the importance of this agenda item, but, in the absence of most of the experts involved in selectivity studies on cod and redfish,

recommends

*that the assessment of changes in mesh size on the interacting fisheries for cod and redfish be deferred for consideration at the June 1982 Meeting.*

3. Acknowledgements

The Chairman expressed his appreciation to Dr. R. W. Trites who convened the Special Session on Remote Sensing, to Mr. E. J. Sandeman who convened the Symposium on Environmental Conditions during the 1970-79 Decade, to Dr M. D. Grosslein who convened the Task Force on the Larval Herring Program, to Dr J. T. Anderson who convened the Flemish Cap Working Group, to Mr. T. W. Rowell who convened the Working Group on Squid Research, to the rapporteurs and participants for their keen interest and cooperation during the various sessions, and to the Secretariat for their usual efficient work. Noting that a new chairman would be presiding over the next meeting of STACFIS, the participants expressed their gratitude to Dr G. H. Winters for his guidance during the past two years.

# ANNEX 1. REPORT OF *AD HOC* WORKING GROUP ON SQUID RESEARCH

Convener: T. W. Rowell

At the June 1981 Meeting of the Scientific Council, the Working Group reviewed all currently available information on the biology and distribution of *Illex illecebrosus*, including the preliminary results of the coordinated research surveys in 1980 and early 1981 (Part B, this volume). Because of the need for further analysis of some data as the basis for full evaluation of the 1981 coordinated research program and the need to develop specific plans for the continuation of this research in 1982, it was agreed that the Working Group should meet during the September 1981 Meeting. Consequently, the Group met at Halifax, Nova Scotia, Canada, during 9-10 September 1981, with scientists in attendance from Canada, Cuba, European Economic Community, Japan, Portugal, Poland, Spain, USSR and USA.

## 1. Consideration of New Information

### a) Off-shelf distribution and abundance of juveniles

Further analysis of the results from a Canadian survey in February-March 1981 in oceanic waters south of Grand Bank (SCR Doc. 81/IX/104) indicated that the greatest concentrations of juvenile *Illex* were found in Slope Water near the northern boundary of the Gulf Stream with rare occurrence in Gulf Stream water. This implies that spawning occurs in the vicinity of the Gulf Stream rather than at the edge of the continental shelf.

### b) Pre-season distribution and abundance

Data on distribution and abundance from a Canadian bottom-trawl survey on the Scotian Shelf in June 1981 (SCR Doc. 81/IX/100) indicated that squid were in the early immigration phase. Largest catches occurred at depths of 92 and 183 m on the southern part of the Shelf where bottom temperatures were 8-12°C.

### c) Mid-season distribution and abundance

Preliminary results from a French bottom-trawl survey on the Scotian Shelf during 28 August-7 September 1981 were orally presented. These data for strata in depths of 92-370 m indicated a much lower abundance of squid than in September 1980 (SCR Doc. 81/VI/38). Length-frequency data indicated the presence of three size groups with large maturing individuals predominating. However, juveniles were observed mainly on the most southwesterly part of the Shelf and were interpreted as late arrivals to the area.

### d) Environmental influence on squid abundance

An analysis of the relationship between squid abundance indices and bottom temperatures from Canadian surveys on the Scotian Shelf in July during 1970-80 (SCR Doc. 81/IX/99) did not show a clear correlation on a year-to-year basis, but the combined data indicated that the highest catch rates were obtained in areas where bottom temperatures were 8-12°C.

### e) Stock definition

Preliminary results of a gel electrophoretic study on polymorphic enzymes as a possible means of distinguishing different populations of *Illex*, utilizing a small sample collected on the Scotian Shelf in June 1981, indicated the absence of polymorphism (SCR Doc. 81/IX/103). The Working Group agreed that further studies of this nature are warranted and proposed that future analyses should be made on samples from a wider area.

## 2. Review of 1981 Program

### a) Hypotheses to be tested

The five hypotheses developed at the September 1980 Meeting were examined and an attempt made to assess their relative merits on the basis of recently acquired data. None could definitely be rejected or accepted. The hypotheses are restated below, followed by observations on each.

i) "Adults move to the edge of the continental shelf and spawn demersially in deep water; larvae are transported at depth or undergo vertical migration and then are transported in near-surface layers to the northwestern border of the Gulf Stream; juveniles later migrate to the continental shelf."

No data were presented for further evaluation of this hypothesis.

ii) "Adults move offshore to spawn pelagically near the northwestern border of the Gulf Stream; larvae remain in the region and juveniles migrate to the continental shelf at unknown depths."

Data presented allow this hypothesis to be modified by removing the phrase "at unknown depths" as migration appears most prevalent at depths of 50-100 m. However, no *Illex* adults have yet been captured in the upper 1,000 m of these waters.

iii) "Adults move offshore through or under the Gulf Stream and spawn in the Sargasso Sea; larvae and juveniles move shoreward through or under the Gulf Stream or by warm-core eddy transport, with the juveniles eventually reaching the continental shelf."

No data were presented for evaluation of this hypothesis, but no adult *Illex* have yet been captured in the upper 1,000 m of these waters.

iv) "Adults move offshore to spawn pelagically in the Gulf Stream, with subsequent migration of juveniles to the continental shelf."

Existing data lessen the probability of this hypothesis being valid as no adults have been captured in Gulf Stream waters, but these waters have not yet been intensively sampled.

v) "Adults move to deep water at the edge of the continental shelf in Subareas 5 and 6 and spawn demersally; larvae move outward to the northwestern edge of the Gulf Stream either at depth or in the surface layer; some of the larvae and juveniles are transported northward to areas bordering the Scotian Shelf and Grand Bank from where they migrate shoreward."

The available data tend to support this hypothesis, as most larval captures have been in southwestern waters. Furthermore, results indicate late-season movement of adults to the southwestern part of the NAFO Area.

As very few *Illex* larvae have been captured and only a fraction of these have been identified as *Illex illecebrosus*, it is doubtful that hypotheses relating to larval distribution and transport will be tested in the near future. The distribution and movement of juveniles are becoming better understood. Highest densities are found in the upper 100 m of Slope Water on the north side of the Gulf Stream. An increase in size of juveniles is apparent from the Gulf Stream area towards the continental shelf. Laboratory experiments show that fertilization does not occur at temperatures below 7°C and that temperatures greater than 10°C are required for embryonic development. These temperature requirements essentially rule out winter spawning near the edge of the continental shelf. Warm-core eddies do not seem to be directly responsible for juvenile transport as only small numbers of juveniles have been taken within them.

b) Area of survey and sampling regime

The Working Group reviewed its earlier discussion on the area to be surveyed for studies on spawning and distribution of larval and early juvenile stages of *Illex*, and reiterates its earlier conclusions on the importance of sampling the broadest possible area of Subareas 3-6 from the edge of the continental shelf through the Gulf Stream and into the Sargasso Sea.

The Working Group also considered the research plans and availability of vessels of Canada, Japan and USSR and agreed that greater research benefits would accrue if the national efforts were divided between broad synoptic surveys and intensive surveys of the Slope Water-Gulf Stream-Sargasso Sea interfaces. It was also agreed that the biological and hydrographic sampling proposed for 1981 should be used as a guide for 1982 sampling.

## 3. Proposed Program for 1982

The cooperative research program for 1982 involves broadening the area of geographical coverage to include extensive surveys in Subareas 5 and 6 as far south as Cape Hatteras (see Part B, this volume, for earlier statement of future research efforts). In addition, research effort will be divided between broad-scale surveys covering the entire area of study and more intensive surveys of the water masses in the immediate area of the Gulf Stream. Increased vessel and gear capabilities will also permit greater depth coverage (to 1,500 m) and the sampling of discrete water masses and depth intervals. Although a somewhat different survey design is planned for 1982, participating research vessels are expected to use the 1981 biological and hydrological sampling regime as a guideline for 1982 surveys.

a) Vessels

Vessel availability and timing of participation in the 1982 survey are given in Table 1. Although USA scientists could not commit vessels to the project, the possibility exists for use of MARMAP survey data for Subareas 5 and 6, and USA scientists will be invited to participate in the Japanese and USSR studies in these subareas.

Table 1. Vessel availability for squid surveys in 1982.

| Country | Vessel | Time of survey | Subareas |
|---|---|---|---|
| Canada | Lady Hammond[1] | Feb. 2-25 | 4 |
| Canada | Gadus Atlantica | Feb. 20-Mar. 11 | 3 |
| Japan | Kaiyo Maru | Jan. 16-Mar. 5 | 3-6 |
| USSR | Atlant | Jan. 20-May 20 | 3-6 |

[1] Preliminary schedule

b) Area of operation and survey design

i) *Lady Hammond.* Assuming the availability of this vessel, intensive surveys will be conducted within a small geographical area (vicinity of 63°W) in the region of the Slope Water-Gulf Stream-Sargasso Sea interfaces, in general accordance with the design used in Phase I of the 1981 program (*NAFO Sci. Coun. Rep.* 1979-80, pages 139-140) but with greater emphasis on hydrographic sampling and water-mass definition in relation to abundance and transport of *Illex*.

ii) *Gadus Atlantica.* Intensive surveys similar in design to those outlined above for the *Lady Hammond* will be conducted in the vicinity of 56°W longitude, using a series of short transects through the Slope Water and Gulf Stream-Sargasso Sea interfaces.

iii) *Kaiyo Maru.* Two series of widely-spaced transects will be sampled in the area between 74° and 56°W longitude, covering waters from the edge of the shelf to the Sargasso Sea, using three specially designed midwater sampling gears (one research trawl, and two smaller rigid-frame sampling nets). The sampling regime will be in general accordance with Phase I of the 1981 proposal, with intention to sample larvae, juveniles and spawning adults to depths as great as 1,500 m.

iv) *Atlant.* A series of widely-spaced transects will be sampled in the area between 75° and 56° W longitude, covering waters from the edge of the shelf to the Sargasso Sea, using essentially the same sampling design and procedures as were employed during Phase II of the 1981 surveys. In addition to this broadscale survey, the *Atlant* may carry out experiments (proposed for 14-28 April 1982) on the catchability and selectivity of research gear for *Illex* juveniles.

c) Data collection, exchange and reporting

Having considered the difficulties encountered in attempts to standardize data collection and reporting formats for the 1981 program, the Working Group agreed that participating scientists from different countries should ensure that data formats and exchange arrangements are mutually acceptable. Analysis and reporting arrangements are also left for mutual agreement between the cooperating scientists.

4. Other Matters

The Working Group advises that four days will be required during the June 1982 Meeting to review new information on squid biology and distribution arising from the proposed 1982 cooperative program, including any outstanding data from the 1981 program. It should also be possible at that time to plan for a cooperative research program for 1983.

# APPENDIX II. REPORT OF STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

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

The Committee met at Halifax on 11 September and at Dartmouth, Nova Scotia, Canada, on 17 September 1981 to consider and report on various matters referred to it by the Scientific Council (see Part E, this volume). The members in attendance were: R. G. Halliday (Chairman), J. Messtroff (EEC), J. P. Minet (EEC), A. T. Pinhorn (Canada) and H. Hatanaka (Japan). The Chairman of the Scientific Council (R. H. Letaconnoux) and the Assistant Executive Secretary (V. M. Hodder) also attended the sessions. The Executive Secretary (Cap. J. E. Cardoso) attended during consideration of Item 5 below.

1. Review of Scientific Publications Since June 1981

a) Statistical Bulletin, Vol. 29 for 1979

The Committee noted that printing of the first NAFO issue of the Bulletin (292 pages) was completed in August 1981, that bound copies were received from the book-binders in early September and that distribution would take place immediately following this meeting.

b) Journal of Northwest Atlantic Fishery Science, Vol. 2

It was initially hoped that two issues of Volume 2 could be achieved in 1981, the first number being scheduled for printing in July-August 1981. However, the delay in receipt of some manuscripts in the final stages of processing, due to the 6-week disruption in the Canadian postal service, resulted in rescheduling production to October 1981 and the decision to publish Volume 2 in only one issue. Meanwhile, the volume was enhanced by the acceptance of three additional short articles. STACPUB requested that an outline of editorial policy and the names of the Editorial Board be included in the forthcoming issue.

The Editor reported that five manuscripts were already in hand for Volume 3 and several others were expected before the end of 1981. With the assistance of the Editorial Board, it seemed realistic to aim for March 1982 for the publication of Volume 3 (No. 1), the intention being that Volume 3 would contain two issues.

c) Scientific Council Studies, No. 2

The Committee noted that technical editing of the NAFO Manual on Groundfish Surveys was nearly completed and that publication in Studies No. 2 was scheduled for November or December 1981.

2. Editorial Board for the Journal

In accordance with the request of STACPUB at the June 1981 Meeting, the Chairman of STACPUB and the Editor contacted the various nominees for appointment to the Editorial Board and reported that the following had agreed to serve as Associate Editors, if appointed:

Mr Arthur Lee (biological oceanography)
Dr Wilfred Templeman (vertebrate fisheries biology)
Mr Edward J. Sandeman (invertebrate fisheries biology)
Dr William G. Doubleday (biomathematics)

STACPUB was extremely pleased that these well-known scientists had agreed to serve on the Editorial Board and accordingly

recommends

*that the Editorial Board be formally established with the appointment of Dr W. G. Doubleday, Mr. A. Lee, Mr. E. J. Sandeman and Dr W. Templeman as Associate Editors to assist the Editor (V. M. Hodder) in the evaluation and processing of papers for the Journal of Northwest Atlantic Fishery Science.*

3. Journal Reprints

As requested at the June 1981 Meeting, the Executive Secretary further investigated the feasibility of upgrading Journal reprints. It was reported that a method had been worked out whereby the additional cost of producing folded reprints would be about 10-12%, relative to the cost of materials and supplies for producing Volume 1 (110 pages). It was noted that a portion of this additional cost could be recovered by increasing the price charged for reprint orders in excess of the number of reprints provided free to authors. STACPUB therefore proposed that the Executive Secretary be requested to use Volume 2 as a pilot study in upgrading the quality of Journal reprints.

4. Abstracting of Documents and Periodicals

The Committee noted that abstracts of ICES meeting documents are published by FAO in its ASFA1 Series and considered whether the same procedure should be followed for the NAFO research documents. As these meeting documents contain on the front page the statement "Not to be cited without prior reference to the author(s)", are not distributed very widely, and often contain very preliminary analyses, the merit of abstracting such documents for world-wide distribution by FAO was questioned. The Committee noted that some of its members would be attending the forthcoming ICES meeting in October 1981 and proposed that they arrange to discuss with ICES the basis for inclusion of meeting documents in FAO's ASFA1 Series.

The Committee requested the Editor to arrange for the inclusion of abstracts of the Journal and Studies articles in FAO's ASFA1 and Biological Abstracts.

5. Distribution of the Journal

The Committee considered it essential to promote the widest possible distribution of the Journal to publicize the work of the Scientific Council and to establish its publication as a primary international fisheries journal. It was realized that increased distribution would result in increased costs and that indiscriminate distribution was not a cost-effective method of meeting this objective. The Committee therefore proposed that an efficient distribution policy, combined with partial cost recovery through subscription fees to certain user sectors of the scientific community, be established. It was presumed that the General Council would continue to cover, in the annual budget, the costs associated with providing a supply of Journal copies to members commensurate with their identified need.

The Committee proposed that the Scientific Council provide guidelines for the organization and control of the free issue of the Journal to its members through representatives of Contracting Parties on the Scientific Council. These representatives should be provided with the current national distribution list by the Executive Secretary and be requested to approve that list or provide a revised version. That process should be completed by 31 December 1981 and then repeated on an annual basis.

In reviewing the lists, representatives should be asked to note that the Scientific Council was not proposing to place a limit on the number of copies supplied to each Contracting Party. That would be considered, however, if the aggregate total of free copies requested exceeded the historical average of about 800 copies per issue. They should also be asked to note that the Scientific Council considers its obligation to be limited essentially to the representatives and employees of governments constituting the Contracting Parties of NAFO. However, recognizing that different situations exist among members with regard to contributions to the work of the Scientific Council by other levels of government and public institutions such as universities, free distribution to employees of these organizations should be based on the recommendations of the national representatives and agreement by the Council. Experience has shown that bulk mailing was an uncertain and inefficient distributional method in some cases and that it was preferable to adopt a method of direct mailing to individual recipients. Representatives should therefore be urged to provide lists of individual scientists, where practical, rather than institutions, with the exception of library copies.

It was proposed that all other routine distribution (with the exceptions provided for below) should be on a subscription basis. Subscription fees should be on a Journal volume (i.e. annual) basis and be set by the Executive Secretary at a level which approximates the costs of production but not so high as to discourage subscription by individual scientists. Exceptions to this distribution policy should be made for other international fisheries agencies to which small numbers of copies would be distributed free or preferably on a publication exchange basis. An exception should also be made for the United States of America, based on its special status as a coastal state in the Convention Area and on the substantial contribution made to the work of the Scientific Council despite its non-member status. Up to 50 free copies should be distributed free as requested by the Director of the Northeast Fisheries Center, Woods Hole, based on the same principles as outlined above regarding distribution.

As the Secretariat does not maintain a library, the present practice of accepting publication exchange arrangements is generally not productive. Exchanges with other international agencies which provide necessary reference material for the work of the Scientific Council and the Secretariat are the exception, as noted above. With the introduction of subscription fees, all other exchange agreements should be cancelled and no new ones entered into.

In order to measure the success of the recommended policy, statistics on production costs and revenues from subscriptions would be required, as well as statistics on Journal distribution, on an annual basis. The Committee proposed that the Executive Secretary be therefore requested to take the steps necessary to be able to report these statistics to the Scientific Council on a fiscal year basis.

6. Promotion of the Journal

The Committee proposed that all previous recipients of ICNAF publications who are not now included in the revised free distribution list be solicited to subscribe to the Journal. However, this would not expand the Journal distribution in relation to the ICNAF Research Bulletin and special measures are required. It was proposed that the Executive Secretary investigate possibilities for advertising the Journal widely and present a plan of action to the June 1982 Meeting. Specifically, STACPUB had in mind calling on the goodwill of other organizations to distribute information to their menbers and on other journals and abstracting services to include announcements in their publications. Much of this should be achievable at little or no cost.

7. Papers Nominated for Possible Publication

The Committee reviewed the research documents presented to the September 1981 Meeting and requested that the Editor invite the authors of the following documents to submit suitably revised manuscripts for possible publication in the Journal or Studies series: SCR Doc. 81/IX/117, 127, 136 and 137.

The Committee noted the recommendations of the Conveners of the Special Session on Remote Sensing and the Symposium on Environmental Conditions during the 1970-79 Decade and agreed that the relevant contributions be published in separate issues of Studies. The Conveners agreed that they would, in collaboration with the Editor, ensure that all relevant manuscripts are completed and subjected to general scientific editing prior to publication.

Regarding the voluminous review paper by C. J. Sindermann entitled "Status of the Northwest Atlantic Herring Stocks", the Committee was informed of the difficulty in obtaining experts willing to review this paper. STACPUB agreed that the author be invited to submit the paper for publication in Studies.

8. Proposed Ichthyoplankton Identification Manual

As agreed at the June 1981 Meeting, an *ad hoc* working group of ichthyplankton systematic experts was convened by Dr D. F. Markle (Canada) to advise on the value and practicality of producing an identification manual. STACPUB accepted the report of the Working Group (Annex 1) and accordingly

recommends

*that the publication of peer-reviewed regional ichthyoplankton identification manuals be implemented, starting with one for the mid-Atlantic Bight area for which a suitable manuscript is available.*

It was agreed that Dr D. F. Markle should organize and convene, when necessary, a Working Group on the Production of Ichthyoplankton Manuals. The group would solicit and oversee the preparation of future manuals, with two to four being envisaged, should the Scientific Council approve the project.

Noting that further research is required on the systematics and identification of problem ichthyoplankton groups and in problem geographical areas, STACPUB

recommends

*that the Scientific Council take steps to encourage research on ichthyoplankton identification problems in the Northwest Atlantic in order to enhance the value of future volumes of the proposed manual.*

9. Other Matters

a) Correction to Scientific Name for Roundnose Grenadier

The Committee agreed that the scientific name for roundnose grenadier in the NAFO List of Species should be revised from *Macrourus rupestris* to *Coryphaenoides rupestris*, as the latter is currently the generally accepted generic name for this species.

b) Utilization of Microfiche/Microfilm for Storage, Retrieval and Distribution of Scientific Council Documents and Publications

The potential value of utilizing this technology was raised, and it was proposed that the Executive Secretary be asked to investigate the potential benefits of microfiche or microfilm and costs of its utilization for further consideration by STACPUB at its June 1982 Meeting. It was further proposed that the Executive Secretary be requested to solicit comments from representatives concerning their capability to utilize this technology and their opinions on its adoption.

c) Acknowledgements

The Chairman thanked the Committee members and the Secretariat for their contribution to the work of STACPUB over these most important and busy first two years of the Organization. The Chairman, who retired at the end of the Meeting, was also thanked by the Committee for his contribution.

# ANNEX 1. REPORT OF *AD HOC* WORKING GROUP ON ICHTHYOPLANKTON MANUALS

Convener: D. F. Markle                                                  Rapporteur: L. Van Guelpen

The *ad hoc* Working Group was established at the June 1981 Meeting of the Scientific Council to review the state of knowledge of ichthyoplankton identification in the Northwest Atlantic, to decide on the feasibility of producing a manual on ichthyoplankton identification, and to propose mechanisms for production of a manual if the project was a practical and worthwhile venture. Consequently, a small group of scientists met at NAFO headquarters, Dartmouth, Canada, on 17 September 1981 to consider the matter. The Working Group consisted of D. F. Markle, L. Van Guelpen and M. Fahay, who attended the entire session, with Sv. Aa. Horsted, J. Anderson, R. G. Halliday and V. M. Hodder attending for only part of the session due to concurrent meetings.

## 1. Background

The Chairman of STACPUB (Dr R. G. Halliday) presented a brief account of the history leading to the formation of the Working Group within the Standing Committee on Publications. He noted that the Committee had discussed the possibility of compiling a loose-leaf, standard format manual on ichthyoplankton identification and distribution for the Northwest Atlantic as a whole, perhaps similar to the sheets occasionally produced by ICES.

## 2. State of Knowledge on Ichthyoplankton

The Group began a point-by-point discussion of zoogeographical areas and taxonomic groups with the intention of deciding (i) whether there existed sufficient primary literature for an ichthyologist to identify eggs and larvae, and (ii) whether manuals existed for the NAFO geographical areas or parts thereof.

The Group noted that the continental shelf from Cape Hatteras to the Gulf of St. Lawrence had a fauna whose larvae were reasonably well known. North of the Gulf of St. Lawrence, the problems are greater with important gaps in knowledge of egg and larval taxonomy (e.g. *Sabastes* and *Gadus*). The Slope Water region was considered to be a geographical area with a distinct fauna whose larvae are mostly undescribed. Young fish in the Gulf Stream are usually developed enough by the time they enter the NAFO area that adult characteristics can frequently be used. The oceanic area east of the Gulf Stream contains poorly known taxa as well as those whose larvae have been described in excellent systematic monographs. The Group also noted that major taxonomic problems remain with eggs and larvae of important commercial species (e.g. Gadidae, Scorpaenidae, Clupeidae, and the percoids) and other ecologically-important groups (Ammodytidae, Cottidae, Liparidae, Bothidae, Lumpenidae, Cynoglossidae) were a few examples mentioned).

Considerable concern was expressed about geographical variation. It was noted that some *Scomber scombrus* larvae from the Gulf of St. Lawrence differed in a diagnostic pigment character from those farther south and in fact resembled *S. japonicus*. Other examples included the larvae of *Pseudopleuronectes americanus* and eggs of *Scophthalmus aquosus*. This area of larval taxonomy has not yet been properly studied.

Seasonal variation, as most commonly seen in changes in egg diameter, was also noted as a source of error in identification. A better understanding of this variation would help to establish the point in the egg production cycle that is sampled.

The available secondary literature (manuals and bibliographies) was considered to be reasonably good, but there were mixed feelings on their usefulness. The "Checklist of Fishes of the Northeastern Atlantic and the Mediterranean" was mentioned as a thorough bibliography, but it requires prior knowledge of the problems. "Development of Fishes of the Mid-Atlantic Bight" was mentioned as the best available manual, but it also requires some prior knowledge of taxonomically-unrelated but similar-looking species. Manuals, especially those that are compendiums, were criticized as vehicles that perpetuate errors. On the other hand, the cost of completely original work may be prohibitive. It was considered that manuals should be critical compilations with diagrams redrawn and diagnostic characters revised to suit the situation in the region covered by the manual.

## 3. Recommendations

The Working Group agreed that there was a natural progression in the increase of knowledge of a taxonomic group. Initially, there were scattered descriptions of certain species. Subsequently, there were wide-spread or oceanic reviews of entire taxa (genera, subfamilies, families, etc.) Since the 1950's, there has been a slow increase in the number of these revisionary works on egg and larval taxonomy. As the primary literature base grows and expertise becomes available, the Working Group agreed that it would be practical and worthwhile to compile and publish regional ichthyoplankton manuals. The Working Group therefore

recommends

a) *that the Scientific Council should encourage its members to pursue the systematic study of egg and larval taxonomy in the Northwest Atlantic, especially on problem ichthyoplankton groups and in problem geographical areas and publish the results of such studies in the primary literature;*

b) *that an ad hoc working group of experts be established to solicit and oversee the preparation of regional manuals for the Northwest Atlantic, which should be (i) based on knowledge of the fauna in particular regions, (ii) subjected to peer-review by NAFO scientists, (iii) cross-reference other manuals in the series when dealing with geographical variation, and (iv) generally follow the style of the first manual in the series but with some freedom by authors to alter the style to suit particular needs, and*

c) *that the nearly-completed manuscript by M. P. Fahay on early stages of marine fishes in the southern part of the NAFO Area be considered as the first manual in the series.*

It was agreed that, if the above recommendations are accepted by the Scientific Council, Dr D. K. Markle, Mr. L. Van Guelpen and Mr M. Fahay should constitute the Working Group to oversee the preparation of manuals in consultation with the NAFO Secretariat and submit a progress report to the June 1982 Meeting.

# PART D

## REPORT OF SCIENTIFIC COUNCIL

Special Meeting, November 1981

CONTENTS

# REPORT OF SCIENTIFIC COUNCIL

Special Meeting, November 1981

Chairman: R. Wells — Rapporteur: V. M. Hodder

The Council met at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada during 23-26 November 1981 to provide advice for 1982 on the conservation of the harp and hooded seal stocks in the Northwest Atlantic and the shrimp stocks in Subareas 0 and 1, as requested by Canada and the European Economic Community (EEC). In addition, at the request of the EEC and with the agreement of the Executive Committee of the Council, a review of the status of the shrimp stock off East Greenland was included in the agenda for this meeting (see Part E, this volume). The Council Meeting was preceded on 20-21 November 1981 by the Workshop on Ageing Shrimp, with J. Fréchette as Convener, to finalize work which was initiated in May 1981 (SCS Doc. 81/VI/14). Representatives attended from Canada, EEC, Iceland and Norway, and observers were present from the United States of America (see Part E, this volume).

The stock assessments were undertaken by the Standing Committee on Fishery Science (STACFIS) whose report, as approved by the Council, is given in Appendix I. Brief summeraries of the stock assessments and other matters considered by the Council are given below.

## I. STOCK ASSESSMENTS (APP. I)

### 1. Assessment of Shrimp Stocks in Subareas 0 and 1

In 1979 and 1980, the offshore shrimp fishery in Subareas 0 and 1 was regulated by an overall total allowable catch (TAC) of 29,500 tons, of which 27,000 and 25,000 tons respectively were taken in these years. The same TAC was advised for 1981 (*NAFO Sci. Coun. Rep.* 1979-80, page 148), but a total of 35,000 tons was set by the coastal states involved. Preliminary statistics for January-October 1981 indicate an offshore catch of about 30,000 tons (Table 1), the major fishing grounds being on the northern part of Store Hellefiske Bank (Div. 0A and 1B) and in Holsteinsborg Deep between 66° and 67°N.

Table 1. Total catches (metric tons) of shrimp in Subarea 0 and offshore parts of Subarea 1 and corresponding TACs, 1973-81.

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|---|
| Catch | 4,692 | 11,945 | 29,190 | 42,766 | 34,300 | 26,869 | 27,087 | 25,406 | 30,332[1] |
| TAC | - | - | - | - | 36,000 | 40,000 | 29,500 | 29,500 | 35,000 |

[1] Preliminary data, January-October

All available biological information on length distributions by sexual development stages and all data on trends in catch rates, biomass estimates and stock composition were considered in advising on a TAC for 1982. It was noted that, after the decline in abundance observed during 1976-79, catch rates increased in 1980 and stabilized in 1981. Data from a photographic survey indicated an increase in biomass in 1981, primarily due to an increase in abundance of small shrimp. Length frequency data confirmed this observation by showing larger proportions of small shrimp in the catches than in previous years. A significant part of this recruiting group could possibly make a substantial contribution to the fishable stock in 1983.

Recognizing the relative stability of the stock in recent years but with some uncertainty about the strength of recruiting year-classes, the Council advises that the overall TAC for the offshore grounds in Subarea 1 and adjacent parts of Subarea 0 in 1982 should not exceed 29,500 tons, the same level as advised previously for 1981. In order to improve the basis for assessing the stock in Subareas 0 and 1, the Council endorses the recommendations of STACFIS regarding future research requirements (see Appendix I).

### 2. Assessment of Shrimp off East Greenland

The shrimp fishery off East Greenland began in 1978, and vessels from Denmark, Faroe Islands, France, Greenland, Iceland and Norway fished in the area in 1980 and 1981. The total catch on both sides of the midline between Greenland and Iceland increased rapidly to 8,000 tons in 1980 (Table 2). Preliminary data indicate a catch of about 5,000 tons for January-October 1981. The fishery which occurred on Strede and Dohrn banks in 1980 was restricted mainly to Strede Bank in 1981 (along the 30°W meridian south of 67°N), possibly due to extensive ice cover observed from April to June 1981. After this period, the fishery shifted slightly northeastward closer to the midline. In 1980 and 1981, mean catch rates (both sides of the midline) peaked in March-April, declined during the summer to low values and increased slightly in the autumn. However, the peak catch rates in 1981 were slightly lower than in 1980.

Table 2. Total catches (metric tons) of shrimp off East Greenland

| | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|
| Catch | 363 | 1,285 | 8,260 | 4,917[1] |

[1] Preliminary data, January-October

The available data indicated that the fishery in the spring exploited berried females which were larger than in other areas of the North Atlantic except for the stock off Cumberland Sound, Baffin Island. By-catches in the shrimp fishery consisted mainly of capelin, small redfish, polar cod, sandeel and small Greenland halibut.

From calculations based on a general production model, it was agreed that 4,200 tons could be a plausible estimate of the maxium sustainable yield. In view of the decline in catch and the significant decrease in catch rates from 1980 to 1981, and noting that this stock lives under extreme environmental conditions and may be sensitive to over-exploitation, the Council urges that a cautious approach should be taken in exploiting this stock and advises that the overall TAC should not exceed 4,200 tons in 1982. In order to improve the basis for assessing this stock off East Greenland, the Council endorses the recommendations of STACFIS regarding future research requirements (see Appendix I).

## 3. Assessment of Seal Stocks

### a) Harp seals

The total catch of 200,162 seals in the Gulf and Front areas in 1981 exceeded the TAC by about 30,000 animals, due to unexpected catches in southern Labrador resulting from unusually light ice conditions along the coast, which enabled small vessels from Newfoundland and southern Labrador to participate in the hunt for whitecoats.

Recaptures of seals marked in the Gulf and Front areas provided unbiased and therefore reliable estimates of pup production in 1978 and 1979 of 469,000 ± 26,000 (mean ± standard error) and 476,000 ± 36,000 respectively.

These estimates were used with other data in a computer simulation to provide the best estimate of pup production (380,000-390,000) in 1967, the starting point of the model, and the best estimate of natural mortality (0.0950-0.0975) for the 1967-81 period. Projections from 1981 to 1991 indicated that TAC increases of 10, 25 and 50% do not cause the simulated population (2.04-2.15 million animals in 1981) to decline, but doubling of the TAC produces a gradual decline to 1.8 million or 1.4 million by 1991 depending on the value of natural mortality used in the first year (i.e. $M_0$ = M or $M_0$ = 3M, where M is natural mortality of age 1+ animals). Replacement yields for 1982 and 1983 were estimated at 285,000 and 301,000 ($M_0$ = M) and at 239,000 and 248,000 ($M_0$ = 3M) respectively. Replacement yields increase to maxima of 338,000 ($M_0$ = M) and 284,000 ($M_0$ = 3M) by 1986 when they effectively become the sustainable yields. The Council notes that insufficient time was available to study the model thoroughly at this meeting and advises that further critical review should be undertaken before the results are adopted as a basis for major revision of management schemes for 1982.

At the joint request of Canada and the EEC, a number of questions on the interaction between harp seals and commercially exploited fish populations were discussed. The general conclusion was that the available information was insufficient to answer the questions adequately.

### b) Hooded seals

The total catch of 13,686 seals in the Front and Gulf areas in 1981 was slightly less than the TAC of 15,000 animals. Preliminary analyses of historical data on production and mortality were considered, but, due to uncertainty about recent levels of pup production and stock size, the Council agreed that there was no firm basis for changing the present management regime.

## II. FUTURE SCIENTIFIC MEETINGS

1. Regular Meeting, June 1982

The Council confirmed that its next meeting would be held at the Holiday Inn, Dartmouth, Nova Scotia, Canada, during 2-18 June 1982. The first 4 days will be allocated for a special session on squid biology and distribution, with T. W. Rowell as Convener. Meetings of the standing committees (STACFIS, STACREC and STACPUB, and associated subcommittees and working groups) will take place during 7-17 June 1982 to deal with the regular business of the Council.

2. Annual Meeting, September 1982

The Council confirmed that its Annual Meeting will be held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada, during 8-13 September 1982, immediately preceding meetings of the General Council and the Fisheries Commission on 14-17 September 1982. Noting the success of the September 1981 Meeting in attracting valuable contributions on environmental conditions during 1970-79 and on remote-sensing applications to fishery science, the Scientific Council agreed that an appropriate theme for the September 1982 Meeting would be "stock discrimination", with emphasis on marine fishes and squid of the Northwest Atlantic, but not excluding contributions on species in other regions if emphasis is on methodology. The Council requested the Executive Committee to arrange for a convener as soon as possible so that an agenda and information about the special session can be circulated early in 1982.

3. *Ad hoc* Working Group on Herring Tagging, January 1982

The Council noted that this Working Group, established at the September 1981 Meeting (see Part C, this volume), will meet at Quebec City, Quebec, Canada, during 12-14 January 1982, with W. T. Stobo as Convener.

## III. APPROVAL OF REPORTS

1. Provisional Report of the September 1981 Meeting

The Council reviewed and formally approved with minor amendment the report of its Meeting at Dartmouth, Nova Scotia, Canada, 8-18 September 1981 (Part C, this volume).

2. Report of this November 1981 Meeting

The Council noted that its report of the present meeting is scheduled for inclusion in the next issue of "Scientific Council Reports" to be published in December 1981, and agreed to formally adopt the report, subject to minor editorial amendment, where necessary, by the repporteur.

## IV. OTHER MATTERS

1. Coordination of Research on Flemish Cap

The Council reviewed its comments at the September 1981 Meeting regarding coordination of research activities on Flemis Cap in 1982 (Part C, this volume, pages 81 and 93). It was agreed that the STACFIS recommendation from that meeting should be modified to ensure that discussions are initiated as soon as possible by correspondence with potential participants so that maximum coordination of 1982 surveys can be achieved. Consequently, the Council requests the Convener of the Working Group (J. T. Anderson) to initiate correspondence on this matter with USSR scientists at PINRO (Polar Research Institute of Marine Fisheries and Oceanography), Murmansk, to arrange for coordination of research in the Flemish Cap area in 1982.

Workshop on Hooded Seals

The Council welcomed the proposal by Norway to hold at Bergen, Norway, in 1983 an international workshop on hooded seals and urges that appropriate support for this undertaking be given by interested Contracting Parties of NAFO.

3. Inadequate Time for Assessments

The Council noted that the time allotted for this meeting was insufficient to deal with all aspects of the assessments of the shrimp and seal stocks, and agreed that 5 working days are required if a similar meeting is held in November 1982.

## V. ADJOURNMENT.

The Chairman expressed his thanks to the Director of the Bedford Institute of Oceanography for the use of conference rooms, to the NAFO Secretariat for their usual efficiency in servicing this meeting, to the Chairman of STACFIS (J. P. Minet) and the Convener of the Working Group on Seals (A. W. Mansfield), and to all participants for their cooperation and contributions. The meeting adjourned at 1630 hours on 26 November 1981.

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

Special Meeting on Shrimp and Seals, November 1981

Chairman: J. P. Minet

Rapporteurs: Various

The Committee met a Dartmouth, Nova Scotia, Canada, during 23-26 November 1981 to review the status of the shrimp stocks in Subareas 0 and 1 and the harp and hooded seal stock in the Northwest Atlantic, as referred to it by the Scientific Council based on joint requests of Canada and the European Economic Community (EEC). In addition, as requested by the EEC, the Committee reviewed the status of the shrimp stock off East Greenland. Scientists attended from Canada, EEC, Iceland, Norway and USA.

In considering the agenda of the Scientific Council, STACFIS agreed that the assessments of shrimp and seals be carried out by two groups which would meet concurrently. Consequently, Dr. A. W. Mansfield agreed to convene the *ad hoc* Working Group on Seals and the Chairman of STACFIS convened the Working Group on Shrimp. These groups met during 23-25 November 1981, and their reports as approved by STACFIS on 26 November are given in Sections I and II below.

## I. ASSESSMENT OF SHRIMP STOCKS

### 1. Shrimp in Subareas 0 and 1

#### a) Fishery trends

The nominal catch of shrimp in Subareas 0 and 1 increased from less than 10,000 tons prior to 1973 to 50,000 tons in 1976 and declined to 32,000 tons in 1980 (Table 1). The offshore shrimp fishery has been regulated by total allowable catch (TAC) since 1977. In 1977 and 1978, total offshore catches in Subareas 0 and 1 were about 34,000 and 27,000 tons against TACs of 36,000 and 40,000 tons respectively. In 1979 and 1980, the offshore fishery was regulated by a TAC of 29,500 tons, of which about 27,000 and 25,000 tons respectively were taken. In 1981, Canada and the EEC set separate TACs of 5,000 and 30,000 tons for Subareas 0 and 1 respectively, although the Scientific Council had advised that the TAC for Subarea 1 and the adjacent parts of Subarea 0 should remain at 29,500 tons. Preliminary statistics for January-October 1981 indicate a total offshore catch of about 30,000 tons from Subareas 0 and 1. The inshore fishery at West Greenland has remained relatively stable at 7,500-8,000 tons except in 1974 when 10,000 tons were taken.

#### b) Distribution (SCR Doc. 81/XI/146, 147, 151, 155)

No research vessel trawl surveys were conducted in Subareas 0 and 1 in 1981, but the photographic survey in Subarea 1 was continued. Information was also available on the distribution of fishing effort for the Greenland and French fisheries in Subarea 1 and the Canadian fishery in Subarea 0. The distribution of fishing effort for Greenland vessels was generally the same in 1981 as in 1980, exhibiting the same northward shift as in 1980 and earlier years, but some differences were evident between the two years. In February-March 1980, fishing effort was concentrated north of Store Hellefiske Bank (between 68° and 69°N), whereas in the same period of 1981 the fishery was concentrated in the Holsteinsborg Deep (between 66° and 67°N), apparently due to ice conditions, where catch rates in 1981 were higher than in 1980. During June-September 1981, Greenland vessels fished mainly to the west of Store Hellefiske Bank (in Subarea 1) between 67° and 69°N, whereas in 1980 more effort occurred in the areas north of 70°N. Fishing effort by French vessels in 1981 was concentrated in Div. 1B between 67° and 68°N. Canadian vessels fished in the adjoining part of Div. 0A generally between 58° and 59°W.

Data from the Danish photographic survey in Subarea 1, based on 2,802 photographs, indicated highest concentrations of shrimp at about 300 m, as in previous years, although there was slight indication of a shift in abundance toward shallower depths.

#### c) Biology (SCR Doc. 81/XI/146, 147, 151, 155)

For the first time since 1978, three modal groups of male shrimp (10-15 mm, 15-20 mm and 20-25 mm carapace length) were clearly apparent in the length frequencies from French commercial catches. The third group may also include some transitionals (20-27 mm) and first spawning females (22-28 mm), although these two stages may belong to a fourth modal group. Well-developed head roe observed in all transitionals and females might be an indication that, after transition, all females take part in reproduction. In 1980, females became ovigerous primarily during September. The length frequencies from the catches by the different fleets were similar in structure. The occurrance of a mode between 15 and 20 mm in Canadian, French and Danish length frequencies, increased numbers of small shrimp from the photographic surveys, and Canadian length composition of discards provide evidence of possible strong recruitment to the fishery in 1982 and 1983.

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

| Area | Country | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| SA 0 | Canada | - | - | - | - | - | - | - | 59 | 1,565 |
| | Denmark | - | - | - | - | 68 | 86 | 67 | - | *[3] |
| | Faroes | - | - | - | - | 239 | - | 115 | - | *[3] |
| | France | - | - | - | - | - | 21 | 7 | - | - |
| | Greenland | - | - | - | - | - | - | 149 | 815 | - |
| | Norway | - | - | - | 65 | 150 | 15 | 791 | - | *[3] |
| | Spain | - | - | - | 327 | - | - | - | - | - |
| | Total | - | - | - | 392 | 457 | 122 | 1,129 | 874 | 3,886 |
| SA 1 | Canada | - | - | - | - | - | - | 245 | 590 | - |
| | Denmark | 196 | 308 | 1,142 | 2,717 | 5,842 | 3,382 | 1,327 | 872 | 976 |
| | Faroes | 1,371 | 2,023 | 5,300 | 11,179 | 12,612 | 8,070 | 6,867 | 3,554 | 689 |
| | France | - | - | - | 803 | 924 | 805 | 353 | 247 | 556 |
| | F.R. Germany | - | - | - | - | 31 | - | - | - | - |
| | Greenland (a)[4] | 7,950 | 10,064 | 8,700 | 7,300 | 7,800 | 7,600 | 7,500 | 7,500 | 7,500 |
| | Greenland (b) | 185 | 180 | 1,089 | 2,478 | 7,081 | 5,531 | 12,527 | 16,767 | 23,156 |
| | Japan | - | - | - | 146 | - | - | - | - | - |
| | Norway | 2,940 | 5,917 | 8,678 | 11,658 | 7,353 | 8,959 | 4,639 | 2,502 | 1,069 |
| | Spain | - | - | 6,948 | 6,925 | - | - | - | - | - |
| | USSR | - | 3,517 | 6,033 | 6,468 | - | - | - | - | - |
| | Total | 12,642 | 22,009 | 37,890 | 49,674 | 41,643 | 34,347 | 33,458 | 32,032 | 33,946 |
| | Offshore | 4,692 | 11,945 | 29,190 | 42,374 | 33,843 | 26,747 | 25,958 | 24,532 | 26,446 |
| 0+1 Offshore Catch | | 4,692 | 11,945 | 29,190 | 42,766 | 34,300 | 26,869 | 27,087 | 25,406 | 30,332 |
| 0+1 Offshore TAC | | - | - | - | - | 36,000 | 40,000 | 29,500 | 29,500 | 35,000[5] |

1 Data for 1973-78 pertain to ICNAF Statistical Area 0 and Subarea 1, and for 1979-81 to the new NAFO Subareas 0 and 1.
2 Preliminary data for January to October.
3 Total of 2,321 tons by Faroes, Denmark and Norway.
4 a = inshore, b = offshore catches.
5 TAC of 30,000 tons for Subarea 1 and 5,000 tons for Subarea 0.

d) Catch and effort (SCR Doc. 81/XI/146, 147, 151, 157)

Catch and effort data, based on haul-by-haul logbook records, were available from the Canadian fishery in Subarea 0 and the French, Greenland and Norwegian fisheries in Subareas 1. The Canadian observer data for the July-September period indicated stabilization of catch rates in Subarea 0 in recent years. Data for a French vessel fishing in a small area west of Store Hellefiske Bank (Div. 1B) showed an increase of about 23% in mean catch rate in July 1981 relative to the same period in 1980. No conclusion could be drawn from the Norwegian data, as smaller vessels participated in the 1981 fishery and the catch rates were not directly comparable with those of previous year.

Data for 6 trawlers (722 GRT) of the Royal Greenland Trade Department showed, as in earlier years, high monthly mean catch rates during March-May, followed by a decrease in catch rates during June-September 1981. The peak spring catch rates were higher than in any year since 1977, due possibly to favorable ice conditions which provided better access to spring concentrations of berried female shrimp in 1981 than in previous years. As was the case in 1980, the Greenland shrimp fishery extended into Div. 1A as far north as 71°N. The mean catch rate of these Greenland trawlers in July-September was considered in previous assessments to be the best stock abundance index available. Following a gradual decline in this mean catch rate during 1976-79, there was an insignificant decrease from 1980 to 1981, indicating stabilization of the catch rate at approximately 450 kg of shrimp per hour trawled. Based on all of the available information, STACFIS agreed that there has been no significant change in the status of the shrimp stock on the offshore grounds in Subareas 0 and 1.

e) Discarding of shrimp (SCR Doc. 81/XI/146, 147)

The only information on shrimp discards in Subarea 1 was an estimate of 6% by weight of the shrimp caught by the French vessel in Div. 1B during 1981. Canadian data for Subarea 0 indicated that the discarding rate increased from 2.4% in June to 7.4% in September 1981, the June and July rates being lower and the September rate higher than those for 1980. The higher rate in September 1981 may be due to increased recruitment of small shrimp to the fishery.

f) By-catches in the shrimp fishery (SCR Doc. 81/XI/146, 151)

As in previous years, redfish (mainly *Sebastes mentella*) was the major by-catch in the shrimp fishery. Canadian data for Subarea 0 during June-September indicated lower by-catches of redfish in 1981 than in 1980, the ranges of monthly values being 3-15% and 2-33% respectively. Excluding incidental catches of Greenland shark, other species (mainly Greenland halibut, American plaice and wolffishes) constituted a maximum of 1% of the total catch. In Subarea 1, there has been a steady decline in by-catches of redfish, particularly in Div. 1B.

g) Biomass estimates (SCR Doc. 81/XI/155)

The only biomass estimate for 1981 was derived from photographic survey data based on a mathematical model introduced at the November 1980 Meeting (SCR Doc. 80/XI/169). New estimates for 1977-80, utilizing all available survey data, were in good agreement with those presented in 1980. The total biomass in the area between 66°00'N and 69°30'N was estimated at 252,000 tons for 1981. This represented a major increase from 177,000 tons indicated for 1980, but special analysis indicated that a large part of the increase was due to greater abundance of small shrimp, although a small increase was indicated for medium-sized shrimp. If the biomass calculations had been based on a density index (number per square meter) instead of a weight index (grams per square meter), the increase in biomass from 1980 to 1981 would have been more pronounced.

It was noted that the variance associated with the photographic survey data remains high and that cautious interpretation of the estimates should be maintained. The trend in biomass estimates for 1977-80 is generally similar to the trend in seasonal catch rates of Greenland trawlers, but the significant increase in biomass from 1980 to 1981 is not reflected in the catch rates. Although a more or less continuous decline in the mean size of shrimp was observed during 1977-81 at a check station sampled in all years in the central area of commercial fishing, the biomass calculations for all years involved were based on the same average individual weight of shrimp. Consequently, the biomass for 1980 may be slightly overestimated and that for 1981 overestimated to a larger degree, due to the increasing abundance of small shrimp.

The greater abundance of small shrimp observed during the photographic survey indicates the potential for good recruitment to the stock in 1982 and 1983. As was the case in previous years, the greater proportion of small shrimp was found at stations in the area northwest of Store Hellefiske Bank.

h) Total allowable catch

Catch rates from the Canadian, French, Norwegian and Greenland fisheries showed only slight increases or decreases between 1980 and 1981 for similar areas and seasons except for the increased spring catch rates of Greenland vessels. Considering all of the available evidence, the Committee concluded that the fishable stock has remained relatively stable during 1979-81. An abundance index, based on weighted catch rates of a comparable group of Greenland trawlers for the July-September period, was previously interpreted to indicate a reduction of approximately 50% in spawning stock biomass from a high (virgin) level in 1975-76 (*NAFO Sci. Coun. Rep.* 1979-80, page 157). This reduction corresponds to the prediction of the model on which the assessment of shrimp stock was first based (*ICNAF Redbook* 1977, page 15). The catch rate for 1981 is close to the predicted level, as indicated in the following table:

| Year | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|
| Relative CPUE | 1.00 | 0.73 | 0.67 | 0.50 | 0.64 | 0.59 |

Interpretation of this index as an indicator of stock biomass implies that, at the present level of removals, stock biomass could be maintained at a level between one-half and two-thirds of the unexploited (virgin) stock. Data were inadequate to provide reliable estimates of stock biomass at specific catch levels.

Data from the photographic survey indicated an increase in biomass in 1981, primarily due to increased abundance of small shrimp. Because many of these shrimp are not fully recruited to the fishery, such an increase would not be apparent from the commercial catch rates. However, commercial length frequency data supported the photographic survey data by showing larger proportions of smaller sizes of shrimp in the 1981 catches than in previous years. A quantitatives estimate of recruitment could not be obtained, but some improvement over the average level should be obvious in 1982. Recognizing the relative stability of the fishable stock in recent years but taking into account the uncertainty about the strength of recruiting year-classes until at least

1982, STACFIS advises that the overall TAC for the offshore grounds in Subarea 1 and the adjacent parts of Subarea 0 in 1982 should remain at the same level advised for 1979-81 (29,500 tons). It was also agreed that the practice of allowing only a small portion of the TAC for the offshore grounds to be taken in the area from 68°00'N to 69°30'N, as a potential protective measure for recruitment to the inshore stock in Disko Bay, should be continued.

i) Future research

Several essential requirements were identified by STACFIS relating to potential improvement of the assessment of the shrimp stock in Subareas 0 and 1. In view of the status of current assessment techniques for shrimp, the results of photographic and research trawl surveys remain an important part of the data base. Analysis of all biological samples, mainly length compositions by sexual development stages, was considered an essential requirement. Also considered was the need to improve the quality of data on discards and catches reported as fresh weight through continuing observer programs and the importance of properly maintaining logbook records on fishing vessels. STACFIS therefore

recommends

*i) that annual photographic surveys be continued and stratified-random trawl surveys be conducted annually, possibly through cooperative arrangements between participating countries;*

*ii) that effort be increased to analyze all biological samples, especially those available from the Greenland fishery;*

*iii) that the observer program be continued with emphasis on improving the quality of data on discards and ensuring that catches are reported as fresh weight rather than processed weight; and*

*iv) that countries participating in the shrimp fishery take steps to ensure that fishing vessel logbooks are completed.*

2. Shrimp at East Greenland

a) Fishery trends

The shrimp fishery in this area was begun in 1978 by an Icelandic vessel on the Icelandic side of the midline between Greenland and Iceland (Table 2). The catch increased to 1,300 tons in 1979, when Norwegian trawlers participated in the fishery, and exceeded 8,000 tons in 1980, following the additional involvement of Danish, Faroese, French and Greenlandic vessels. Preliminary data for January-October 1981 indicate a catch of about 5,000 tons of shrimp on both sides of the midline, considerably below the level of 8,000 tons aimed at by the EEC for the area west of the midline.

Table 2. Nominal catches (metric tons) of shrimp (*Pandalus borealis*) at East Greenland, 1978-81.

| Country | 1978 | 1979 | 1980 | 1981[1] |
|---|---|---|---|---|
| Denmark | - | - | 702 | 581 |
| Faroes | - | - | 4,233 | 713 |
| France | - | - | 50 | 353 |
| Greenland | - | - | 200 | 1,004 |
| Iceland | 363 | 485 | 614 | 125 |
| Norway | - | 800 | 2,461 | 2,141 |
| Total | 363 | 1,285 | 8,260 | 4,917 |

[1] Preliminary data for January-October

b) Distribution (SCR Doc. 81/XI/157, 158, 165, 167)

The shrimp fishery off East Greenland in 1981 took place in the Strede and Dohrn Bank area but was more restricted than in 1980. On the western side of the midline, fishing occurred mainly during April-June. Danish, French and Norwegian data indicated that the fishery was restricted to the area along the 30°W meridian south of 67°N during April and May, possibly due to extensive ice cover. A northeastern shift in the fishery closer to the midline was observed in June. French data indicated that trawling took place in depths of 250-480 m during April-May. On the Icelandic side of the midline, the fishery was delayed until late May, also due to the unusual southward extension of ice cover. No data were available to explain the geographical distributions of shrimp, particularly the smaller size-groups.

c) Biology (SCR Doc. 81/XI/157, 158, 165, 167)

The biology of shrimp off East Greenland is not well known, mainly because sampling is not possible in the winter due to ice cover, thus limiting the accumulation of biological knowledge on the stock over all phases of the life cycle. Nevertheless, some typical characteristics can be noted.

The shrimp are characterized by their large size (mean carapace length 24-34 mm), being larger than in any other area of the North Atlantic except the stock off Cumberland Sound, Baffin Island. Sex reversal occurs at large sizes, but nothing definite is yet known about the growth and age of the shrimp due to the complete lack of small individuals in the samples. Although most females are ovigerous in late summer (spawning starting in July), there are indications that some of the females are not fertilized each year. It has been noted that the egg-bearing period is very long, but nothing definite about the length of the period can be stated due to the absence of winter samples. It is possible that the East Greenland stock is supported partly by its own larvae and partly by shrimp larvae drifting into the area from Icelandic waters. The stock may also be at its northern biological limit and thus be very sensitive to environmental changes.

d) Catch and effort (SCR Doc. 81/XI/157, 158, 165, 167)

Monthly catch rates, based on logbook data for the Danish, French, Greenland, Icelandic and Norwegian fisheries in 1980 and 1981, are given in Table 3. In both years, the catch rates were highest in March-April, declined to very low values during the summer and increased slightly in the autumn. The peak catch rates during March-April were significantly lower in 1981 than in 1980. Although ice conditions in the area during early 1981 may have hindered full access to the shrimp resource and thereby influenced the catch rates, it was agreed that the differences in catch rates reflected heavy impact of the fishery on the resource.

Table 3. Catch rates (kg per hour trawling) for the shrimp fishery off East Greenland in 1980 and 1981.

| Year | Month | Denmark and Greenland | France | Iceland[1] | Norway |
|---|---|---|---|---|---|
| 1980 | Mar | - | - | - | 904 |
| | Apr | 660 | - | - | 704 |
| | May | 420 | - | 125 | 378 |
| | Jun | 140 | - | 90 | 98 |
| | Jul | 70 | 69[2] | 104 | - |
| | Aug | 70 | - | 123 | 95 |
| | Sep | 180 | - | 96 | 145 |
| | Oct | 110 | - | - | 99 |
| | Nov | 145 | - | - | 160 |
| 1981 | Mar | - | - | - | 322 |
| | Apr | 480 | 433 | - | 291 |
| | May | 260 | 261 | - | 146 |
| | Jun | 120[2] | 144 | 99 | 113 |
| | Jul | - | - | 78 | - |
| | Aug | - | - | 39 | 39[2] |
| | Sep | - | - | - | 42[2] |

1 Data from Icelandic side of midline between Greenland and Iceland; all other data from the Greenland side of the midline.

2 Based on very small catches.

e) Discarding of shrimp (SCR Doc. 81/XI/157, 158)

French data showed a discard rate of less than 1% by automatic sorting with the possiblity of some additonal discarding by hand. Norwegian data indicated a discard rate of 15%, but this estimate was based on information from only one vessel and extrapolation to the entire Norwegian fleet was considered questionable. However, since the samples were taken during the peak fishing period, it probably approximately reflects the discarding practice of the Norwegian fleet. Discarding of shrimp is not known to occur in the Icelandic fishery.

f) By-catches in the shrimp fishery (SCR Doc. 81/XI/157, 158, 165)

Information on by-catches of fish in the shrimp fishery by Greenland, French, Icelandic and

Norwegian vessels indicated that capelin and small redfish were the most common species. Significant quantities of polar cod, sandeel and small Greenland halibut were sometimes taken but the amounts varied between countries. Icelandic data for October 1980 (ICES C. M. 1981/K:7) indicated by-catches (number per hour trawling) of 71 polar cod (10-22 cm), 55 redfish (10-27 cm), 52 capelin (10-19 cm) and 15 Greenland halibut (12-88 cm). Norwegian data for April-May 1981 showed by-catches (number per hour trawling) of 124 redfish (8-32 cm) and 64 Greenland halibut (16-59 cm).

g) Biomass estimates

No estimate of the shrimp biomass off East Greenland could be made from the data available.

h) Total allowable catch

It was not possible to obtain a reliable estimate of the stock size of shrimp off East Greenland in order to provide an estimate of the sustainable yield. However, preliminary calculations, based on general production model, indicated that 4,200 tons could be a plausible estimate.

Considering that the monthly catch rates in 1981 were significantly lower than in 1980 even though a part of the decrease might have been due to more severe ice conditions in 1981, that the total catch of 5,000 tons during January-October 1981 was only 60% of the proposed level on the Greenland side of the midline, that the stock may be living under extreme environmental conditions and therefore be very sensitive to possible overexploitation, and that the only available estimate of maximum sustainable yield was derived from a general production model, STACFIS advises that the overall TAC for 1982 should not exceed 4,200 tons.

i) Future research

Research requirements for the West Greenland area apply equally well to the stock between East Greenland and Iceland. Of special importance is sampling on a year-round basis in the whole area of distribution whenever ice conditions permit fishing to take place. The interaction of this stock with those of other areas should be investigated with special regard to larval drift. There is a lack of knowledge about environmental factors affecting the area, such as the influence of pulsations of the Irminger Current over the shrimp grounds. Environmental studies are specially important because the shrimp in this area seem to be living at the northern limit of its distribution. Consideration should be given to a tagging study, as the stock consists mainly of large shrimp and a considerable portion of the females do not appear to be available to the fishery during the last part of the year. STACFIS therefore

recommends

*i) that a sampling program be carried out to monitor the composition of the stock in the whole area of distribution on a year-round basis;*

*ii) that plankton surveys be carried out to observe the drift of shrimp larvae;*

*iii) that a study of environmental conditions be undertaken, including the current system in the area; and*

*iv) that a tagging experiment be carried out to determine the migration patterns of various size groups of shrimp.*

3. Other studies on shrimp

a) Information on the Gulf of Maine stock (SCR Doc. 81/XI/148)

STACFIS welcomed the presentation of a paper on recent trends in the USA shrimp fishery in the Gulf of Maine. It was noted that nominal catches had increased to peak levels (11,000-13,000 tons) in the late 1960's and early 1970's and then declined precipitously to only 400 tons in 1977. The catch remained at approximately this level during 1979-80 but increased to 1,000 tons in 1981. Data from research vessel surveys indicated that the biomass had declined by 80-90% during the 1970's. Little if any recovery has been indicated by commercial indices of abundance and data from research vessel surveys by the State of Maine, but some improvement since 1977 is evident from Northeast Fisheries Center surveys. Temperature appears to have been an important factor in determining historical trends in abundance for this stock, although in recent years the relative impacts of temperature and exploitation on recruitment have been difficult to quantify. Management became intensive during the 1970's with declining abundance, culminating in closure of the fishery during 1978, but a winter-spring fishery has been allowed in subsequent years.

The Committee considered that the Gulf of Maine situation could provide useful biological data for interpretation of life history aspects and environmental impacts on recruitment. It was also noted that the Gulf of Maine fishery constituted an example of an unrestricted winter fishery on ovigerous females and could therefore provide the basis for future inferences on stock-recruitment relationships.

b) Workshop on age determination of shrimp

STACFIS noted that the Shrimp Ageing Workshop which met at Quebec City, Quebec, Canada, during 11-14 May 1981 to consider various techniques for estimating the age composition of shrimp from biological sampling data, had reconvened (with Mr. J. Fréchette as Convener) at NAFO Headquarters during 20-21 November 1981 to finalize discussions and complete its report. The report of the Workshop will be presented at the regular meeting of STACFIS in June 1982.

## II. ASSESSMENT OF SEAL STOCKS

1. Harp seals

a) Review of fishery (SCS Doc. 81/XI/28)

Provisional Canadian and Norwegian statistics for the "Gulf" and "Front" areas in 1981 indicate at total catch of 200,162 harp seals, of which 176,328 were young of the year. Due to an ususually small amount of ice along the Labrador coast in 1981, coastal residents and a fleet of small (longliner-type) vessels were able to exploit the young seals in the area. This resulted in the catch exceeding the TAC by approximately 30,000 animals. There was no information on harp seal catches in the Canadian Arctic and at West Greenland in 1981. Denmark provided final figures for West Greenland catches in 1977 and updated estimates for 1978-80. These data indicated that the annual total catch for these arctic regions in 1977-80 was probably in the order of 12,000-14,000 harp seals.

b) Research in 1981 (SCR Doc. 81/XI/149, 152, 153, 154, 158, 160, 161, 162, 163, 164, 166)

Canada reported on pup production estimates from mark-recapture experiments (SCR Doc. 81/XI/153), on mean age at sexual maturity and age specific pregnancy rates (SCR Doc. 81/XI/152), on a reanalysis of population dynamics (SCR Doc. 81/XI/166), on the interaction of harp seals and their food organisms (SCR Doc. 81/XI/154), on changes in blood properties of fasting and feeding harp seal pups (SCR. Doc. 81/XI/158), on energetics of nursing (SCR 81/XI/160), on changes in energy stores during neonatal development (SCR Doc. 81/XI/161), on changes in composition and energy content of harp seal milk (SCR Doc. 81/XI/162), on post-weaning growth (SCR Doc. 81/XI/163), and on energy utilization during the post-weaning period (SCR Doc. 81/XI/164). Denmark reported on recaptures at West Greenland up to 1981 of harp seals tagged and branded in the Newfoundland area (SCR. Doc. 81/XI/149) and presented age frequencies of samples from northwest Greenland in 1978 and 1979 compared with those of previous years.

c) Population assessment

i) Pregnancy rate (SCR Doc. 81/XI/152)

There was no significant change in mean age at maturity and age-specific pregnancy rates for 1981 from those of recent years. The available data were inadequate to determine if pregnancy rates are lower in the old females.

ii) Pup production (SCR Doc. 81/XI/153)

Data from the 1977-80 mark-recapture experiments were reanalyzed using new information on tag recoveries in 1981. Tagging was carried out in both the Front and Gulf areas in 1978-1980, and it was thus possible to test the hypothesis that the number of recoveries from each area was proportional to the number orginally tagged. The observed recoveries were compared with expected frequencies by a $\chi^2$ goodness-of-fit test. The results indicated that the 1978 and 1979 marked cohorts produced unbiased estimates of pup production but that the 1980 data deviated significantly from the expected frequencies. Because tagging was carried out only in the Gulf in 1977 on a small number of seals, it was not possible to test the assumption of random sampling or uniform distribution of recovered tags, and consequently the 1977 estimate of production was considered unreliable. Estimated production in 1978, 1979 and 1980 was 469,000 ± 26,000 (mean ± standard error), 476,000 ± 36,000 and 434,000 ± 52,000 pups respectively, the 1978 and 1979 estimates being considered the most reliable. At the November 1980 Meeting, the estimates from the mark-recapture experiments were combined to give a mean estimate of pup production for the 1977-80 period of 410,000 with nominal standard error of 46,000. That estimate was combined with a survival index estimate to give the best available point estimate of pup production of 375,000 in 1980.

iii) Natural mortality, stock size and replacement yield (SCR Doc. 81/XI/152, 166)

A method was presented that used the probability distributions of the observed ratios between survival of the 1967 and 1968 cohorts and the 1971 and 1972 cohorts, together with the new mark-recapture estimates of pup production in 1978 and 1979, to obtain the most likely values for pup production (380,000-390,000) in 1967, the starting point of the model, and for instantaneous natural mortality (0.0950-0.0975) in the 1967-81 period. In view of the uncertainty about age-specific mortality rates, two simulations were undertaken. In the first case, the same natural mortality rate applied to all age-groups, resulting in most likely estimates for 1981 of $M = 0.0975$ and population size of 2.15 million age 1+ seals. In the second case, natural mortality in the first year was assumed to be 3 times that of age 1+ animals (i.e. $M_0 = 3M$), resulting in estimates for 1981 of $M = 0.095$ and population size of 2.04 million age 1+ seals.

Projections were made from 1981 to 1991, utilizing present age-specific hunting selectivities and age-specific pregnancy rates. Projections over this period were considered necessary to allow for possible changes in the age structure and to permit the cohorts entering under the assumed management regimes to reach an age where their contribution to pup production, and hence population size, could be assessed. Increases in the TAC of 10%, 25% and 50% do not cause the simulated population to decline, but a doubling of the TAC produces a gradual decline to 1.8 million animals in 1991 with $M_0 = M$ and to 1.4 million animals with $M_0 = 3M$. Replacement yields for 1982 and 1983 were estimated at 285,000 and 301,000 animals respectively for $M_0 = M$ and 239,000 and 248,000 animals respectively for $M_0 = 3M$. Replacement yields increase to maxima of 338,000 ($M_0 = M$) and 284,000 ($M_0 = 3M$) by about 1986 when they can be regarded as sustainable yields. However, these projections are uncertain due to possible changes in pregnancy rate and density-dependent effects. In view of the complexity of the new analysis and the lack of time to study it thoroughly at this meeting, STACFIS agreed that further critical review should be undertaken before the results are adopted as the basis for major revision of management schemes for 1982.

d) Interaction between harp seals and commercially exploited fish populations (SCR Doc. 81/XI/154)

The Committee considered the questions noted in the joint Canada-EEC request for advice on seals as follows:

*i) What quantities of commercially exploited fish and invertebrates are estimated to be consumed annually by Northwest Atlantic harp seals? What is the size, age and species-stock composition of this consumed food?*

There is as yet little information to produce reasonable estimates of the quantities of food items eaten because of variability in species composition of the food by season, location, age of seals, and biased sampling (i.e. during whelping and moulting periods when seals do not feed regularly). Analysis of existing data should be completed by next year, and studies on energetics of harp seals, now in progress, will give better estimates of metabolic rates and therefore food demand.

*ii) What direct or indirect (e.g. through competition for food) effects would increasing or decreasing the Northwest Atlantic harp seal population to 25% above or below its current abundance be expected to have on exploited fish and invertebrate stocks and yields from them?*

The effects are unknown for the reasons given in the answer to (*i*).

*iii) To what extent, where and when are Northwest Atlantic harp seals accidently killed in commercial fisheries for other marine animals?*

Accidental deaths, attributable to commercial fisheries are normally very few. Although harp seals have been captured in small numbers as by-catch in salmon drift-nets off West Greenland, this fishery has greatly diminished. Shrimp trawlers occasionally take seals off West Greenland, and the rare seals summering around Newfoundland may be caught by fishing gear. In 1981, with abnormally early melting of ice off eastern Newfoundland leading to an unusually early start of the cod gillnet fishery, about 1,000 beaters and bedlamers were taken as by-catch, this figure being much above normal.

*iv) To what extent, when and where do Northwest Atlantic harp seals compete directly with fishermen by taking commercially exploited fish species near, in or from fishing gear?*

The information available indicates that such competition is rare.

*v) To what extent does such competion damage gear or fish or disturb the functioning of the gear?*

Much damage is known to occur occasionally to gillnets in the cod fishery of northern Norway, but there is no evidence of such damage in the Northwest Atlantic.

*vi) Is there evidence that harp seals indirectly affect exploited fish and invertebrate populations through propagation of disease or parasites?*

There is no special knowledge of the potential effects of harp seal parasites and diseases on exploited fish populations. However, harp seals are regarded as relatively unimportant hosts of the codworm, *Porrocaecum decipiens*, either because they summer outside its geographical range where *Contracaecum* and the herring worm *Anisakis* also predominate, or because infestation rates are low in contrast to those for grey seals, *Halichoerus grypus*, and harbor seals, *Phoca vitulina*.

e) Future research

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

recommends

*i) that further biological samples of moulting harp seals and beaters be taken at the Front;*

*ii) that sampling of harp seals be continued in the Gulf of St. Lawrence and off northwest Newfoundland in winter for studies of age composition and reproduction;*

*iii) that studies on the energetics and feeding of harp seals, including milk transfer from mother to pup, be continued for the Gulf and Front areas and initiated for the Arctic;*

*iv) that Norway and Denmark participate in a joint study with Canada on the accuracy of age determination of harp seals from teeth; and*

*v) that catch statistics of harp seals be improved for the northern Gulf of St. Lawrence and the Arctic regions.*

2. Hooded seals

a) Review of fishery (SCS Doc. 81/XI/27)

Provisional Canadian and Norwegian statistics for 1981 indicate a total catch of 13,686 hooded seals. Denmark provided revised statistics for the catch of hooded seals at West Greenland in 1977 and preliminary figures for 1978-80, indicating an average catch of about 3,500 seals at West Greenland and a total of 5,000-6,000 if catches at East Greenland are included.

b) Research in 1981 (SCR Doc. 81/XI/150)

Denmark provided an updated analysis of catches and biological studies on hooded seals in Greenland during 1970-80, including age frequencies for northwest Greenland up to 1980. Canada reported that 183 hooded seal pups were tagged in the Gulf in 1981 with 19 local recoveries, and that age samples of female hooded seals taken at the Front in 1979-81 had been analyzed.

c) Population assessment

The Committee considered the results of some preliminary analyses by Canada of historical data relating to production and mortality parameters of hooded seals in the Northwest Atlantic. Estimates of natural mortality for adult females ranged from 0.11 to 0.13 and annual pup production during the late 1960's was estimated from survival indices to have been about 40,000. However, because of uncertainty about recent pup production and stock size, STACFIS agreed that there was no firm basis for changing its previous advice and therefore advises that the present management regime should be continued.

d) Future research

i) STACFIS noted the proposal by Norway to host at the Institute of Marine Research, Bergen, in 1983 an international workshop on hooded seal biology, distribution and stocks, and agreed that such a meeting would provide an opportunity for scientists to present much hitherto unpublished data. STACFIS accordingly

recommends

*that the Scientific Council should provide appropriate endorsement of the Norwegian proposal to host an international workshop on hooded seals in 1983.*

ii) In view of the uncertainty about stock size levels of hooded seals since the late 1960's and the absence of a recent analytical assessment, STACFIS

recommends

*that an effect be made to estimate current pup production and stock size of hooded seals.*

## III. ADJOURNMENT

There being no further business, the Chairman expressed his thanks to all participants, especially to the Convener of the Working Group on Seals and to the various rapporteurs, for their keen interest and cooperation during the course of the meeting, and to the Secretariat staff for their efficiency in the preparation of documents and reports.

# PART E

## MISCELLANEOUS

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v) Shrimp (*Pandalus*) stock at East Greenland (Annex 3)

c) Mesh assessment (maximization of yield per recruit at $F_{0.1}$ for cod and redfish in Div. 3M (FC Doc. 80/IX/16, revised).

d) Review of Working Group reports
   i) Squid biology and distribution (Convener: T. W. Rowell)
      - Preliminary results of 1981 coordinated surveys
      - Trends in abundance and fishery characteristics
      - Patterns of distribution and migration and enviromental influences
      - Biological characteristics
      - Coordination of research
      - Future research needs

e) Gear and selectivity studies (*NAFO Sci. Coun. Rep.* 1979-80, page 87)
   i) Selection studies on Greenland halibut
   ii) Selection studies on Silver hake and Squid
   iii) Other studies

f) Ageing techniques and validation studies (*NAFO Sci. Coun. Rep.* 1979-80, page 88)
   i) Redfish age determination and validation
   ii) Roundnose grenadier age determination and validation
   iii) Further progress on ageing squid
   iv) Progress report on shrimp ageing workshop (SCS Doc.81/VI/14)
   v) Other studies

g) Review of relevant fishery science papers not considered under the above items

h) Other matters

3. Research Coordination (Chairman: V. A. Rikhter)

   a) Statistics and sampling (SCS Doc. 81/VI/17)
      i) CWP activities relevant to NAFO (SCS Doc. 81/VI/3,11)
      ii) Fishery statistics (requirements and adequacy of national reporting)
      iii) Sampling program (acquisition and processing of data) (SCS Doc. 81/VI/16)
      iv) Review of scientific observer program in 1980
      v) List of fishing vessels for 1980-progress report
      vi) Other matters

   b) Biological surveys
      i) Review of survey activity in 1980 and plan for 1981
      ii) Review of draft manual on groundfish surveys (SCS Doc. 81/VI/7)
      iii) Review of stratification schemes
      iv) Other matters

   c) Environmental studies
      i) MEDS progress report for 1980 (SCR Doc. 81/VI/82)
      ii) Review of environmental studies in 1980
      iii) Other matters

   d) Review of tagging activities reported in 1980 (SCS Doc. 81/VI/6)

   e) Other matters
      i) Request by Fisheries Commission for review of gear definitions relevant to NAFO fishery regulations (FC Doc. 81/IV/4, revised)

4. Publications (Chairman: R. G. Halliday)

   a) Publications and editorial policy

   b) Proposed ichthyoplankton manual

   c) Coordination of research information for the NAFO area

   d) Papers nominated for possible publication

   e) Possible need for special issues of Studies

   f) Other matters

5. Collaboration with Other Organizations

   a) Eleventh session of CWP in July 1982

   b) Proposed NAFO/ICES study on redfish at Greenland

6. Adoption of reports

   a) Report of Standing Committee on Fishery Science (STACFIS)

   b) Report of Standing Committee on Research Coordination (STACREC)

   c) Report of Standing Committee on Publications (STACPUB)

   d) Report of Scientific Council, February 1981 (see Part A, this volume)

7. Proposed Amendment to Rules of Procedure (Annex 4)

8. Election of Officers

9. Future Scientific Council Meetings, 1981/82

10. Other Business

11. Adjournment

C. <u>ANNUAL MEETING, SEPTEMBER 1981</u>

1. Opening (Chairman: R. H. Letaconnoux)

   a) Appointment of rapporteur

   b) Adoption of agenda

   c) Plan of work

2. Fishery Science (Chairman: G. H. Winters)

   a) Special session on remote-sensing methods and their possible application to fisheries science (Convener: R. W. Trites)
      i) General introduction and overview of the nature and use of remote-sensing data
      ii) Use of satellites for mapping sea surface temperatures, fronts and eddies
      iii) Water color as it relates to chlorophyll and primary production
      iv) Fluorescence and luminescence techniques and measurements
      v) Remote-sensing data for Northwest Atlantic - format, availability and costs - past, present and future
      vi) Other considerations

   b) Symposium on environmental conditions in the Northwest Atlantic during the 1970-79 decade (Convener: E. J. Sandeman)
      i) Historical review of ocean climate in the Northwest Atlantic and events leading up to the decade
      ii) Meteorological conditions during the decade
      iii) Ice and icebergs during the decade
      iv) Oceanographic conditions during the decade - regional overviews
         - Subareas 0 and 1
         - Subareas 2, 3 and 4
         - Subareas 5 and 6
         - General considerations
      v) New insights about fisheries and oceanography
      vi) Other considerations

   c) Task force on Larval Herring Program (Convener: M. D. Grosslein)
      i) Herring stock interrelationships in Gulf of Maine region
      ii) Studies of spawning stocks in Gulf of Maine
      iii) Larval herring and related zooplankton studies
      iv) Status of larval herring program data base, publications, etc.
      v) Other matters
      vi) Recommendation to NAFO

   d) *Ad hoc* Working Group on Flemish Cap Project (Convener: J. T. Anderson)
      i) Evaluation of existing data base
      ii) Review of results from recent surveys
      iii) Stock-recruitment relationship for cod
      iv) Calibration of different sampling techniques - plankton and groundfish
      v) Other matters

   e) *Ad hoc* Working Group on Squid Research (Convener: T. W. Rowell)
      i) Further evaluation of data from 1981 surveys
      ii) Coordination of research surveys for 1982
      iii) Other matters

f) Other matters
   i) Special contribution on evaluation of scientific advice provided for management of the Northwest Atlantic fish stocks, with particular reference to cod
   ii) Evaluation of the impact of changes in mesh size on the interacting fisheries for cod and redfish in Div. 3M

3. Publications (Chairman: R. G. Halliday)

   a) Further review of editorial policy
   b) Establishment of editorial board
   c) Proposed ichthyoplankton identification manual
   d) Selction of papers for possible publication
   e) Other matters

4. Adoption of Reports

   a) Standing Committee on Fishery Science (STACFIS)
   b) Standing Committee on Publications (STACPUB)
   c) Report of June 1981 Meeting of Scientific Council (see Part B, this volume)

5. Rúles of Procedure

   a) Proposal to amend Rule 3.1 regarding election of officers (see Annex 4)
   b) Proposal to amend Rule 4.1 so that a draft provisional agenda is sent 100 days before the data fixed for the opening of the meeting (SCS Doc. 81/IX/25)

6. Review of Future Meeting Arrangements

   a) Mid-term meeting for assessment of shrimp and seals (20-26 November 1981)
   b) Mid-term meeting for assessment of cod and capelin (mid-February 1982, if necessary
   c) Regular meeting, June 1982

7. Election of Officers

8. Other Matters

9. Adjournment

D. SPECIAL MEETING, NOVEMBER 1981

1. Opening (Chairman: R. Wells)

   a) Appointment of rapporteur
   b) Adoption of agenda
   c) Plan of work

2. Fishery Science (Chairman: J. P. Minet)

   a) Review of harp and hooded seals (Annex 5) (Convener: A. W. Mansfield)
      i) Review of fishery
      ii) Research in 1981
      iii) Stock relationships
      iv) Population assessment
         - Vital rates
         - Pup production
         - Stock size
         - Sustainable yield
      v) Interactions between harp seal and fish populations
      vi) Future research needs

   b) Review of shrimp stocks in Subareas 0 and 1, and at East Greenland[1] (Annexes 6 and 3) (Convener: J. P. Minet)
      i) Review of fishery trends
      ii) Distribution and biology

iii) Catch and effort
iv) By-catches in shrimp fishery
v) Biomass estimates
vi) Total allowable catches
vii) Future research needs

c) Other matters

3. Adoption of Reports

   a) Report of September 1981 Meeting of Scientific Council (see Part C, this volume)

   b) Report of Scientific Council (this meeting), including report of STACFIS

4. Review of Future Meeting Arrangements

   a) Regular Meeting (2-18 June 1982)

   b) Annual Meeting (8-17 September 1982)

5. Other matters

   a) Proposed international workshop on hooded seals

   b) Report of Shrimp Ageing Workshop

6. Adjournment

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[1] Assessment of East Greenland shrimp stock included on the Agenda at the request of EEC (Annex 3) and with the concurrence of the Scientific Council.

## ANNEX 1. EXTRACT FROM CANADIAN REQUEST FOR ADVISE ON THE SCIENTIFIC BASIS FOR MANAGEMENT IN 1981 OF CERTAIN STOCKS IN SUBAREAS 0 AND 4

Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels:

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications of fishable stock size in both the short and the long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As a general reference point, the implications of continuing to fish at $F_{0.1}$ in 1981 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and to those to be expected at the $F_{0.1}$ level. Management options for arriving at the latter stock size on a shorter time scale should be developed. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1981 and the long term.

b) For those stocks subject to general production-type assessments, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference point should be the level of fishing effort (≡F) which is two-thirds that calculated to be required to take the MSY catch in the long term.

c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence on stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stock.

(*NAFO Sci. Coun. Rep.* 1979-80, page 170)

## ANNEX 2. CANADIAN REQUEST FOR ADVICE ON THE SCIENTIFIC BASIS FOR MANAGEMENT IN 1982 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

Canada requests that the Scientific Council, at its meeting in advance of the 1981 NAFO Annual Meeting, provide advice on the scientific basis for management of the following stocks in 1982:

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

It is further suggested that, subject to the concurrence of the other coastal state concerned, the Scientific Council, prior to the 1981 Annual Meeting of NAFO, provide advice on the scientific basis for management in 1982 of the following stocks:

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

Although capelin (Subarea 2 and Div. 3K; Div. 3LNO) stocks were considered at the February 1981 Meeting of the Scientific Council, it is requested that the Standing Committee on Fisheries Science, at its June 1981 Meeting, consider whether the analyses conducted in February are sufficient to provide the basis for advice on management in 1982 and whether reconsideration of the status of these stocks after completion of the 1981 fishery, but in advance of the 1982 fishery, would provide significant improvements in the basis for advice on management.

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

a) For those stocks subject to analytical dynamic-pool type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications of fishable stock size in both the short and long term. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing productive potential of the stock, management options should be evaluated in relation to spawning stock size. As a general reference point, the implications of continuing to fish at $F_{0.1}$ in 1982 and subsequent years should be evaluated. The present stock size should be described in relation to those observed historically and to those expected at the $F_{0.1}$ level. Management options for arriving at the latter stock size on a shorter time scale should be developed. Opinions of the Scientific Council should be expressed in regard to stock sizes, catch rates, and TACs implied by these management strategies for 1982 and the long term.

b) For those stocks subject to general production-type assessments, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the general reference point should be the level of fishing effort (≡F) which is two-thirds that calculated to be required to take the MSY catch in the long term.

c) For those resources on which only general biological and/or catch data are available, no standard criteria on which to base advice can be established. The evidence on stock status should, however, be weighed against a strategy of optimum yield management and maintenance of stock biomass at levels of about two-thirds that of the virgin stock.

Dr A. W. May
Assistant Deputy-Minister for Atlantic Fisheries
Department of Fisheries and Oceans
Ottawa, Canada

## ANNEX 3. EEC REQUEST FOR ADVICE ON THE SCIENTIFIC BASIS FOR MANAGEMENT IN 1982 OF CERTAIN STOCKS IN SUBAREAS 0 AND 1

The EEC requests the Scientific Council to provide advice for the following stocks, subject to the agreement of the other coastal state concerned in the case of joint stocks:

a) Stocks occurring both in the EEC and Canadian fihsery zones: Greenland halibut, roundnose grenadier, and shrimp in Subareas 0 and 1.

b) Stocks occurring in the EEC fishery zone: cod, redfish and catfish (wolffish) in Subarea 1.

For the above-mentioned stocks, the present state of exploitation should be reviewed and options for management in 1982 given. Where possible, these should be expressed graphically in terms of catch in 1982 and the size of the spawning stock biomass on 1 January 1983, for a range of values of F which covers at least -50% to +25% of F in 1980.

For cod in Subarea 1, it is requested that catches for each year up to and including 1984 and spawning stock biomasses for each year up to and including 1985 are calculated for maintaining F at the following levels from 1982 onwards: $F = 0.1$, $F = 0.2$, $F = F_{0.1}$, $F = F_{Max}$ and $F = 0.6$. For 1981, F will be that value needed to take the TAC of 50,000 tons. All values of F refer to that on the most heavily exploited age-groups. What will be the effects on the stock of maintaining a TAC of 50,000 tons for the period 1981-1985? Up-to-date mesh assessments should be made for an increase from the present minimum 120 mm alternatively to 130 mm, 140 mm and 160 mm mesh sizes.

Regarding the shrimp (*Pandalus*) stock at West Greenland, the consequences of a TAC of 30,000 tons for the EEC zone and 5,000 tons for the Canadian zone for the year 1982 should be assessed, together with other alternatives, such as 25,000 plus 5,000 tons and 35,000 plus 5,000 tons.

The shrimp stock at East Greenland should be assessed by the same NAFO assessment working group, in agreement with ICES Resolution 1980/2:6-19. The consequences of a TAC of 6,000, 8,000 and 10,000 tons in 1982 on the state of this stock for 1983 should be tentatively explored.

Mr M. Marcussen, Head of Division
Directorate General for Fisheries
Commission for the European Communities
Brussels, Belgium

## ANNEX 4. PROPOSED AMENDMENT TO RULES OF PROCEDURE FOR THE SCIENTIFIC COUNCIL

Rule 3.1, as adopted on 13 June 1980, is as follows: "The Chairman and Vice-Chairman shall take office at the conclusion of the annual meeting at which they are elected" (*Scientific Council Reports, 1979-1980*, page 109).

Canada proposes that Rule 3.1 should be replaced by the following: "The Chairman and Vice-Chairman shall take office at the conclusion of an annual meeting. Election of these officers shall take place either at such annual meeting or at a special meeting held previous to such annual meeting".

## ANNEX 5. JOINT CANADIAN/EEC REQUEST FOR ADVICE ON THE SCIENTIFIC BASIS FOR MANAGEMENT OF SEAL FISHERIES

At the request of Canada, the Scientific Council at a special meeting in November 1980 provided advice on the scientific basis for management in 1981 of stocks of harp seals and hooded seals within national fishery limits in NAFO Subareas 0, 1, 2, 3 and 4. The Canadian Government and the EEC consider it desirable that the Scientific Council similarly provide advice on the scientific basis for seal management over two hunting seasons, i.e. for 1982 and 1983.

For stocks of both species it is requested that the Council comment on the following aspects:

1. Current stock size and pup production and recent trends in these parameters.

2. Current replacement yield and sustainable yield at present stock size and in the long term, under varying options of age compositions in the catch, including that recently occurring.

3. Trends in population size based upon the present quota levels and quota levels which vary from these levels by + or - 10%, 25% or 50% for all removals except those by traditional hunting in the Canadian Arctic and at Greenland.

It is requested that the Council specifically note the effects, if any, of unusual ice conditions in 1981 and the manner in which such effects have been incorporated into the estimates and comments on the above aspects. Further, it is requested that the Council document and review available information relevant to interactions between Northwest Atlantic harp seals and commercially exploited fish populations and fisheries, and to provide scientific advice on the following questions insofar as available data permit:

a) What quantities of commercially exploited fish and invertebrates are estimated to be consumed annually by Northwest Atlantic harp seals? What is size, age and species-stock composition of this consumed food?

b) What direct or indirect (e.g. through competition for food) effects would increasing or decreasing the Northwest Atlantic harp seal population to 25% above or below its current abundance be expected to have on exploited fish and invertebrate stocks and yields from them?

c) To what extent, where and when are Northwest Atlantic harp seals accidentally killed in commercial fisheries for other marine animals?

d) To what extent, when and where do Northwest Atlantic harp seals compete directly with fishermen by taking commercially exploited fish species near, in, or from fishing gear?

e) To what extent does such competition damage gear or fish or disturb the functioning of the gear?

f) Is there evidence that harp seals indirectly affect exploited fish and invertebrate populations through propagation of disease or parasites?

It is suggested that the Council meet and report during the autumn of 1981 with dates to be established through appropriate consultation.

Mr M. Marcussen
Head of Division
Directorate General for Fisheries
Commission of the European Communities
Brussels, Belgium

Dr A. W. May
Assistant Deputy Minister for Atlantic Fisheries
Department of Fisheries and Oceans
Ottawa, Ontario, Canada

# ANNEX 6. CANADIAN AND EEC REQUEST FOR ADVICE ON THE SCIENTIFIC BASIS FOR MANAGEMENT IN 1982 OF THE SHRIMP STOCKS IN NAFO SUBAREAS 0 AND 1

Canada and the EEC request the Scientific Council to assess the status of shrimp stocks in NAFO Subareas 0 and 1 and to advise both on the short term and long term consequences of 1982 catches of 25,000, 30,000, 35,000, 40,000 and 45,000 tons and the TACs required to maintain the stock biomass at levels of about two-thirds and one-half that of the virgin stock.

Mr M. Marcussen
Head of Division
Directorate General for Fisheries
Commission of the European Communities
Brussels, Belgium

Dr A. W. May
Assistant Deputy Minister for Atlantic Fisheries
Department of Fisheries and Oceans
Ottawa, Ontario, Canada

*(The original individual requests by Canada and EEC for assessment of the shrimp stocks were listed in Annex 2 of NAFO Circular Letter 81/65, dated 9 October 1981. The above joint request was received on 25 November 1981 after the Scientific Council had nearly completed its work.)*

# II. LIST OF SCIENTIFIC COUNCIL RECOMMENDATIONS, 1981

the production of an ichthyoplankton identification manual for the Northwest Atlantic is a practical and worthwhile venture ..................................... 76

C. ANNUAL MEETING, SEPTEMBER 1981

1. The appropriate agencies involved in remote-sensing technology relevant to sea-surface temperatures in the NAFO area should be encouraged to produce an improved product ............................................................... 85

2. The analysis of available satellite water-color data for the NAFO area should be encouraged, and NOAA/NESS (Nimbus NET group) should be alerted about the important geographical areas for which coverage is inadequate ....................... 85

3. The Scientific Council should consider a restructuring of its committees to include a clear focus for research on remote-sensing relevant to fisheries science ................................................................... 85

4. STACPUB should consider for publication in the appropriate NAFO series the papers presented to the Special Session on Remote-Sensing ........................... 86

5. The Scientific Council should consider a restructuring of its committees to ensure that environmental matters are dealt with on a regular basis .................. 87

6. STACPUB should consider for publication in the appropriate NAFO series the papers presented to the Symposium on Environmental Conditions during the 1970-79 Decade ............................................................... 88

7. An *ad hoc* working group should meet during 12-14 January 1982 to summarize all Canadian and USA tag releases and recoveries relevant to the herring stocks in Subareas 4, 5 and 6 and to review analyses related to movements of adults and juveniles, stock identification, and mortality rates ............................ 89

8. A study should be undertaken to determine whether a relationship exists between cod recruitment and biomass on Flemish Cap and environmental indices based on temperature and salinity data available in the MEDS data base .............. 92

9. Participants of the Flemish Cap Working Group should initiate discussions with a view to redefining the project's objectives as soon as possible so that maximum coordination of 1982 surveys can be achieved ............................... 93

10. A four-day session on squid biology and distribution should be included in the scheduling of the June 1982 Meeting in order to review all available information and to plan for cooperative research in 1983 ....................................... 94

11. The assessment of changes in mesh size on the interacting fisheries for cod and redfish should be deferred for consideration at the June 1982 Meeting ................ 95

12. Establishment of the Editorial Board, consisting of Dr. W. G. Doubleday, Mr. A. Lee, Mr. E. J. Sandeman and Dr. W. Templeman as Associate Editors to assist the Editor (Mr. V. M. Hodder) in the evaluation and processing of papers for the Journal of Northwest Atlantic Fishery Science ...................................... 101

13. Publication of peer-reviewed regional ichthyoplankton identification manuals starting with one for the mid-Atlantic Bight area for which a suitable manuscript is available ............................................................. 103, 106

14. Steps should be taken to encourage research on ichthyoplankton identification problems in the Northwest Atlantic, in order to enhance the value of future volumes of the proposed manual ..................................................... 103, 106

15. Establishment of an *ad hoc* working group of experts to solicit and oversee the preparation of regional ichthyoplankton identification manuals for the Northwest Atlantic, which should (i) be based on knowledge of the fauna in particular regions, (ii) be subjected to peer-review by NAFO scientists, (iii) cross-reference other manuals in the series when dealing with geographical variation, and (iv) generally follow the style of the first manual in the series but with some freedom by authors to alter the style to suit particular needs ...................... 106

D. SPECIAL MEETING, NOVEMBER 1981

# III. LIST OF RESEARCH AND SUMMARY DOCUMENTS, 1981

## RESEARCH DOCUMENTS, 1981

| SCR Doc. | Serial | |
|---|---|---|
| 81/II/1 | N264 | AKENHEAD, S. A., J. CARSCADDEN, H. LEAR, G. R. LILLY, and R. WELLS. On the cod capelin interaction off northeast Newfoundland and Labrador. (18 pages) |
| 81/II/2 | N265 | WELLS, R. Effects of changes in mesh size upon yield per recruit of cod in Division 3M. (5 pages) |
| 81/II/3 | N267 | CARSCADDEN, J., G. H. WINTERS, and D. S. MILLER. Assessment of the Division 3L capelin stock, 1967-1980, using SCAM. (13 pages) |
| 81/II/4 | N268 | CARSCADDEN, J., and D. S. MILLER. Analytical assessment of the capelin stock in Subarea 2 and Division 3K, using SCAM. (8 pages) |
| 81/II/5 | N269 | MILLER, D. S., and J. E. CARSCADDEN. Acoustic survey results for capelin (*Mallotus villosus*) in Divisions 2J+3K and 3LNO, 1980. (10 pages) |
| 81/II/6 | N270 | LARRANETA, M. G. Ecology and fishing of cod stocks in Divisions 3M and 3NO. (8 pages) |
| 81/II/7 | N271 | LILLY, G. R. Influence of the Labrador Current on predation by cod on capelin and sand lance off eastern Newfoundland. (8 pages) |
| 81/II/8 | N272 | LILLY, G. R., R. WELLS, and J. CARSCADDEN. Estimates of the possible consumption of capelin by the cod stocks in Divisions 2J+3KL and 3NO. (9 pages) |
| 81/II/9 | N273 | CHEKHOVA, V. A., and A. I. POSTOLAKY. Abundance and biomass of cod on the Grand Bank (Divisions 3NO) and Flemish Cap (Division 3M). (9 pages) |
| 81/II/10 | N274 | BAKANEV, V. S. Results of Soviet investigations on capelin in the Northwest Atlantic in 1980. (10 pages) |
| 81/II/11 | N275 | BISHOP, C. A., and S. GAVARIS. Stock assessment of cod in Division 3NO. (25 pages) + Addendum (3 pages) |
| 81/II/12 | N276 | GAVARIS, S. Assessment of the cod stock in Division 3M. (11 pages) + Addendum 1 (3 pages) + Addendum 2 (3 pages) |
| 81/II/13 | N277 | WELLS, R. Distribution and abundance of cod on the Flemish Cap in January 1981 and mortality in 1980. (7 pages) |
| 81/II/14 | N278 | NAKASHIMA, B. S. Sampling variation and survey design for capelin (*Mallotus villosus*) densities from an acoustic survey in Divisions 3LNO, 1980. (8 pages) |
| 81/II/15 | N279 | WELLS, R. The number of research vessel tows on the Flemish Cap is never enough. (3 pages) |
| 81/VI/16 | N292 | KULKA, D. W. Observed by-catch in the Flemish Cap cod and redfish fisheries in 1979 and 1980 by Canadian observers. (2 pages) |
| 81/VI/17 | N293 | RIKHTER, V. A. Dynamics of optimum fishing intensity on fish with strong fluctuations in abundance. (14 pages) + Addendum (1 page) |
| 81/VI/18 | N294 | BULATOVA, A. Yu., V. M. KISELEVA, K. G. KONSTANTINOV, A. I. POSTOLAKY, and V. A. CHEKHOVA. Preliminary assessment of some demersal fish stocks in the Newfoundland and Labrador areas. (9 pages) |
| 81/VI/19 | N295 | BURMAKIN, V. V. Water temperature in the Labrador and Newfoundland areas in 1980. (7 pages) |
| 81/VI/20 | N296 | SAVVATIMSKY, P. I. On length measurements of roundnose grenadier (*Coryphaenoides rupestris*) in the Northwest Atlantic. (11 pages) |
| 81/VI/21 | N288 | KOELLER, P. A. Vertical distribution and optimum sampling strategy for 0-group silver hake (*Merluccius bilinearis*) surveys on the Scotian Shelf. (13 pages) |

Research Documents (continued)

| | | |
|---|---|---|
| 81/VI/22 | N290 | ATKINSON, D. B., W. R. BOWERING, Sv. Aa. HORSTED, J. P. MINET, and D. G. PARSONS. A review of the biology and fisheries of roundnose grenadier (*Macrourus rupestris*), Greenland halibut (*Reinhardtius hippoglossoides*) and shrimp (*Pandalus borealis*) in Davis Strait (NAFO Subareas 0 and 1). (58 pages) |
| 81/VI/23 | N302 | DAWE, E. G., P. C. BECK, and H. J. DREW. Distribution and biological characteristics of young short-finned squid (*Illex illecebrosus*) in the Northwest Atlantic, February 20-March 11, 1981. (20 pages) |
| 81/VI/24 | N303 | DAWE, E. G., P. C. BECK, H. J. DREW, and G. H. WINTERS. Long-distance migration of a short-finned squid (*Illex illecebrosus*). (4 pages) |
| 81/VI/25 | N304 | DAWE, E. G., G. R. LILLY, and J. A. MOORES. An examination of the influence of squid (*Illex illecebrosus*) on recruitment in several finfish stocks off eastern Newfoundland and Labrador. (14 pages) |
| 81/VI/26 | N305 | DAWE, E. G., and H. J. DREW. Historical records of mature female short-finned squid (*Illex illecebrosus*) from the Northwest Atlantic and the first record of a mature female captured inshore at Newfoundland. (9 pages) |
| 81/VI/27 | N306 | BECK, P. C., E. G. DAWE, and J. DREW. Breakdown of squid (*Illex illecebrosus*) catches in NAFO Subarea 3 and Division 4R, 1980, with length and sex composition from Newfoundland inshore commercial samples and early season off-shore areas. (17 pages) |
| 81/VI/28 | N307 | DAWE, E. G., and G. V. HURLEY. Forecasting inshore abundance of short-finned squid (*Illex illecebrosus*) at Newfoundland. (18 pages) |
| 81/VI/29 | N308 | O'DOR, R. K., N. BALCH, and T. AMARATUNGA. The embryonic development of the squid, *Illex illecebrosus*, in the laboratory. (11 pages) |
| 81/VI/30 | N309 | HATANAKA, H. Outline of Japanese squid fishery in NAFO Subareas 3 and 4 in 1980. (9 pages) |
| 81/VI/31 | N310 | HATANAKA, H. Estimation of abundance index of *Illex* squid on the southern edge of the Scotian Shelf in September 1980. (8 pages) |
| 81/VI/32 | N311 | FEDULOV, P. P., and T. AMARATUNGA. On dates of short-finned squid, *Illex illecebrosus*, immigation onto the Scotian Shelf. (8 pages) |
| 81/VI/33 (Revised) | N315 | LANGE, A. M. T., and M. P. SISSENWINE. Evidence of summer spawning of *Illex illecebrosus* (LeSueur) off the northeastern United States. (17 pages) |
| 81/VI/34 | N316 | MOHN, R. K. Abiotic factors relating to squid abundance as determined from groundfish cruises, 1970-1980. (11 pages) |
| 81/VI/35 | N317 | AMARATUNGA, T., and M. ROBERGE. Summary of 1980 *Illex illecebrosus* fishery in Subarea 4 in relation to 1977-79 data. (12 pages) |
| 81/VI/36 | N318 | AMARATUNGA, T. Biology and distribution patterns in 1980 for squid, *Illex illecebrosus*, in Nova Scotian waters. (10 pages) |
| 81/VI/37 | N319 | DUPOUY, H., and P. DERIBLE. Catch, effort and biological characteristics of squid (*Illex illecebrosus*) in the French fishery in Subareas 3 and 4, 1980. (7 pages) |
| 81/VI/38 | N320 | DUPOUY, H. Biological characteristics and biomass estimate of the squid, *Illex illecebrosus*, on Scotian Shelf (Div. 4VWX) in late summer of 1980. (13 pages) |
| 81/VI/39 | N321 | AMARATUNGA, T. Summary of larval-juvenile surveys in November 1980 and January 1981 in Subarea 4. (15 pages) |
| 81/VI/40 | N322 | MOHN, R. K. Yield per recruit analysis of Div. 4VWX squid by simulation. (15 pages) |
| 81/VI/41 | N323 | FROERMAN, Yu. M., M. FEDULOV, V. V. KHALYUKOV, E. N. SHEVCHENKO, and T. AMARATUNGA. Preliminary results of the RV *Atlant* survey for short-finned squid, *Illex illecebrosus*, in Subarea 4 between 3 March and 4 May 1981. (13 pages) |

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|---|---|---|
| 81/VI/42 | N324 | SAUSKAN, V. I., P. P. FEDULOV, and T. AMARATUNGA. Some features of water masses and and spatial distribution of nektonic groups in the area between the Scotian Shelf and the Gulf Stream. (13 pages) |
| 81/VI/43 | N325 | FROERMAN, Yu. M., E. M. SHEVCHENKO, and T. AMARATUNGA. Preliminary estimate of short-finned squid biomass from the RV *Atlant* squid counting survey in Subarea 4 during March-May 1981. (4 pages) |
| 81/VI/44 (Revised) | N326 | VALDES, E., and E. I. FRAXEDAS. Redfish selectivity study on Flemish Cap, May 1981. (9 pages) |
| 81/VI/45 | N327 | FOREST, A., and J. C. POULARD. Water temperature distributions in NAFO Subdivision 3Ps in autumn 1980 and late winter 1981. (9 pages) |
| 81/VI/46 | N328 | ZUBCHENKO, A. V. Ecological-faunistic review of parasitic fauna of some Macrouridae in the Northwest Atlantic. (12 pages) |
| 81/VI/47 | N329 | ALBIKOVSKAYA, L. K. On distribution and biomass of three species of wolffish, Atlantic wolffish (*Anarhichas lupus* Linné), spotted wolffish (*A. Minor* Olafsen), northern wolffish (*A. latifrons* Steenstrup et Hallgrimsson), in the Newfoundland area. (11 pages) |
| 81/VI/48 (Revised) | N330 | HORSTED, Sv. Aa. Subarea 1 cod: data for 1980 and estimate of stock and yield for 1980-84. (31 pages) |
| 81/VI/49 | N331 | RIKHTER, V. A., V. F. TUROK, and Yu. S. GRINKOV. The distribution of some groundfish species and short-finned squid on the Scotian Shelf during the 1980 fishing season from the data of Soviet observers. (15 pages) |
| 81/VI/50 | N332 | STEIN, M. Transports of heat and volume in the West Greenland current during autumn 1979. (8 pages) |
| 81/VI/51 | N333 | STEIN, M. Temperature anomalies along the Seal Island section (Div. 2J) between 1969 and 1980. (3 pages) |
| 81/VI/52 | N336 | McKONE, W. D. Effects of changes in codend mesh size upon yield per recruit of redfish in Division 3M. (8 pages) |
| 81/VI/53 (Revised) | N337 | GAVARIS, C. A. An assessment of redfish on the Flemish Cap. (7 pages) |
| 81/VI/54 | N338 | BRODIE, W. B., and T. K. PITT. An assessment of the yellowtail stock in Divisions 3LNO. (9 pages) |
| 81/VI/55 | N339 | STEVENSON, S. C. Summary of discarding and estimates of total removals by Canadian trawlers during the 1980 Divisons 3LNO American plaice fishery. ( 8 pages) |
| 81/VI/56 | N340 | GRUDTSEV, M. E., A. A. NESTEROV, and A. B. BENDIK. Studies of Atlantic saury, *Scomberesox saurus* (Walbaum), on the Scotian Shelf in October-November 1980. (7 pages) |
| 81/VI/57 | N341 | NIKOLSKAYA, T. L. Isolation of deepwater redfish (*Sebastes mentella*) stocks on the Grand Newfoundland Bank. (9 pages) |
| 81/VI/58 | N342 | BLINOV, V. V. Method of estimating the effect on trawl catches of changes in trawl selectivity. (14 pages) |
| 81/VI/59 | N343 | ATKINSON, D. B., and C. A. GAVARIS. Divisions 3LN redfish stock assessment. (15 pages) |
| 81/VI/60 | N344 | ATKINSON, D. B. Assessment of roundnose grenadier in NAFO Subareas 2+3. (12 pages) |
| 81/VI/61 | N345 | PITT, T. K., and W. B. BRODIE. A stock assessment update of American plaice in NAFO Divisions 3L, 3N and 3O. (14 pages) |
| 81/VI/62 | N346 | BIDENKO, G. E., V. A. RIKHTER, and V. F. TUROK. Results of experimental fishing for silver hake on Scotian Shelf in July 1980. (9 pages) |

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| 81/VI/63 | N347 | GRINKOV, Yu. S., and V. A. RIKHTER. Some data on distribution of groundfish and short-finned squid along the oceanic slopes of the Scotian Shelf (Div. 4WX) in spring 1979. (13 pages) |
| 81/VI/64 | N348 | BOWERING, W. R., and W. B. BRODIE. Stock assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KL with projected catches for 1982. (17 pages) |
| 81/VI/65 | N349 | GAVARIS, S. Surplus production analysis for the cod stock in NAFO Divisions 2J+3KL. (6 pages) |
| 81/VI/66 | N350 | WELLS, R. Status in 1980 of the cod stock in Divisions 2J+3KL. (13 pages) |
| 81/VI/67 | N351 | VAZQUEX, A. On cod stocks in NAFO waters. (5 pages) |
| 81/VI/68 | N352 | SINCLAIR, A. F. Juvenile argentine (*Argentina silus*) on the Scotian Shelf. (6 pages) |
| 81/VI/69 | N353 | NI, I-HSUN, and W. D. McKONE. The distribution and concentration of redfish species in Newfoundland and Labrador waters. (10 pages) |
| 81/VI/70 | N354 | NI, I-HSUN. The use of vertebrae frequencies to indicate the distribution of sharp-beaked redfish, *Sebastes mentella* and *S. fasciatus*. (17 pages) |
| 81/VI/71 | N356 | SINCLAIR, A. F. Recent trends in argentine abundance on the Scotian Shelf. (7 pages) |
| 81/VI/72 | N357 | KONSTANTINOV, K. G. On some problems of selectivity of a commercial trawl. (8 pages) |
| 81/VI/73 | N358 | KONSTANTINOV, K. G. Methods and results of the total trawl survey of bottom fish in Subarea 3 in 1971-1980. (6 pages) |
| 81/VI/74 | N359 | WALDRON, D. E. An assessment of the Scotian Shelf silver hake (*Merluccius bilinearis*) population for 1980. (26 pages) |
| 81/VI/75 | N360 | GRIGOREV, G. V., and V. P. SEREBRYAKOV. Eggs of the rock grenadier, *Coryphaenoides rupestris* Gunnerus 1765. (4 pages) |
| 81/VI/76 | N361 | TURUK, T. N. Year-to-year and seasonal fluctuations in feeding and biological indices of the Flemish Cap Bank cod. (14 pages) |
| 81/VI/77 | N362 | KONSTANTINOV, K. G. Influence of water temperature on cod year-classes strength on the Flemish Cap Bank. (7 pages) |
| 81/VI/78 | N363 | BOROVKOV, V. A. Variability of oceanographic conditions in the Hamilton Bank area in the autumn period. (12 pages) |
| 81/VI/79 | N364 | BOROVKOV, V. A., and B. P. KUDLO. Water circulation in the Baffin Land, Labrador, Newfoundland and Flemish Cap areas in 1980. (12 pages) |
| 81/VI/80 | N365 | NI, I-HSUN. The use of anal fin ray frequencies to indicate the stock units of deep-water redfish, *Sebastes mentella*, and rosefish, *S. fasciatus*. (14 pages) |
| 81/VI/81 | N367 | SINCLAIR, A., D. WALDRON, and B. WOOD. Comparative fishing for silver hake on the Scotian Shelf using 90 mm and 60 mm codends. (10 pages) |
| 81/VI/82 | N370 | KEELEY, J. R. Marine Environmental Data Service report for 1980-1981. (30 pages) |
| 81/VI/83 | N372 | KEELEY, J. R. Oceanographic data transmitted from the Flemish Cap area, September 1979 to December 1980: Data record no. 2. (16 pages) |
| 81/VI/84 | N377 | AMARATUNGA, T. Preliminary update of *Illex illecebrosus* morphometrics in Subarea 4 for 1980. (10 pages) |
| 81/IX/85 | N378 | MARÍ, A., and E. VALDÉS. Age and Growth of silver hake, *Merluccius bilinearis*, on the Scotian Shelf. (7 pages) |
| 81/IX/86 | N379 | MARÍ, A., and R. COYULA. Mortality rates for 0-group silver hake on the Scotian Shelf. (3 pages. |

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| 81/IX/108 | N412 | MOUNTAIN, D. G. Oceanographic conditions in Subareas 5 and 6 during 1970-79. (15 pages) |
| 81/IX/109 | N413 | YAMANAKA, I. Application of artificial satellites data for fisheries studies in Japan. (25 pages) |
| 81/IX/110 | N414 | TOPLISS, B. J. Water color in inshore areas. (11 pages) |
| 81/IX/111 | N417 | TRITES, R. W. Overview of oceanographic conditions within NAFO Subareas 2, 3, and 4 for the 1970-79 decade. (67 pages) |
| 81/IX/112 | N418 | IRBE, J. G., R. K. CROSS, and A. SAULESLEJA. Remote sensing of surface water temperatures on the Great Lakes and off the Canadian Atlantic Coast. (16 pages) |
| 81/IX/113 | N419 | MURRAY, J. J., and R. M. HAYES. Application of a satellite-tracked fishing vessel transmitting terminal (FVTT) to fisheries management and science. (12 pages) |
| 81/IX/114 | N420 | SAULESLEJA, A., and D. W. PHILLIPS. Meteorological conditions in the decade 1970-79 and their impacts over the Northwest Atlantic. (32 pages) + Corrigendum (2 pages) |
| 81/IX/115 | N421 | SMITH, W. G., D. G. MCMILLAN, and A. WELLS. The distribution and abundance of Atlantic herring larvae in the Gulf of Maine regions as determined from MARMAP surveys during autumn and winter, 1980-81. (7 pages) |
| 81/IX/116 | N422 | ANDERSON, J. T. Larval fish surveys on Flemish Cap, 1980. (14 pages) |
| 81/IX/117 | N423 | PENNEY, R. W., and J. T. ANDERSON. Otolith analysis of age and growth of larval redfish (*Sebastes* sp.) on Flemish Cap, 1979 and 1980. (15 pages) |
| 81/IX/118 | N424 | LILLY, G. R. Distribution and relative abundance of juvenile redfish on the Flemish Cap in 1978-81 based on recoveries from cod stomachs. (15 pages) |
| 81/IX/119 | N425 | GAVARIS, C. A., and W. E. LEGGE. Distribution and abundance of small redfish on the Flemish Cap. (12 pages) |
| 81/IX/120 | N426 | AKENHEAD, S. A. Local sea-surface temperature and salinity on the Flemish Cap. (7 pages) |
| 81/IX/121 | N427 | KITANO, K. Visual features of the Kuroshio eddies as seen in the infrared satellite images from NOAA-6. (5 pages) |
| 81/IX/122 | N428 | WARING, G. T. Results of the international herring tagging program conducted by USA in the Gulf of Maine, Georges Bank and contiguous waters from 1976-1978. (24 pages) |
| 81/IX/123 | N429 | CHAMBERLIN, J. L. Application of satellite infrared data to analysis of ocean frontal movements and water mass interactions off the northeastern United States. (15 pages) |
| 81/IX/124 | N430 | MCGLADDERY, S. E. A survey of parasities of Northwest Atlantic herring *Clupea harengus* L.: preliminary account. (20 pages) |
| 81/IX/125 | N431 | SINDERMANN, C. J. A prospectus and plan of action for herring stock identification using parasite tags. (6 pages) |
| 81/IX/126 | N432 | SINCLAIR, M, and T. D. ILES. Oceanographic and Atlantic herring life history distributions of interest in relation to the herring stock problem in the Georges Bank, Gulf of Maine and Bay of Fundy areas. (26 pages) |
| 81/IX/127 | N433 | ANTHONY, V. C. The use of meristic counts in indicating herring stocks in the Gulf of Maine and adjacent waters. (37 pages) |
| 81/IX/128 | N434 | DUNBAR, M. J. Twentieth century marine climatic change in the Northwest Atlantic and subarctic region. (32 pages) |
| 81/IX/129 | N435 | KEELEY, J. R. Potential temperature and salinity anomalies in the 1970's along the Flemish Cap section. (17 pages) |

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81/IX/130 N436 WOLFORD, T. C. Sea ice and iceberg conditions, 1970-79. (10 pages)

81/IX/131 N437 GOWER, J. F. R. On the possibility of observing natural chlorophyll *a* fluorescence from space. (3 pages)

81/IX/132 N438 BORSTAD, G. A., R. M. BROWN, D. TRAUX, T. R. MULLIGAN, and J. F. R. GOWER. Application of remote sensing techniques in oceanographic studies of the British Columbia salmon fishery. (9 pages)

81/IX/133 N439 ANTHONY, V. C. Status of herring tagging research in the Gulf of Maine. (3 pages)

81/IX/134 N440 BERNSTEIN, B. B., and K. H. MANN. Changes in the near-shore ecosystem of the Atlantic Coast of Nova Scotia, 1968-81. (11 pages)

81/IX/135 N441 SERGEANT, D. E. Some biological correlates of environmental conditions around Newfoundland in the decade 1970-79: harp seals, blue whales and fulmar petrels. (8 pages)

81/IX/136 N442 BOLZ, G. R., and R. G. LOUGH. Ichthyoplankton abundance, diversity, and spatial pattern in the Georges Bank-Nantucket Shoals area, autumn and winter seasons 1971-1977. (23 pages)

81/IX/137 N443 COHEN, R. E., and R. G. LOUGH. Larval herring food habits over three spawning seasons (1974-76) in the Georges Bank-Nantucket Shoals area. (37 pages)

81/IX/138 N444 GRAHAM, J. J., and D. B. SAMPSON. Factors affecting the depth distribution of larval herring (*Clupes harengus* L.) in coastal Maine waters. (9 pages)

81/IX/139 N446 STEIN, M. Hydrographic conditions off West Greenland during autumn 1980 and March 1981. (5 pages)

81/IX/140 N447 GRAHAM, J. J., and B. J. JOULE. Preliminary evaluation of the 1980 larval year-class strength of coastal Maine herring. (22 pages)

81/IX/141 N449 MAY, A. W., R. G. HALLIDAY, R. WELLS, and E. DUNNE. Management of Canadian cod stocks. (18 pages)

81/IX/142 N450 AKENHEAD, S. A. Fisheries oceanography and the nature of carrying capacity for larval marine fishes. (27 pages)

81/IX/143 N453 YENTSCH, C. S. Satellite observation of phytoplankton distribution associated with large scale oceanic circulation. (11 pages)

81/IX/144 N479 EDEL, H. Availability of remote sensing data for the Northwest Atlantic. (12 pages)

81/IX/145 N480 GOWER, J. F. R. General overview of the nature and use of satellite remote sensing data for fisheries application. (28 pages)

81/XI/146 N455 PARSONS, D. G., P. J. VEITCH, and G. E. TUCKER. Data on the shrimp (*Pandalus borealis*) fishery in Division OA, 1981. (20 pages)

81/XI/147 N456 DUPOUY, H., J. P. MINET, and P. DERIBLE. Catch, effort and biological characteristics of shrimp (*Pandalus borealis*) in the French fishery off West Greenland, 1981. (15 pages)

81/XI/148 N457 CLARK, S. H. Recent trends in the Gulf of Maine northern shrimp fishery. (23 pages)

81/XI/149 N454 LARSEN, F. Report on harp seal recoveries in Greenland, 1980-81. (4 pages)

81/XI/150 N462 KAPEL, F. O. Studies of hooded seals in Greenland, 1970-1980. (18 pages)

81/XI/151 N458 CARLSSON, D. M. Data on the shrimp fishery in NAFO Subareas 0+1 in 1980 and 1981. (36 pages)

81/XI/152 N459 BOWEN, W. D., and D. E. SERGEANT. Mean age at sexual maturity and age-specific pregnancy rates of Northwest Atlantic harp seals in 1980 and 1981. (5 pages)

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| 81/XI/153 | N460 | BOWEN, W. D., and D. E. SERGEANT. Further investigations of harp seal pup production between 1977 and 1980 from mark-recapture. (6 pages) |
| 81/XI/154 | N461 | BOWEN, W. D. Harp seals and their foods: how do they interact? (8 pages) |
| 81/XI/155 | N463 | KANNEWORFF, P. Biomass of shrimp (*Pandalus borealis*) in NAFO Subarea 1 in 1977-81, estimated by means of bottom photography. (19 pages) |
| 81/XI/156 | N464 | JAKOBSEN, T., and S. TORHEIM. The Norwegian fishery for shrimp, *Pandalus borealis*, off West Greenland in 1981. (4 pages) |
| 81/XI/157 | N465 | DUPOUY, H., J. P. MINET, and P. DERIBLE. Catch, effort and biological characteristics of shrimp (*Pandalus borealis*) in the French fishery off East Greenland in 1981. (13 pages) |
| 81/XI/158 | N466 | JAKOBSEN, T., and S. TORHEIM. Norwegian investigations on shrimp, *Pandalus borealis*, in East Greenland waters in 1981. (9 pages) |
| 81/XI/159 | N467 | WORTHY, G. A. J., and D. M. LAVIGNE. Changes in blood properties of fasting and feeding harp seal pups, *Phoca groenlandica*, after weaning. (19 pages) |
| 81/XI/160 | N468 | STEWART, R. E. A., and D. M. LAVIGNE. Energetics of nursing in the harp seal *Phoca groenlandica*: energy transfer and female condition. (30 pages) |
| 81/XI/161 | N469 | WORTHY, G. A. J. Changes in energy stores during neonatal development in the harp seals, *Phoca groenlandica*. (9 pages) |
| 81/XI/162 | N470 | LAVIGNE, D. M., R. E. A. STEWART, and F. FLETCHER. Changes in composition and energy content of harp seal milk during lactation. (15 pages) |
| 81/XI/163 | N471 | WORTHY, G. A. J., D. M. LAVIGNE, and W. D. BOWEN. Post-weaning growth of the harp seal, *Phoca groenlandica*. (37 pages) |
| 81/XI/164 | N472 | WORTHY, G. A. J., and D. M. LAVIGNE. Energy utilization of harp seals, *Phoca groenlandica*, during the post-weaning period. (11 pages) |
| 81/XI/165 | N473 | CARLSSON, D. Data on shrimp fishery at East Greenland in 1980 and 1981. (14 pages) |
| 81/XI/166 | N474 | ROFF, D. A., and W. D. BOWEN. Population dynamics of harp seals, 1967-1991. (31 pages) |
| 81/XI/167 | N475 | HALLGRIMSSON, I. Preliminary information on the Icelandic shrimp (*P. borealis*) fishery in the Denmark Strait in 1981. (2 pages) |

## SUMMARY DOCUMENTS, 1981

| SCS Doc. | Serial | |
|---|---|---|
| 81/II/1 | N266 | NAFO Secretariat. Report to Scientific Council on inadequate response to specified data requirements for stock assessments. (1 page) |
| 81/II/2 | N280 | NAFO. Provisional report of Scientific Council, Dartmouth, Canada, 17-20 February 1981. (21 pages) |
| 81/II/3 | N281 | CWP Secretary. Report of the tenth session of the Coordinating Working Party on Atlantic Fishery Statistics (CWP), July 1980. (65 pages) |
| 81/VI/4 | N291 | MAXIM, C., and C. MAXIM. Romanian research report for 1980. (7 pages) |
| 81/VI/5 | N287 | NAFO Secretariat. Extracts from resolutions passed at the 68th Statutory Meeting of ICES, October 1980. (2 pages) |
| 81/VI/6 | N289 | NAFO Secretariat. Tagging activities reported for the Northwest Atlantic in 1980. (13 pages) |

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| 81/VI/7 (Revised) | N297 | DOUBLEDAY, W. G. (Editor). Manual on groundfish surveys in the NAFO area. (78 pages) |
| 81/VI/8 | N298 | NAFO Secretariat. National reports on collecting and processing fisheries statistics. (54 pages) |
| 81/VI/9 | N299 | HATANAKA, H. Japanese research report for 1980. (6 pages) |
| 81/VI/10 | N300 | NAFO. Historical catches of selected species by stock area and country for the period 1970-79. (38 pages) |
| 81/VI/11 | N301 | NAFO. CWP recommendations and proposals relevant to the work of the Scientific Council. (8 pages) |
| 81/VI/12 | N334 | SMIDT, E. (Editor). Denmark (Greenland) research report for 1980. (25 pages) |
| 81/VI/13 | N335 | KONSTANTINOV, K. G. Report of USSR investigations in subareas off Newfoundland, Labrador and Baffin Land in 1980. (27 pages) |
| 81/VI/14 | N355 | FRECHETTE, J. Summary report of Shrimp (*Pandalus borealis*) Ageing Workshop, Quebec City, Quebec, Canada, 11-14 May 1981. (5 pages) |
| 81/VI/15 | N366 | NAFO Secretariat. Provisional nominal catches in the Northwest Atlantic, 1980. (50 pages) |
| 81/VI/16 | N368 | NAFO Secretariat. Provisional list of sampling data for 1979. (58 pages) |
| 81/VI/17 | N369 | NAFO Secretariat. Notes on statistical activities and publications, 1980/81. (4 pages) |
| 81/VI/18 | N371 | MINET, J. P. France research report for 1980. (9 pages) |
| 81/VI/19 | N478 | GIBSON, J. A., and E. D. ANDERSON. United States of America report on research in the Northwest Atlantic during 1980. (20 pages) |
| 81/VI/20 | N375 | NAFO. Provisional report of Scientific Council, Dartmouth, Canada, 3-19 June 1981. (71 pages) |
| 81/IX/21 | N376 | NAFO. Report by the Scientific Council to the Fisheries Commission on its review of gear definitions. (2 pages) |
| 81/IX/22 | N383 | FRAXEDAS, E., and O. LEIVA. Cuban research report, 1980. (4 pages) |
| 81/IX/23 | N384 | SANDEMAN, E. J., J. S. SCOTT, and J. BOULVA. Canadian research report for 1980. (19 pages) |
| 81/IX/24 | N445 | PACIORKOWSKI, A. J. Polish research report, 1980. (8 pages) |
| 81/IX/25 | N314 | NAFO. Canadian proposal re change to rules of procedure for the Scientific Council. (1 pages) |
| 81/IX/26 | N448 | DANKE, I. German Democratic Republic research report for 1980. (3 pages) |
| 81/IX/27 | N452 | NAFO. Provisional report of the Scientific Council, Dartmouth, Canada, 8-18 September 1981. (34 pages) |
| 81/XI/28 | N476 | NAFO Secretariat. Provisional sealing statistics for the Northwest Atlantic, 1981. (2 pages) |
| 81/XI/29 | N477 | NAFO. Report of Special Meeting of Scientific Council, Dartmouth, Canada, 23-26 November 1981. (24 pages) |

# V. LIST OF PARTICIPANTS IN SCIENTIFIC COUNCIL MEETINGS, 1981

| | CANADA | Meetings |
|---|---|---|
| S. A. Akenhead | Northwest Atlantic Fisheries Center, P.O. Box 5667, St. John's, Nfld. | C |
| J. T. Anderson | " " " " " | C |
| D. B. Atkinson | " " " " " | B |
| C. A. Bishop | " " " " " | A B |
| W. D. Bowen | " " " " " | D |
| W. R. Bowering | " " " " " | B |
| W. Brodie | " " " " " | B |
| J. E. Carscadden | " " " " " | A |
| E. L. Dalley | " " " " " | C |
| E. G. Dawe | " " " " " | B C |
| C. A. Gavaris | " " " " " | C |
| S. Gavaris | " " " " " | A |
| G. R. Lilly | " " " " " | A C |
| D. S. Miller | " " " " " | A |
| B. Nakashima | " " " " " | C |
| D. G. Parsons | " " " " " | D |
| A. T. Pinhorn | " " " " " | A B C |
| T. K. Pitt | " " " " " | B |
| E. J. Sandeman | " " " " " | C |
| R. Wells | " " " " " | A B C D |
| G. H. Winters | " " " " " | A B C D |
| R. G. Kingsley | Newfoundland Dept. of Fisheries, P.O. Box 4750, St. John's, Nfld. | C |
| H. J. Squires | " " " " " | B |
| J. A. Gagne | Marine Fish Division, BIO, P.O. Box 1006, Dartmouth, N.S. | C |
| R. G. Halliday | " " " " | A B C |
| T. D. Iles | " " " " | C |
| R. Mahon | " " " " | C |
| A. Sinclair | " " " " | B |
| M. Sinclair | " " " " | C |
| W. T. Stobo | " " " " | C |
| D. E. Waldron | " " " " | C |
| P. F. Brodie | Marine Ecology Laboratory, BIO, P.O. Box 1006, Dartmouth, N.S. | C |
| K. Drinkwater | " " " " | C |
| R. W. Trites | " " " " | B C |
| C. K. Ross | Atlantic Oceanography Laboratory, BIO, P.O. Box 1006, Dartmouth, N.S. | C |
| B. J. Topliss | Atlantic Geosciences Center, BIO, P.O. Box 1006, Dartmouth, N.S. | C |
| T. Amaratunga | Invertebrates and Marine Plants Division, P.O. Box 550, Halifax, N.S. | B C |
| R. K. Mohn | " " " " " | B C |
| T. W. Rowell | " " " " " | B C |
| J. A. Koslov | Department of Oceanography, Dalhousie University, Halifax, N.S. | C |
| A. A. Rosenberg | " " " " " | C |
| P. J. Carrothers | Marine Fish Division, Biological Station, St. Andrews, N.B. | B |
| P. A. Koeller | " " " " | B |
| J. S. Scott | " " " " | B |
| A. W. White | " " " " | C |
| D. F. Markle | Huntsman Marine Laboratory, St. Andrews, N.B. | C |
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