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REPORT OF SCIENTIFIC COUNCIL

Annual Meeting, September 1990

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REPORT OF SCIENTIFIC COUNCIL
Annual Meeting, September 1990

I. PLENARY SESSIONS

Chairman: B. W. Jones

Rapporteur: T. Amaratunga

The Scientific Council met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, during 10-13 September 1990, to consider and report on various matters listed in the provisional agenda (see Appendix IV). Representatives attended from Canada, Denmark (Greenland), European Economic Community (EEC), Japan and the Union of Soviet Socialist Republics (USSR) and an observer from United States of America (USA). The Assistant Executive Secretary was in attendance.

The meeting was preceded by the Special Session on "Management Under Uncertainties Related to Biology and Assessments, With Case Studies on Some North Atlantic Fisheries", which was held during 5-7 September 1990 with J. Shepherd as Convener and participation by scientists from Canada, Denmark (Greenland), EEC, Japan, New Zealand, USA and USSR.

The opening meeting was called to order on 10 September 1990 at 1025 hr.

The Chairman welcomed the representatives to the 12th Annual Meeting. The Assistant Executive Secretary was appointed rapporteur. The Council adopted the agenda recognizing that the General Council or the Fisheries Commission might have specific requests that the Council would have to address.

Although the Report of the June 1990 Scientific Council had been adopted at the June meeting, the Chairman requested that he be notified of any errors. It was noted that there could be a problem with the format of the stock summary sheet. The time series of recommended TACs gives a single value for each year, whereas the advice is now normally formulated as a range of management options. The indication of a single value for the recommended TAC could therefore be misleading. It was agreed that there should be further discussion to decide on a format that would resolve this problem.

The session was adjourned at 1040 hr.

On 12 September 1990, the meeting was called to order at 0910 hr.

The Scientific Council was addressed by the Fisheries Commission at its meeting on 11 September 1990 to respond to a number of requests for information and questions posed by Contracting Parties. The following were the responses:

1. In response to the request concerning the calculation of the estimated catch of 40,000 tons of cod in Div. 3M, the Council reported that the figure of 40,000 tons was derived as follows:
 - Catches of non-member country pair trawlers determined on the basis of logbook data for one of those vessels = 15,000 tons.
 - Unreported catches of member country vessels sighted in the area = 8,000 tons.
 - Unreported by-catch from the redfish fishery in depths less than 400 m = 7,000 tons.
 - Additional catches of other member and non-member non-pair trawler vessels from sightings = 10,000 tons (very rough estimate).
2. In response to the request for additional information on the spawning stock biomass for redfish in Div. 3M, the Council reported that there were no specific data on the size of the spawning stock biomass but the strong 1980 year-class is now maturing and the expectation is that this will result in an increase in spawning stock biomass.

3. In response to the request for information on the effect of fishing Div. 3NO capelin at levels higher than the recommended 10%, the Council reported that the normal biological reference points are not relevant for species such as capelin. The recommended 10% exploitation rate is a relatively conservative one which takes into account uncertainty about the size of recruiting year-classes and also the importance of capelin in the ecosystem.
4. In response to the request for information on the state of the stock of cod in Div. 3M in view of recent high catches, the Council reported that the exploitable biomass in 1989 was estimated to be about 100,000 tons. Even allowing for growth, catches since then are likely to have reduced the biomass to about half this level.
5. Information was requested on the origin of the previously proposed target level for exploitable biomass of 85,000 tons for cod in Div. 3M, and the question was asked: As this target had been exceeded in 1989, was there a need to continue the moratorium? The Council reported that the previous target for exploitable stock biomass was a strategy proposed by the Fisheries Commission for which the Scientific Council was requested to provide the appropriate figure for the stock size. The Scientific Council advocates that any target stock size should be set in terms of spawning stock biomass. Although the exploitable stock biomass exceeded 85,000 tons in 1989, the spawning stock biomass was still below any desirable level and it is to allow a recovery of the spawning stock that a continuation of the moratorium is advised.
6. With respect to cod in Div. 3NO, the Council was asked: a) are the reasons for the decline in recruitment known? and b) is information available on discards of cod in view of the small mesh sizes used in some flatfish fisheries? The Council reported that: a) no information is available concerning the reasons for declining recruitment, and b) directed fishing for cod is carried out by a different fleet (pair trawlers) from those fishing for flatfish (otter trawlers). A legal mesh size is used in the cod fishery. The by-catch of cod in the flatfish fishery is low and, as those caught are retained on board, discarding is minimal. No information is available, however, on the size composition of the cod by-catch.
7. The question was asked: in view of recent high catches in excess of the TACs, does the Scientific Council have confidence in the catch of 24,000 tons reported for 1989 for redfish in Div. 3LN? The Council reported that some reduction in catch is expected as a result of vessels diverting to fish for redfish in Div. 3M or for Greenland halibut. The provisional figure for 1989, however, does not include catches made by South Korea which could be in the range of 10,000-15,000 tons.
8. The Council was asked: does the stock of American plaice in Div. 3LNO provide a clear example of how a stock declines from overfishing in spite of constant recruitment? The Council reported that recruitment has been at a relatively stable level in recent years but at a lower level than in the 1970s. Fishing mortality has been increasing on fully recruited age groups, and has now reached $F = 0.6$ compared with $F_{max} = 0.51$. Fishing in excess of the TACs has contributed to the reduction of the stock but it is not a stock that would be cited as a classic example of overfishing.
9. The Council was asked: is the advice for yellowtail flounder in Div. 3LNO optimistic in view of the changed exploitation pattern? The Council reported that the advice will be slightly optimistic. The changed exploitation pattern will result in a lower yield-per-recruit but, because there is no analytical assessment, no quantitative evaluation can be given.

The session was then adjourned at 1015 hr.

The Council reconvened at 1330 hr on 12 September 1990 and adopted the reports of the Standing Committees: Appendix I - Report of Standing Committee on Fishery Science (STACFIS), Appendix II - Report of Standing Committee on Research Coordination (STACREC), Appendix III - Report of Standing Committee on Publications (STACPUB).

The session was adjourned at 1400 hr.

On 13 September 1990 the meeting was convened at 1300 hr, to consider a request from the Fisheries Commission for advice on the possibility of restricting the redfish fishery in Div. 3M to deeper depths to minimize the by-catch of cod.

The advice of the Scientific Council is that if redfish fishing were to be restricted to depths greater than 400-500 m, a significant reduction in the by-catch of cod would be expected. However, available information suggests that catch rates of redfish are lower in the deeper water. In addition, *Sebastes marinus* are only found in shallower waters and would not be caught if the fishery was restricted to the deeper waters. The TAC advice was based on a biomass estimate for both redfish species combined (*S. mentella* and *S. marinus*) and it is not possible at present to estimate the biomass for each species separately. Therefore the advised TAC would not be applicable to a redfish fishery restricted to depths in excess of 400 m. In order to provide advice on the overall implication of restricting to depths greater than 400 m, detailed information on the seasonal and interannual distributions of both redfish and cod would be required. These data are currently not available.

The session was adjourned at 1345 hr.

The concluding session of the Scientific Council was called to order at 1745 hr on 13 September 1990.

Brief summaries of Standing Committee Reports and other matters considered by the Council are given below in Sections II-VIII. The agenda, the list of participants and the list of research (SCR) and summary (SCS) documents are given in Appendix IV-VI.

The meeting was adjourned at 1900 hr.

II. FISHERY SCIENCE (see STACFIS Report, App. I)

1. Stock Assessments

The Council was unable to assess the capelin in Div. 3L at the June 1990 Meeting because of calibration problems with acoustic survey data for 1990. Since then attempts to solve those problems were made, although with limited success, and the stock was assessed during this meeting. Details of the assessment are given in the Report of STACFIS in Appendix I, while a Summary Sheet of the assessment is given below.

2. Special Session on Management Under Uncertainties

The Council endorsed the general discussions and conclusions presented to STACFIS by the convener, J. Shepherd (EEC-UK), at the end of the Special Session. The Council made special note that participants considered the Special Session to be a very successful meeting and resulted in highlighting observations regarding management under uncertainties. Congratulations were extended to the convener for a job well done.

The Council noted that the two recommendations forwarded by the convener to STACFIS were addressed and reported by STACFIS and STACPUB in their respective reports.

The Council agreed with the view of STACFIS that the name "Special Session of the Scientific Council" might have created the impression that it was a closed meeting of the Scientific Council. In order to have the widest possible participation, the Council agreed that the forthcoming meeting should be named "Symposium hosted by the NAFO Scientific Council", and requested the Assistant Executive Secretary to insert an appropriate statement in the announcements to indicate that the meeting is open to the scientific community.

SUMMARY SHEET - Capelin in Division 3L

Source of Information:

Year	1983	1984	1985	1986	1987	1988	1989	1990	Max	Min	Mean	Years
Recommended TAC	60	38	60	130	283	90	335	350	350	16	128	1979-90
Agreed TAC	30	26	26	55	25	45	46	56	56	10	33	1979-90
Actual landings	25	33	25	48	19	54	51		54	12	30	1979-89
Sp. stock biomass ¹ ('000 tons)	473	382	596	1300	2830	900	3345	3500				
Recruitment ² (age 2) (10 ⁹)	20.0	73.2	73.2	63.7	87.8	380.4	314.8					
Mean F	No information available											

¹ Spawning stock biomass not measured. These were projected from acoustic estimates.

² Recruitment at age 2 in the year shown. Recruitment 1982-85 were projections from acoustic surveys. From 1986 to present, measured directly from acoustic surveys.

Catches: All catches are inshore and determined by market. The dominant market is Japanese roe market.

Data and Assessment: Inshore indices of abundance from catch rates and aerial survey. Projections from acoustic survey estimates of year-class abundance.

Fishing Mortality: Not estimated but very low. Recommended TACs based on exploitation rate of 10%. Catches were much lower than recommended TAC in recent years.

Recruitment: Estimated from acoustic surveys. There was no estimate on the strength of the 1988 year-class.

State of Stock: Highest biomass in late-1980s due to two consecutive strong year-classes (1986 and 1987).

Forecast for 1990: No projection possible.

Option Basis	Predicted catch (1991)	Predicted SSB (1.1.1992)
F _{0.1} =		
F ₈₉ =		
F _{max} =		

Recommendation: No recommendation for 1991.

Special Comments: Past TACs have been determined on the basis of market forecast. Catches in 1991 at around 50,000 tons, as taken in recent years, will be well below the 10% exploitation level.

3. Review of Current Arrangements for Conducting Stock Assessments

a) Selection of Designated Experts

The Council noted that STACFIS had assigned laboratories with the responsibility of providing Designated Experts on a stock by stock basis. The Council urged the various laboratories to confirm to the Assistant Executive Secretary their willingness to provide such services and to provide names of the nominated scientists. This process should be concluded before 1 November 1990 to enable the Designated Experts to contact other scientists to arrange for exchange of data, well in advance of the 1991 assessments.

b) Documentation of Assessments

The Council noted that STACFIS discussed the format of scientific documents prepared by Designated Experts, and the Report of STACFIS and the Scientific Council for presentation of the assessments. The Council endorsed the recommendations made by STACFIS in this respect.

4. Future Special Sessions

a) Special Session in September 1991

The topic for September 1991 was discussed by STACFIS and the Council endorsed the new title "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes" for the meeting to be convened by H. Hovgård (Denmark-Greenland). The Council was pleased to note that the general theme and specific topics were finalized and preparations were well underway.

The Council agreed that the meeting should be described as "Symposium hosted by the NAFO Scientific Council" and that announcements should state that the meeting is open to the scientific community.

b) Proposed Theme for Special Session in September 1992

Three possible topics were discussed by STACFIS, and the Council endorsed the proposal to arrange a workshop on "State-of-the-Art in Fish Stock Assessment: a Tutorial/Workshop on Calibration Methods and Their Practical Use". The Council welcomed the suggestions for the selection of co-conveners. The Council agreed that this workshop would retain the status of Special Session of the Scientific Council.

III. RESEARCH COORDINATION (see STACREC Report, App. II)

1. Fisheries Statistics

The Council noted with concern that some STATLANT 21B reports for 1988 were still outstanding. Several STATLANT 21B reports for 1989 had been received since June, but many reports were yet outstanding. Only one STATLANT 21A report for 1989 was outstanding. The Council noted that delays in providing timely reports meant that data were not available for stock assessments, and that some publications such as *NAFO Statistical Bulletin* Vol. 38, could not be produced on schedule.

IV. PUBLICATIONS (see STACPUB Report, App. III)

1. Review of Editorial Board

The Council noted the decision by STACPUB that an additional Associate Editor for Vertebrate Fisheries Biology was not required for the present.

2. Invitational Papers

The Council was pleased to note the progress made on the first invitational paper.

3. Review of Papers

In view of the very important observations regarding uncertainties in fisheries management highlighted at the Special Session, the Council endorsed the recommendation by STACPUB that the papers and proceedings of the Special Session be published in a special issue of the *NAFO Scientific Council Studies* to allow for expedient circulation.

V. FUTURE MEETING ARRANGEMENTS

1. June 1991 Meeting of Scientific Council

The Council confirmed that the Scientific Council together with its Standing Committees and Subcommittees would meet during 5-19 June 1991 at NAFO Headquarters in Dartmouth, Nova Scotia, Canada.

2. Special Session and Annual Meeting, September 1991

The Council confirmed that the Annual Meeting of the Scientific Council would be held during 9-13 September 1991 in Halifax, Nova Scotia, Canada. The meeting would be preceded by the Symposium titled "Changes in Abundance and Biology of Cod Stocks and Their Possible Causes" with H. Hovgård (Denmark-Greenland) as convener during 4-6 September 1991.

3. June 1992 Meeting of Scientific Council

The Council agreed on the tentative dates of 3-17 June 1992 for the meeting of the Scientific Council.

VI. OTHER BUSINESS

1. Questions by the Fisheries Commission

Responses to several requests for information and questions from the Fisheries Commission forwarded to the Council during the meeting are given above (see Plenary Sessions).

VII. ADOPTION OF REPORTS

1. Committee Reports of Present Meeting

The Council reviewed and adopted the reports of the Standing Committees as presented by the respective Chairmen on 12 September 1990.

VIII. ADJOURNMENT

There being no further business, the Chairman expressed his appreciation to the Chairmen of the Standing Committees (H. Lassen, W. B. Brodie and V. P. Serebryakov) and all the participants for their contributions in the cooperative spirit to make this meeting a success. Having received appreciative words from Fisheries Commission delegates for the clarity of the Scientific Council Report, the Chairman said his personal thanks were due to everyone, particularly H. Lassen, for their support. Noting that H. Lassen steps down from the most demanding job in the Council as Chairman of STACFIS, he extended thanks for guiding STACFIS through the last two years in an efficient and friendly way. He then welcomed D. B. Atkinson, the incoming Chairman of STACFIS.

The Chairman, on behalf of the Council, bid farewell to Sv. Aa. Horsted and extended the very best wishes to him for a long and happy retirement.

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

Chairman: H. Lassen

Rapporteur: Various

The Committee met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, during 10-12 September 1990, to consider and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (Greenland), EEC, Japan and USSR, and an observer from the USA.

The meeting was preceded on 5-7 September 1990 by the Special Session on "Management Under Uncertainties Related to Biology and Assessments, with Case Studies on Some North Atlantic Fisheries". STACFIS received the report of the Special Session from the convener J. Shepherd (EEC-UK) (see Annex 1 this report).

Matters which were considered at both meetings are outlined below.

I. STOCK ASSESSMENTS

1. Capelin in Division 3L (SCR Doc. 90/07, 59, 60)a) Introduction

Nominal catches of capelin in this Division were less than 4,000 tons between 1970 and 1973, then increased to 58,000 tons in 1974 and declined to 12,000 tons in 1979. No offshore fishing has occurred since 1978. Provisional statistics for 1989 indicated a total catch of 51,000 tons in the inshore fishery by purse seines, traps and beach seines during June and July. In recent years, the final TAC has been based on the market forecast for roe capelin.

Recent TACs and catches ('000 tons) are as follows:

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Advised TAC	16	30	- ¹	60	38	60	130	283	90	335	350
TAC	16	30	30	30	26	26	55	25	45	46	56
Catch	14	24	27	25	33	25	48	19	54 ²	51 ²	

¹ No STACFIS advice

² Provisional data

b) Input Datai) Commercial fishery

A logbook survey of the inshore capelin fishery in Div. 3L, designed to provide estimates of catch-per-unit effort, was initiated in 1981. Trapnets and purse seines (where catches were derived from the addition of the quantities actually landed and the quantities of discards from logbooks) show relatively high catch rates in recent years. Both indices showed an increase from 1988 to 1989 such that the 1989 trap index was the second highest in the series and the 1989 purse seine catch rate was the highest.

	1981	1982	1983	1984	1985	1986	1987	1988	1989
Trapnets (tons/day)	2.9	3.1	3.4	2.9	4.6	4.6	8.8	6.2	6.7
Purse seines (tons/day)	9.4	16.4	18.8	14.3	16.4	19.0	18.1	20.7	24.3

Discarding rates (which included dumping of dead capelin as well as releasing fish alive) in 1989 for purse seines were 21% and 23% for traps which were slightly higher than the 14% and 17% respectively in 1988 and considerably lower than the 35% and 74% respectively in 1987.

The 1986 and 1985 year-classes accounted for 75% and 21% of the 1989 commercial catch (by numbers) respectively.

ii) Research data

Aerial surveys of capelin in Trinity and Conception Bays have been conducted in June and July since 1982. Total surface area of schools, estimated from aerial photographs, provided an index of abundance. Aerial coverage of the four transects was variable due to poor weather conditions but the 26 hours of flying time was only slightly lower than the 1982-88 average of 29 hours and ancillary information indicated that the peak spawning run was covered. The 1989 estimate of total school surface area was the second highest in the series and approximately 83% of the highest (1987).

The aerial survey index, the two inshore catch rates and the projected biomass from acoustic surveys have shown the same general trends.

The USSR conducted an acoustic survey in Div. 3LNO during 18 May-5 June 1989, and this resulted in a biomass estimate of 2,458,000 tons. A similar survey during 1988 provided a biomass estimate of 3,950,000 tons. In the 1989 survey, the 1986 year-class was dominant accounting for 51% of the numbers and 64% of the biomass. An estimate for the Div. 3L stock from the overall estimate for Div. 3LNO could not be extracted.

Larval surveys have been conducted by the USSR since 1983 and the results of these surveys were discussed in the assessment report of capelin in Div. 3NO (see Report of the June meeting).

Final biomass estimates from a Canadian acoustic survey conducted during 9-27 May 1990 were not available due to calibration problems. However, preliminary analysis of the data indicated that capelin were distributed throughout the survey area and distribution patterns were comparable to those observed during 1988 and 1989. Age compositions in research midwater trawl catches were similar to previous years with two-, three- and four-year-olds accounting for 58%, 28% and 9% respectively.

c) Estimation of Parameters

The major contributors to the mature population in Div. 3L during 1991 will be the 1987 and 1988 year-classes. The most recent estimates of the 1987 year-class were from acoustic surveys conducted during May 1989. These estimates indicated that this year-class may have a range from about 34% (USSR estimate) to 85% (Canadian estimate) of the strength of the strong 1983 year-class as 2-year-olds. A portion of the 1987 year-class will have matured and spawned during 1990 and thus, since the 1989 estimate, this year-class will have been reduced in abundance due to natural mortality, spawning mortality and fishing mortality. STACFIS noted that the acoustic estimates derived in 1989 and the estimates of spawning mortality and age specific maturation rates used in projections have potentially large variances. Consequently, STACFIS concluded that projections of this year-class from 1989 acoustic estimates to the 1991 spawning season would not be appropriate.

There is no estimate of the abundance of the 1988 year-class available and consequently, no projections could be made. However, based on qualitative evidence from the 1990 Canadian acoustic survey and

indications from the USSR 0-group survey, STACFIS concluded that there was no cause for concern about the abundance of this year-class.

There are neither estimates of biomass for 1990 nor estimates of the strength of the 1988 year-class available. Consequently, STACFIS is unable to provide TAC advice in relation to the management target level established in 1979 of an exploitation rate of 10% of mature biomass. There have been no signs of any significant decline in abundance during 1987-89 and it is noted that the advised TAC corresponding to the 10% exploitation rate has been around 300,000 tons during three of the last four years. The actual TAC is set on market considerations and in most recent years, 1988-90, around 50,000 tons. STACFIS concluded that even with the limited information available, this level of catch in 1991 would be well below a 10% exploitation rate.

II. REPORT OF SPECIAL SESSION (see Annex 1)

1. Special Session on Management Under Uncertainties

STACFIS received the report of the 5-7 September 1990 Special Session on "Management Under Uncertainties Related to Biology and Assessments, with Case Studies on Some North Atlantic Fisheries" from the convenor J. Shepherd (EEC-UK). Many aspects of biological uncertainties had been discussed (see complete report in Annex 1) and STACFIS recognized the value of the contributions. STACFIS endorsed the convenor's recommendation that the papers presented to the Special Session should be published either in full, or as extended abstracts for papers to be published elsewhere (e.g. the *J. Northw. Atl. Fish. Sci.*), in a special volume of the *NAFO Scientific Council Studies* series, and requested STACPUB to consider this recommendation and to consider an appropriate review procedure for such a volume.

Following discussions based on the convenor's recommendation, STACFIS agreed that the name "Special Session of the Scientific Council" might have created the impression that this was a closed meeting of the Scientific Council. STACFIS was anxious to have the widest possible attention to such sessions and agreed it was desirable to change the name to:

"Symposium hosted by the NAFO Scientific Council"

and further proposed that the Council ask the Assistant Executive Secretary to insert in the next flyer announcing the 1991 symposium, an appropriate sentence indicating that this meeting is open to the scientific community.

III. REVIEW OF CURRENT ARRANGEMENTS FOR CONDUCTING STOCK ASSESSMENTS

1. Designated Experts

The following laboratories were identified by STACFIS for providing Designated Experts for the June 1991 assessments:

Cod	SA 1	GFRI, Denmark ¹
	Div. 3M	IIM, Vigo ²
	Div. 3NO	DFO, Newfoundland ³
Redfish	SA 1	BFA, Hamburg ⁴
	Div. 3M	PINRO, Murmansk ⁵
	Div. 3LN	DFO, Newfoundland ³
Silver Hake	Div. 4VWX	DFO, Dartmouth ⁶
American plaice	Div. 3M	IIM, Vigo ²
	Div. 3LNO	DFO, Newfoundland ³
Witch flounder	Div. 3NO	DFO, Newfoundland ³
Yellowtail flounder	Div. 3LNO	DFO, Newfoundland ³

Greenland halibut	SA 0+1 SA2+Div. 3KL	GFRI, Denmark ¹ DFO, Newfoundland ³
Roundnose grenadier	SA 0+1 SA 2+3	GFRI, Denmark ¹ DFO, Newfoundland ³
Wolffish	SA 1	GFRI, Denmark ¹
Capelin	Div. 3L Div. 3NO	DFO, Newfoundland ³ DFO, Newfoundland ³
Squid	SA 3+4	DFO, Newfoundland ³
Northern shrimp	SA 0 + 1 Denmark Strait	GFRI, Denmark ¹ Iceland ⁷

-
- ¹ Greenland Fisheries Research Institute, Tagensvej 135, 1, DK-2200 Copenhagen N, Denmark
Telephone - 31 85 44 44; Telefax - 31 85 01 66; Telex - 19405
- ² Instituto Investigaciones Marinas
Muelle de Bouzas, Vigo, Spain
Telephone - 86 23 19 30; Telefax - 86 29 27 62
- ³ Northwest Atlantic Fisheries Centre
Department of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland, Canada
Telephone - 772-2030; Telefax - 772-2156; Telex - 016-4698
- ⁴ Institut für Seefischerei
Palmaille 9, D-2000 Hamburg 50, Federal Republic of Germany
Telephone - 040 38905194; Telefax - 040 38905129
- ⁵ Polar Research Institute of Marine Fisheries and Oceanography (PINRO)
6 Knipovich Street, Murmansk, 18363, USSR
Telex - 64-126357
- ⁶ Bedford Institute of Oceanography, Marine Fish Division
P. O. Box 1006, Dartmouth, Nova Scotia, Canada
Telephone - 426-9347; Telefax - 426-2256; Telex - 01931552
- ⁷ Marine Research Institute, Skulagata 4, P. O. Box 1390
121 - Reykjavik, Iceland
Telephone - 354-1-20240; Telefax - 354-1-623790; Telex - 7400746

2. Documentation of Assessments

STACFIS discussed the respective contribution of the various NAFO scientific documents/reports in the communication of stock assessment results and of general information on the fisheries and resource status. For instance, it was noted that the sections entitled "Description of the Fishery" are often sketchy and insufficient to provide an appreciation of the main characteristics of a particular fishery (e.g. gear composition, seasonality of landings, etc.). With respect to the presentation of scientific analysis and their results, a better balance between completeness and relevancy must be found.

STACFIS noted that the Scientific Council Reports serve at least three purposes at present and suggested that these purposes would be better served if some clear distinction of the underlying functions were introduced. From their initial drafting to their publication, the STACFIS/Scientific Council reports serve a number of objectives:

- a) They form the basic vehicle for the development of consensus among the scientists attending the meetings with respect to the various questions raised.
- b) They serve as a record of the assessments and recommendations made at particular meetings. As such, they constitute a compromise since they do not contain as much information as detailed minutes of the deliberations. However, the information presented is, in general, sufficiently detailed to provide an account of the major recommendations made, and of their background.

- c) These reports serve as the official vehicle for communicating scientific advice to the Fisheries Commission or the organizations that requested advice.

In summary, it is difficult to achieve all goals in a single report. However, STACFIS recognized that the task of creating an alternative form for scientific/communication reports was not a trivial one and proposed to take a progressive approach. In particular, STACFIS recommends that: *the main research (SCR) document related to the assessment of a given stock serves as the focal point for integrating the scientific information pertinent to the assessment of that stock and that it be updated, as soon as possible after the scientific meeting, so as to reflect the analyses performed in support of the final assessment.* STACFIS noted that the tendency in recent years had been to update the SCR documents shortly after its meeting but recommends that:

- a) *the practice of updating the SCR document be generalized and streamlined to ensure that the final SCR document contains all data and analyses needed to substantiate the conclusions agreed upon by STACFIS, and*
- b) *the Summary Sheets be enhanced so as to provide a broader historical perspective with respect to catch trends and to the status of the resource (e.g. recruitment, spawning stock biomass, fishing mortalities).*

The main focus of the Summary Sheets must remain on "the results" as opposed to "how the results were obtained", which will remain the main thrust of the STACFIS/Scientific Council Reports.

IV. FUTURE SPECIAL SESSIONS

1. Special Session in September 1991

The topic and theme for the 1991 Special Session was discussed. It was stressed that the theme "Atlantic Cod" should attract groups studying the causes of recent abrupt changes in growth and in abundance. This should call for contributions from scientific groups not usually involved with NAFO. The title was amended and a draft of a flyer was prepared.

2. Proposed Theme for Special Session in September 1992

STACFIS discussed three topics:

- a) A Symposium hosted by NAFO Scientific Council titled "Impact of marine mammals on commercial fisheries in the North Atlantic".
- b) A Symposium hosted by NAFO Scientific Council titled: "Impact of Changes in Environmental Conditions in the North Atlantic: a Decadal Review". This topic should focus on how the North Atlantic system had gone through extremes in the early- to mid-1980s and returned to normal (?) versus the end of the decade. Also outlooks into the 1990s would be welcome.
- c) A Special Session of the Scientific Council titled "State-of-the-Art in Fish Stock Assessments: a Tutorial/Workshop on Calibration Methods and Their Practical Use".

STACFIS decided that Topic c) be chosen for 1992.

STACFIS asked D. B. Atkinson and H. P. Cornus to solicit co-conveners from both sides of the North Atlantic and present a document to the June 1991 Meeting with the details worked out. It was recognized that this Special Session would have to have limited attendance depending on availability of rooms, computers and lecturers. It was agreed that the Special Session would have three main areas of activities:

- Lectures on the various methods and computer packages.
- Exercises using the computer packages with simulated datasets.
- Exercises on real data.

It was also recognized that tutorial material should be prepared specifically for this Session, and if the tutorial material would be of suitable quality and of a reasonable wide scope, publication of the material in the form of a manual should be considered.

V. OTHER MATTERS

1. Review of Scientific Papers

The 3 papers submitted to STACFIS on:

- a) Tizol, R., M. Isaac, and G. Arencibia. Age determination of silver hake by chemical composition of otoliths. (SCR Doc. 90/03, Serial No. N1706)
- b) Saborido, F., and J. Paz. Distribution and abundance of cod on the Flemish Cap, July 1988 and 1989. (SCR Doc. 90/92, Serial No. N1824)
- c) Paz, J., and M. G. Larrañeta. Year-class variations of American plaice and yellowtail flounder in Div. 3LNO and the abundance of other commercial fish (SCR Doc. 90/114, Serial No. N1850).

were found to be relevant to stock assessments and STACFIS agreed to review those documents at the June 1991 Meeting, when assessments would be carried out.

2. Acknowledgements

In closing the meeting, the Chairman noted that his term of office had come to an end. He thanked the members of the Committee for their co-operation and support during the last two years. He also expressed his appreciation of the help of the Secretariat and especially the help of the Assistant Executive Secretary. He welcomed the incoming Chairman, B. Atkinson (Canada), and wished him well in the coming two years.

REPORT OF SPECIAL SESSION ON MANAGEMENT UNDER UNCERTAINTIES RELATED TO BIOLOGY AND ASSESSMENTS, WITH CASE STUDIES ON SOME NORTH ATLANTIC FISHERIES

1. Introduction

The Special Session on "Management under uncertainties related to biology and assessments, with case studies on some North Atlantic fisheries", with J. Shepherd (EEC-United Kingdom) as convener, was held at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, during 5-7 September 1990. A total of 23 presentations were made (SCR Doc. 90/93 to 90/113 and 90/115), in four sessions concerned with: sources of uncertainty, case studies, interactions with policy, and provision of advice.

The formal presentations were followed by a panel discussion, the panel members being: J. Shepherd (Chairman, EEC-UK), A. Rosenberg (USA), A. Sinclair (Canada), H. Lassen (Denmark/Greenland) and C. Francis (New Zealand). The Session was attended by scientists from Canada, Denmark (Greenland), EEC, Japan, New Zealand, USA, and USSR.

2. Specific Topics

a) Sources of uncertainty

Almost everything that concerns the provision of management advice is uncertain to a greater or lesser extent, and the effect of these uncertainties on the advice is quite variable. Specific areas of uncertainty are:

- the state of the stock (biomass, age structure, ..., etc.);
- the state of exploitation (fishing mortality, exploitation pattern, ..., etc.);
- stock identity (completeness, composition, mixing, migration);
- biological parameters (natural mortality, growth, maturity, ..., etc.);
- system structure (single or multispecies, nature of fleets, effects of environment);
- future recruitment (short-term, long-term, stock-recruitment relation);
- data (catches, effort, surveys, ..., etc.); and
- objectives of management (maximum yield, earnings, profit, gastronomy, social aspects, minimum stock size, stability of catches, effort, etc.).

In the session on this topic, the presentations concerned uncertainties due to multispecies interactions, recruitment variability, stock identity and mixing, discards, fecundity and growth parameters; but it was recognized that these were only a selection and by no means an exhaustive list. In general, the effects of sampling or measurement error could be assessed relatively easily: the consequences of structural error (e.g. model mis-specifications) are much more difficult to handle. However, it may be that even simple observation errors are sufficient to obscure the effects of structural changes (such as inclusion/exclusion of multispecies effects (SCR Doc. 90/112)) so that these cannot be determined. In general, simulation methods (including bootstrap estimation and related techniques) are excellent and powerful tools for studying and assessing the effects of uncertainty in complex systems.

Recruitment variability is an invariable feature of fish stocks. There is now clear evidence of different levels of variability between species groups, and strong evidence for higher variability at the extremities of geographical ranges (SCR Doc. 90/101). Recruitment fluctuations are not usually random, but are often serially correlated (positively) indicating persistence in the stock or its environment, and this seems to be associated with late first exploitation and/or high latitude stocks.

Mis-specification of stock structure can lead to severe mis-estimation of the effects of fishing (SCR Doc. 90/106). The effects can be explained by modelling for specific situations, but at the moment, general conclusions have not been deduced.

Commercial statistics invariably relate to landings of fish, and do not give accurate estimates of removals when discarding is prevalent. This may lead to serious mis-estimation of the state of a stock, and the effects of management options. The quantities discarded may be estimated directly (e.g. by observers) but this is expensive. When large quantities are discarded, these may be estimated by comparison of length compositions of landings with those of the stock as estimated by research vessel surveys, provided these are sufficiently precise (SCR Doc. 90/110). The effects can be estimated by comparative modelling. The dependence of discard rates on external factors (e.g. year-class strength, market conditions) is most important and really needs to be determined by statistical analysis before accurate allowance can be made in forecasts.

The survival of young fish from eggs to recruitment is extremely variable, and responsible for much of the scatter of stock recruitment diagrams. For some (most ?) stocks, fecundity is also very plastic, varying considerably even from year to year (SCR Doc. 90/115). It is therefore desirable for stock recruitment studies to be based on egg production (population fecundity) rather than spawning stock biomass. This is not possible unless routine observations of fecundity are carried out, which is quite expensive, but a case can be made for fecundity estimation being as desirable as age determination. Indicator levels of population fecundity (e.g. in effect, spawning stock size) can be derived as follows:

- A safe population level, given by dividing the size of a good year-class by a moderate value of survival.
- A critical population level, given by dividing the size of a good year-class by a high level of survival.

Errors in growth parameters due to sampling error in length/age determination may be substantial, and are highly (inversely) correlated. The effect on yield curves and $F_{0.1}$ and F_{max} estimates can be estimated by Monte Carlo simulation (SCR Doc. 90/94).

b) Case Studies

An extensive investigation of the consistency and precision of some assessments of Northwest Atlantic fish stocks was carried out by a CAFSAC workshop (SCR Doc. 90/96 + Addendum). For most stocks considered, there was a tendency to underestimate F and overestimate population size, as determined by both retrospective studies and simulation tests. The cause has not yet been clearly identified, but candidates are: misreporting, incorrect estimation of M in the presence of a trend in F , and mis-specification of the partial recruitment (exploitation) pattern (perhaps). Monte Carlo simulation of the assessment procedure using ADAPT is feasible and yields valuable information on the confidence intervals of the assessments. Retrospective tests could also be carried out routinely, and might even be used to estimate correction factors for current assessments, if a systematic tendency is observed.

Case studies of stocks at Greenland indicate that severe uncertainty can lead to a situation where no advice can be offered (SCR Doc. 90/99). This is tolerable when exploitation levels are low, but is a severe problem if this is not so. For cod, the future catch can only be forecast once the fish are 2- or 3-years old, since 0- and 1-group recruitment estimates have been completely misleading in some cases. Errors are much less troublesome if there is a long lead-time before first exploitation of a year-class, several year-classes contribute substantially to the fishable stock, and the yield curve is reasonably flat. Long-term management advice is however almost impossible to provide because of extreme fluctuations of year-class strength and the effects of unpredictable episodes of emigration. The shrimp fishery shows that a steady TAC policy is feasible only when exploitation rates are low and recruitment is steady.

Historical analysis of assessments for cod in Div. 3Pn and 4RS also show a consistent overestimation of stock size (SCR Doc. 90/105). Simulation testing shows that the most important variables are recruitment, the method of assessment used, and growth (weight-at-age). The management (F_{max} , $F_{0.1}$, etc.) has relatively little influence and would not have prevented stock decline in this case. It is not possible to determine whether the current assessment may still be biased, but with improved methodology (e.g. ADAPT) and increased reliance on survey data, this is thought to be less likely.

A similar historical analysis for American plaice in Div. 3LNO also indicates a consistent overestimation of stock size as judged by the current interpretation (SCR Doc. 90/97). In this case too, a wide variety of assessment procedures were used over the last 10-20 years, but this does not fully explain the effect, since retrospective analyses show the same feature. There seems to be some discrepancy between the SPA results and the CPUE and RV indices for this stock, which may be caused by problems with the basic catch data, perhaps because of unrecorded discarding.

The cod stock in Div. 2J+3KL has been analyzed extensively because of recent difficulties with the assessment, triggered by a change to modern methodology in 1988 (SCR Doc. 90/104). The main cause of the sudden change in the assessment was however not due to this, but to a change in the confidence attached to the survey results for 1984 and 1985 (which were low for environmental reasons) and that for 1986 which is now clearly seen to be an outlier, although this could not have been known at the time. Nevertheless, excessive reliance on subjective methods and a failure to combine all available data with appropriate weighting contributed to the problem.

c) Interactions with Policy

Extensive Monte Carlo simulations using current methodology have also been carried out for Div. 2J+3KL cod to assess the precision of current assessments (SCR Doc. 90/103). The results are of course wholly conditional on the current assessment model, and the assumed error levels in the data and assumptions used. Nevertheless, they give a clear indication of the confidence regions attached to current results, and show that fishing mortality estimates have a CV of about 14%. Catch forecast estimates for a status quo calculation have a considerably tighter confidence region than those for immediate reductions to F_{max} or $F_{0.1}$, as expected. The calculations required are moderately time-consuming (about 1 work station day) but by no means excessive.

Errors in the estimation of biomass from surveys need to take account of the possible spatial autocorrelation between results from nearby stations (SCR Doc. 90/109). This is especially important for handling the results of hydroacoustic surveys along transects, but may also be relevant to trawl surveys when stations are sufficiently close to one another. The spatial statistics often indicate anisotropy, and this can be allowed for. The results may be used for posterior estimation of survey error,

and also for survey planning (e.g. choosing the distance between transects or stations to obtain a desired precision).

The procedure by which quotas are selected once an assessment is complete (quota policy) depends on a complex interaction of biological, social and economic factors (SCR Doc. 90/107). Traditional (constant F or constant escapement) policies may not be optimal when judged by objective criteria. By parameterising possible families of quota policies, parameter optimisation methods may be used to determine appropriate strategies. The process requires that a utility function for quotas be selected, and because of social, economic and practical factors this will usually be non-linear. This may reflect, for example, the need for stability in catch and effort, as well as the limited capacity of markets. The method provides an alternative to dynamic programming methods, and can be combined with Monte Carlo simulation to allow for uncertainties, variability of recruitment and so on. The latter factor turns out to have only a small influence on the choice of policy, whereas error in estimating stock size is influential. The results indicate that constant low fishing mortality strategies are close to optimal under a wide range of conditions, so that the $F_{0.1}$ rule-of-thumb is not an inappropriate choice in practice.

Fourier Amplitude Sensitivity Testing provides an efficient alternative to Monte Carlo methods for assessing the precision of assessments and catch forecasts (SCR Doc. 90/95). It has the additional advantage that the sensitivity to individual input parameters can be determined, so that the results are more general and more easily modified to allow for changed assumptions (e.g. those concerning data error levels). For highly exploited stocks such as North Sea cod, the catch forecasts are crucially dependent on recruitment estimates, whilst the estimates of stock size are also considerably affected by estimates of F and existing adult population levels. The method may be used to attach confidence regions to the final graphs used to illustrate management options for managers.

An analysis of the factors affecting fisheries in terms of control theory suggests that these may be modelled as the result of three interacting control processes: due to the biological processes, the management process, and the fishery economics (SCR doc. 90/113). Such a system has complex dynamics, and responds in a dynamic way to uncertainties and natural variability. The effects of various management strategies (constant catch, constant F, multi-year TACs, etc.) may be determined. The results suggest that attempts to track year-to-year variations may be inappropriate, given plausible levels of uncertainty in assessments.

The management of transboundary stocks presents special problems (SCR Doc. 90/98), particularly when fleets operating in different areas use different gears and exploit different stock components. The deficiencies of the data available from some fleets for flatfish stocks in Div. 3LNO make reliable assessments and catch forecasts impossible for the present. Given suitable data, however, multiple fleet catch forecast methods could perhaps be used to check the validity of assumptions about the affects of the individual components of the fishery.

d) Provision of Advice

The effect of uncertainties of various sorts in assessments can be summarized for managers by assessing risk - expressed as the probability of "something nasty" happening (SCR Doc. 90/93). The definition of "something nasty" should preferably be in terms of something immediately comprehensible to managers and/or the industry (e.g. economic loss, numbers of boats forced out of operation, etc.). Simulation tools are well adapted to the calculations required. The final presentation should, if possible, display the results for a range of risk levels, and not pre-judge the issue of what level of risk would be acceptable. The choice of time frame for the risk calculations is important and, if possible, results should be presented for a selection of time-scales of

interest. The results may also be used to judge the adequacy of traditional rules of thumb (e.g. $F_{0.1}$, $SSB_{crit} = 0.2 * SSB_0$, etc., etc.).

Bootstrap estimation methods are very suitable for the estimation of confidence levels from a wide variety of assessment calculations, including forecasts from dynamic surplus production models (SCR Doc. 90/108). Fewer than 1,000 realizations may be sufficient for some calculations, and non-parametric error distributions may be used if required.

Simulations of the effects of compound management strategies, which interpolate between classical (F_{max} , $F_{0.1}$) strategies and *status quo* management, show that these are generally preferable to the conventional strategies (SCR Doc. 90/100). Results so far available relate to a case where the current F is high, and show that in this case a "split-the-difference" strategy results in lower variability of catch and effort, for a small loss in aggregate yield. Similar results are expected to apply even where the current F level is relatively low, and would still apply even when available data are very precise.

Information obtained by the beverage method on the interaction between advice and management suggests that the advice presumes a rational search for some defined optimum state, whilst the policy determination more often involves a political search for an acceptable compromise (SCR Doc. 90/102). It is suggested that increasing uncertainty shifts the balance from the former to the latter process. Given high levels of uncertainty, it is doubtful that a stock assessment is worthwhile. In addition, the rational process usually presumes a long time-scale, whilst that of the political process may be very short (less than one year).

Simulation studies of the effect of various rebuilding strategies for depressed stocks may be used to determine risk levels for various options (SCR Doc. 90/111). The results may be expected to depend crucially on the assumptions made about any possible shift of the probability distribution of recruitment as stock size changes, and also on whether or not the assessment of the current level of F is correct. The results may be presented to managers in the form of risk diagrams, as well as simple trajectories with confidence limits. Trade-offs between short-term losses and long-term gains for various options can also be displayed.

3. Panel Discussion

In opening the panel discussion J. Shepherd suggested that the Serebryakov method for determining a critical stock size could be widely applicable and would fill an important need for objective estimation of such a quantity. The "high" and "moderate" levels of recruitment and survival (or recruits-per-unit SSB) required could be estimated using 90th percentiles and medians respectively, following the philosophy used for the estimation of F_{high} and F_{med} .

He also considered that it was more useful to present results to managers in terms of risk, rather than as histograms, even if only because this was a more condensed presentation so that more information could be transmitted on a single sheet of paper. Assessment scientists should explore possible presentations in consultation with managers to find the most useful format. It would be desirable to fix a convention as soon as possible to avoid the confusion which would otherwise occur: he proposed plotting increasing risk against increasing levels of exploitation, as he felt this would be the most easily understood. It would be possible to add confidence limits to the standard graphical presentations often provided for managers, and some experiments along these lines should be tried. (Convener's note: he also thinks that upper and lower quartiles would be more appropriate than 95% confidence limits, which exaggerate the uncertainty, but did not say so at the time!)

A. Rosenberg stressed that some uncertainties (e.g. recruitment fluctuations) will not go away and cannot be reduced by management action or improved methodology. It is important to consider therefore the implications of such uncertainties for management strategy and not just the effect they have on the

precision of the results. Secondly, it was important to stress that projections into the future were based on knowledge (and uncertainty) now, and would be modified in practice as times goes on, both by improved understanding of the system, and of the nature and size of the uncertainties themselves. In particular, advice (e.g. that concerning possible multiple-year TACs) would in practice be up-dated. If one were to consider active adaptive (exploratory) management, it was important first to be sure that one would be able to detect the results of deliberate perturbations: this was not obviously possible in all cases. In the discussion which followed, participants stressed that depleted stocks generally have a long time to recovery, and that the effects of triggering adverse consequences on the industry had to be taken into account. It was felt that the major uncertainties were those in the basic catch data and the stock-recruitment relationship, and it was important not to dissipate effort studying relatively minor factors. The tools for estimating precision of assessments were available. The problem of assessing absolute accuracy was much more difficult, since the possibility of model mis-specification was real and severe.

A. Sinclair commented that we had to consider whether we had the tools to provide advice at the level of precision required by managers, and whether the costs of using them (e.g. research vessel surveys) were commensurate with the benefits. In some cases less precise management was necessary simply because of the excessive costs. The management strategy was relevant, because fixed F strategies demanded more precise stock size estimates than status quo strategies, whilst with the latter one could never be sure that one was going anywhere useful. Minimum stock size (escapement) strategies were even more demanding of precise results. Secondly, it was important not to consider the biological system in isolation. The fishery dynamics - the reaction of the fleet to both management and natural events - was also important. Those interactions could be simple - e.g. the tendency to increased mis-reporting when restrictive TACs were in force - or quite complex, e.g. the economic response to the fleet to change. The main priority should be to get the system structure correct in models. In the discussion it was pointed out that economists (like scientists) were good at doing easy things that were not all that useful, but had troubles in answering the crucial questions (e.g. how much increased effort and/or investment should be expected in response to increased profitability?). Improved dialogue with economists was needed, and assessments should include economic considerations where appropriate. It was important however that the advice was unbiased, and not intentionally conservative (or vice versa). Clear presentation (preferably graphically) of the options and their consequences was needed.

H. Lassen suggested that we needed to move beyond single species, single fleet studies. The real problems usually concerned mixed fisheries and multiple fleets, and might indeed need to consider individual boats, as well as the existence of spatial variation across various fishing grounds. It was not clear that we were capable of providing useful results at that level of detail. Secondly, he pointed out that there were various players (scientists, managers, fishermen, politicians, bankers, processors, etc., etc.) in the problem, which could be regarded as a game in which each player acted in his own interest. It was probably an over-simplification to suggest that this could be summarized by a single utility or objective function.

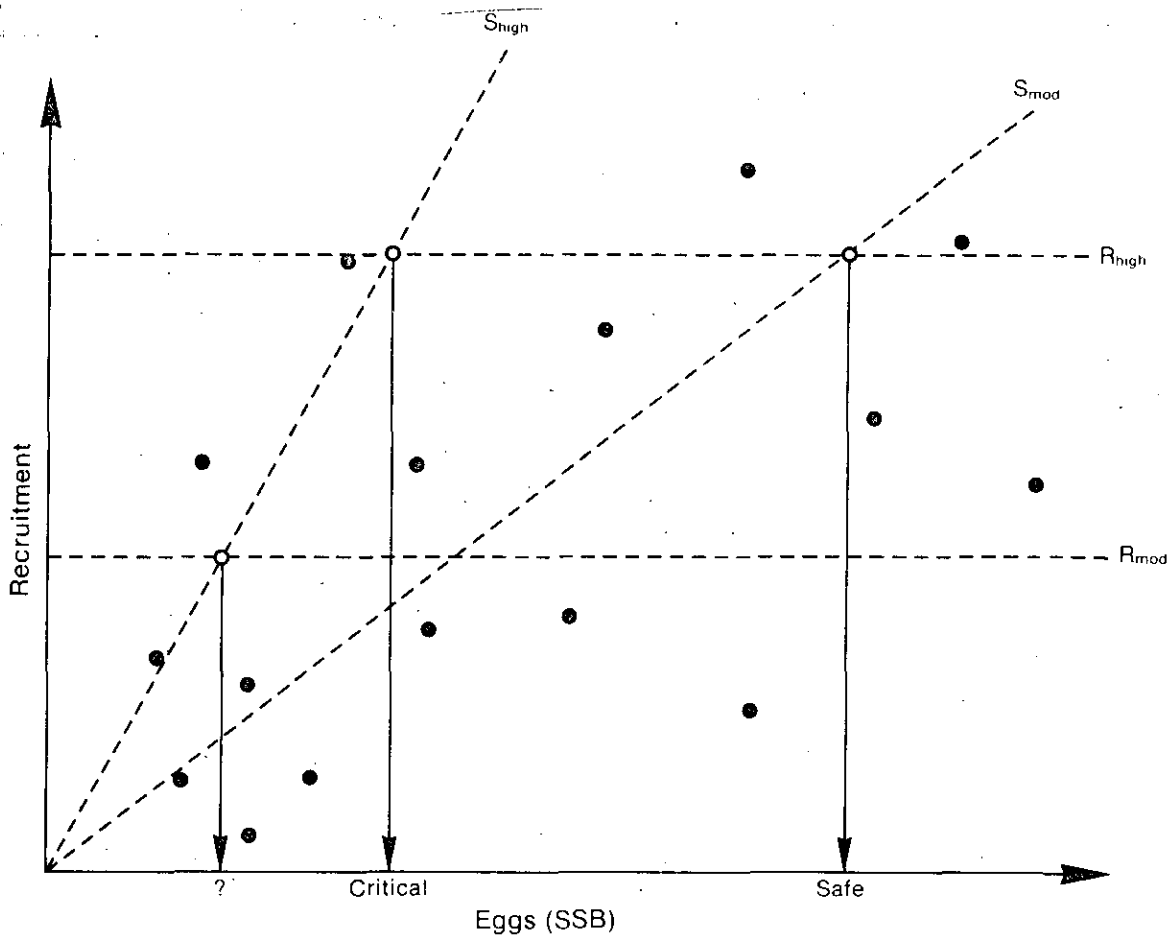
C. Francis pointed out that risk really needed to be expressed in economic terms - managers and fishermen did not appreciate messages phrased in terms of spawning stock biomass in the same way as biologists. Also, we should recognize that simple persistence (renewability) of living resources has some value, and adjust our calculation accordingly (e.g. by using lower discount rates than might be suggested by the industry, perhaps). Furthermore, it was very important to focus on the results over appropriate time-scales since there was usually a conflict between what was desirable in the short-term and the long-term. J. Shepherd suggested that computing Internal Rates of Return might be a useful way of condensing this problem in a comprehensible way.

In his closing remarks, the convener expressed his appreciation to the authors for producing excellent and relevant papers with very little prompting (on his part, at least), and especially to the panel members for helping to ensure a

stimulating discussion. He also thanked the Secretariat for their efficiency in setting up the meeting and ensuring its smooth running.

4. Conclusions

- a) The indicator levels of spawning stock size proposed by Serebryakov are likely to be most useful and are commended for further study and experimental application, as adjuncts to the F_{high} and F_{mod} indicator levels for fishing mortality (Fig. 1).



Population fecundity capable of giving a good year-class with:

- moderate survival -----> safe level
- high survival -----> critical level

Fig. 1. Determination of critical population size (after Serebryakov).

- b) The relationship of the critical level so obtained to that given by the 20% rule-of-thumb proposed by Beddington and Cooke should be examined for a range of stocks.
- c) The most serious uncertainties in practice may be those due to model misspecifications, errors in basic catch data (especially mis-reporting), and uncertainty about the stock-recruitment relationship.
- d) Objective methods of assessment which combine all available data with appropriate weights are to be preferred. Freedom for subjective

intervention in the procedure needs to be strictly controlled (but not prevented). A strong preference for well-chosen default procedures is an appropriate framework.

- e) The precision of current assessments, conditional on the assumptions made concerning model structure and data error levels, can be assessed by Monte Carlo simulation methods (especially bootstrap estimation techniques) given adequate computing resources. This is a desirable addition to standard assessment procedures wherever possible.
- f) The absolute accuracy of assessments is much more difficult to determine, and the most appropriate tool available at present appears to be retrospective analysis using current methodology.
- g) The effects of uncertainties may be presented to managers in the form of graphs indicating the risk of "something bad" happening as a function of management options (see e.g. Fig. 2). The definition of "something bad" should preferably be in terms of economic loss. Simulation methods are well adapted to the calculations required. Various possible presentations should be presented to managers on an experimental basis, in order to stimulate their reactions to the utility of the alternatives. It should be conventional to plot increasing risk against increasing exploitation level, in order to minimize any possible confusion.

Risk that SSB is less than critical level

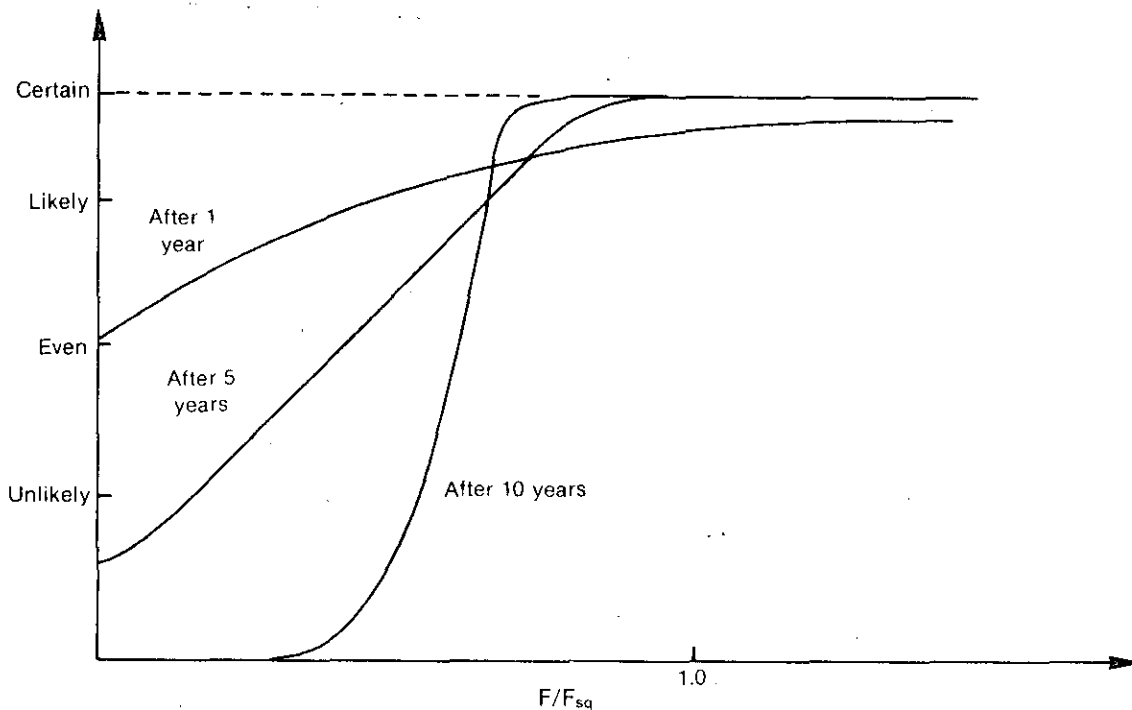


Fig. 2. Presentation of advice in terms of risk (illustration).

- h) Compound management strategies which interpolate between classical strategies (F_{max} , $F_{0.1}$) and status quo management are found to be superior according to various criteria, and yield lower variability of catch and effort. Such strategies should be seriously considered by managers as options especially when current F values are far from the long-term target levels.

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

Chairman: W. B. Brodie

Rapporteur: Various

The Committee met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, on 10 September 1990. Representatives attended from Canada, Denmark (Greenland), EEC, Japan and USSR.

1. Acquisition of STATLANT 21A and 21B Reports

STACREC noted that the STATLANT 21A reports for 1989 from EEC-France (M) and France (SP) have now been received, but that the report from Norway has yet to be provided.

There have been no STATLANT 21B reports for 1988 received to date from Canada (N), Greenland and the USA.

Several STATLANT 21B reports for 1989 have been received since June, leaving as outstanding the reports for Bulgaria, Canada (all components), EEC (France, United Kingdom, and Italy), Faroe Islands, France (SP), Greenland, Iceland, Norway, Romania, and USA.

STACREC reiterates its concern about the delays in the provision of these reports and recommends that every effort be made by the statistics reporting offices to have the STATLANT 21A and 21B reports submitted on time.

2. Publication of Statistical Information

STACREC noted that the publication of NAFO Statistical Bulletin Vol. 38 has been delayed further, pending the submission of STATLANT 21B reports from Canada (N), Greenland, and USA.

An addendum to the provisional catches for 1989 (SCS Doc. 90/21) was released, which provided the data from the STATLANT 21A reports of EEC-France (M) and France (SP).

3. Other Mattersa) Acknowledgements

There being no other matters to consider, the Chairman thanked the NAFO Secretariat for providing updates on the statistics, and the meeting was adjourned.



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

Chairman: V. P. Serebryakov

Rapporteur: W. R. Bowering

The Committee met at the Lord Nelson Hotel, Halifax, Nova Scotia, Canada, on 11 September 1990. In attendance were V. P. Serebryakov (Chairman, USSR), W. R. Bowering (Canada), A. Vazquez (EEC), and the Assistant Executive Secretary (Tissa Amaratunga).

1. Review of Editorial Board

The Assistant Executive Secretary informed STACPUB that the progress on papers being reviewed for the Journal was at a satisfactory level. Concerns regarding the workload had not been raised by the Editorial Board particularly Associate Editors for Vertebrate Fisheries Biology. It was agreed therefore that an additional Associate Editor for Vertebrate Fisheries Biology was not required at this time.

2. Invitational Papers

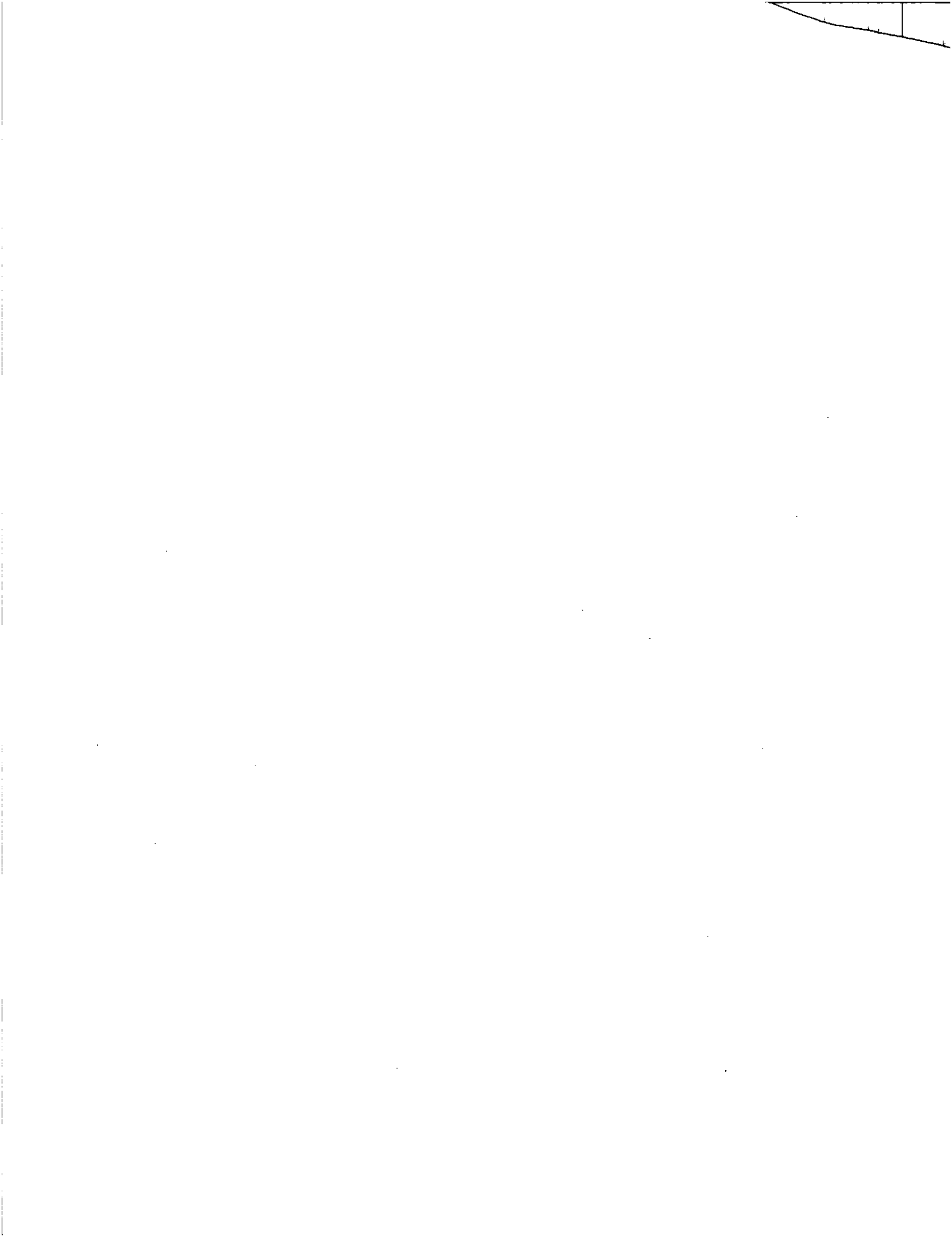
The Assistant Executive Secretary informed STACPUB that the invited paper by R. G. Halliday and A. T. Pinhorn was expected to be received for technical editing shortly following the Annual Meeting. No further progress on other invited papers was reported.

3. Review of Papers

STACPUB reviewed the papers of the Special Session held prior to the Annual Meeting. It was the collective opinion of STACPUB that the papers highlighted very important observations regarding uncertainties in fisheries management and is of significant interest to many people. It was however noted that many papers were not considered to be complete studies and were unlikely to be appropriate for the Journal. It was therefore recommended that *the proceedings be published (with the authors' permission) in a special issue of the NAFO Scientific Council Studies to allow for expedient circulation to interested parties.*

4. Other Mattersa) Acknowledgements

The Chairman expressed his gratitude to Special Session convener, John Shepherd, for presenting a review of the session. The Chairman also thanked the Rapporteur, W. R. Bowering, for outstanding records of the meeting and the Assistant Executive Secretary and the NAFO Secretariat staff for their excellent work in preparing working papers for the consideration of STACPUB. There being no other business, the Chairman then adjourned the meeting.



APPENDIX IV. AGENDA FOR SCIENTIFIC COUNCIL MEETING - SEPTEMBER 1990

I. Opening (Chairman: B. W. Jones)

1. Appointment of rapporteur
2. Adoption of agenda
3. Plan of work

II. Fishery Science (STACFIS Chairman: H. Lassen)

1. Stock assessments
 - a) Capelin (Div. 3L) (See SCS Doc. 90/23)
2. Report of Special Session on "Management Under Uncertainties Related to Biology and Assessments, with Case Studies on Some North Atlantic Fisheries" (5-7 September 1990 with J. Shepherd as Convener).

a) General Theme

The intention of the Special Session is to explore the implications for management of the uncertainties in both the dynamics of fish stocks, and those in the assessment of their past, present and future states. It is hoped that it will be possible to discuss some case studies from the North Atlantic, but theoretical contributions are also welcome. Some suggestions for special topics are given below, but these are not exhaustive. Contributions from management work of living marine resources other than fish stocks (e.g. whales) would offer opportunity for wider discussion.

b) Specific Topics

Sources of uncertainty: their magnitude and effects
 The interaction of biological uncertainties with management policies
 Communication of advice

3. Review of current arrangements for conducting stock assessments.
 - a) Selection of designated experts
 - b) Status of preliminary assessments done by designated experts. Documentation of data and of assessments.
 - c) Format and contents of Scientific Council Reports.
4. Future Special Sessions
 - a) Special Session in September, 1991 on "Atlantic Cod: The Understanding on Physiology, Dynamics, Ecology and Environmental Relationships"
 - b) Proposed theme for Special Session in September 1992

5. Other Matters

III. Research Coordination (STACREC Chairman: W. B. Brodie)

1. Acquisition of STATLANT 21A and 21B reports
2. Publication of statistical information

3. Other matters
- IV. Publications (STACPUB Chairman: V. P. Serebryakov)
1. Review of Editorial Board
 2. Invitational papers
 3. Review of papers for possible publication
 - a) Review of proposals from past meetings
 - b) Contributions to present meeting
 - c) Other contributions
 4. Other Matters
- V. Review of Future Meeting Arrangements
1. June 1991 Meeting of the Scientific Council
 2. Special Session and Annual Meeting, September 1991
 3. June 1992 Meeting of Scientific Council
- VI. Other Business
- VII. Adoption of Reports
1. Committee Reports of present meeting
 2. Report of Scientific Council, September 1990
- VIII. Adjournment

APPENDIX V. LIST OF PARTICIPANTS

CANADA

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Bowering, W. R.	" " " " " " " "
Brodie W. B.	" " " " " " " "
Carscadden, J. E.	" " " " " " " "
Coady, L.	" " " " " " " "
Fahrig, L.	" " " " " " " "
Hoenig, J. M.	" " " " " " " "
Miller, D.	" " " " " " " "
Myers, R. A.	" " " " " " " "
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APPENDIX VI. LIST OF RESEARCH AND SUMMARY DOCUMENTS

RESEARCH DOCUMENTS (SCR)

<u>SCR #</u>	<u>Ser. #</u>	
90/03	N1706	<u>TIZOL, R., M. ISAAC, and G. ARENCIBIA.</u> Age determination of silver hake by chemical composition of otoliths.
90/92	N1824	<u>SABORIDO, F., and J. PAZ.</u> Distribution and abundance of cod on the Flemish Cap, July 1988 and 1989.
90/93*	N1828	<u>FRANCIS, R. I. C. C.</u> Risk analysis in fishery management.
90/94*	N1829	<u>PRAGER, M. H., and C. D. JONES.</u> Effects of growth variability on estimation of the biological reference point $F_{0.1}$, with examples from Chesapeake Bay, USA.
90/95*	N1830	<u>COOK, R. M., P. A. KUNZLIK, and R. J. FRYER.</u> On the quality of North Sea cod stock forecasts.
90/96*	N1831	<u>SINCLAIR, A., D. GASCON, R. O'BOYLE, D. RIVARD, and S. GAVARIS.</u> Consistency of some Northwest Atlantic groundfish stock assessments.
90/97*	N1832	<u>BRODIE, W. B.</u> A review of the assessments of the American plaice stock in Div. 3LNO in relation to the recent decline in stock abundance.
90/98*	N1833	<u>BRODIE, W. B., S. J. WALSH, and W. R. BOWERING.</u> Managing transboundary flatfish stocks - sources and consequences of uncertainty.
90/99*	N1834	<u>HORSTED, Sv. Aa.</u> Biological advice for and management of some of the major fisheries resources in Greenland waters.
90/100*	N1835	<u>PELLETIER, D., and A. LAUREC.</u> Toward more efficient adaptive TAC policies with error-prone data.
90/101*	N1836	<u>MYERS, R. A.</u> Population variability and the range of a species.
90/102*	N1837	<u>LASSEN, H.</u> Biological uncertainties in fish stock management.
90/103*	N1838	<u>RESTREPO, V. R., J. W. BAIRD, C. A. BISHOP, and J. M. HOENIG.</u> Quantifying uncertainty in ADAPT (VPA) outputs using simulation - an example based on the assessment of cod in Divisions 2J+3KL.
90/104*	N1839	<u>BAIRD, J. W., C. A. BISHOP, and E. F. MURPHY.</u> Sudden changes in the perception of stock size and reference catch levels for cod in Divisions 2J+3KL.
90/105*	N1840	<u>FRÉCHET, A.</u> A declining cod stock (3Pn, 4RS), how can we learn from the past?
90/106*	N1841	<u>FAHRIG, L., and B. ATKINSON.</u> Concurrent exploitation of multiple stocks: a redfish simulation study.
90/107*	N1842	<u>MYERS, R. A.</u> Setting quotas in a stochastic fishery.
90/108*	N1843	<u>KIZNER, Z. I.</u> Bootstrap estimation of the confidence intervals of stock and TAC assessments with the use of dynamic surplus production models.

- 90/109* N1844 KIZNER, Z. I. The error of the biomass estimate as a function of survey parameters and the statistics of a concentration density field.
- 90/110* N1845 TALLMAN, R. Reduction of uncertainty caused by discarding in the fisheries of the Gulf of St. Lawrence.
- 90/111* N1846 ROSENBERG, A. A., and S. BRAULT. Stock rebuilding strategies over different time scales.
- 90/112* N1848 SHELTON, P. A., L. FAHRIG, and R. B. MILLAR. Uncertainty associated with cod-capelin interactions: how much is too much?
- 90/113* N1849 MOHN, R. Stability and sustainability of harvesting strategies in a modelled fishery.
- 90/114 N1850 PAZ, J., and M. G. LARRANETA. Year-class variations of American plaice and yellowtail flounder in Div. 3LNO and the abundance of other commercial fish.
- 90/115* N1851 SEREBRYAKOV, V. P. Prediction of year-class strength under uncertainties related to survival in early life history of some North Atlantic commercial fish.

* Special Session Papers.

SUMMARY DOCUMENTS (SCS)

<u>SCS #</u>	<u>Ser. #</u>	
90/24	N1823	<u>PACIORKOWSKI, A. J.</u> Polish research report, 1989.
90/25	N1860	<u>NAFO.</u> Report of Scientific Council, Annual Meeting, September 1990.