PART A

Scientific Council Meeting, 4-19 June 1997

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SCIENTIFIC COUNCIL MEETING - 4-19 JUNE 1997

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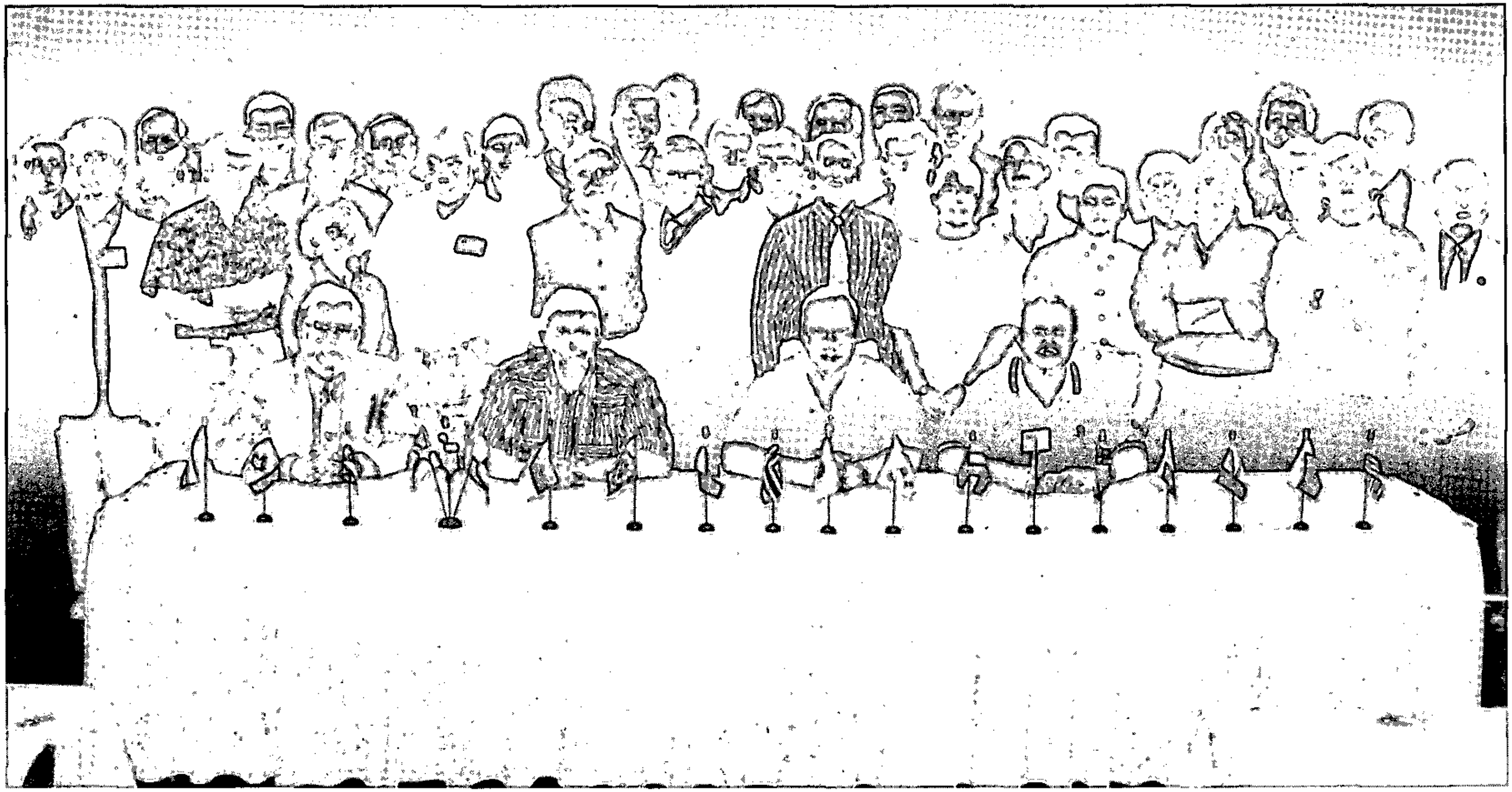
Sitting: M. Stein, H. P. Cornus, W. R. Bowering, D. Power



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REPORT OF SCIENTIFIC COUNCIL

4-19 June 1997

Chairman: W. R. Bowering Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada during 4-19 June 1997, to consider the various matters listed in its agenda.

Representatives attended from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Norway, Russian Federation and United States of America. The Assistant Executive Secretary was in attendance.

The Executive Committee met prior to the opening session of the Council, and the Provisional Agenda and work plan were discussed in relation to the work distribution of the Scientific Council and its Committees.

The opening session of the Council was called to order at 1015 hours on 4 June 1997.

The Chairman welcomed everyone to the fourth consecutive year at this venue for the June Meeting. The Assistant Executive Secretary was appointed rapporteur.

The Chairman noted that as discussed during the 7-13 September 1996 Meeting of the Council, J. Casey (EU-United Kingdom) had been unable to undertake the Chairmanship of the Standing Committee on Fishery Science (STACFIS) which resulted in some subsequent acting Chairmanships. The Chairman accordingly thanked W. B. Brodie (Canada, who chaired STACFIS during November 1996 Meeting), H. P. Cornus (EU-Germany, who chairs STACFIS at this meeting) and M. Stein (EU-Germany, who chairs the Standing Committee on Publications (STACPUB) at this meeting).

The Council accepted the proposal to appoint a Nominating Committee composed of M. Stein (EU-Germany) and D. Power (Canada) to propose nominations for the office of Chairman of the Scientific Council, Vice-Chairman of the Scientific Council and Chairman of STACPUB, and Chairman of the Standing Committee on Research Coordination (STACREC).

The Council was informed by the Executive Secretary, that in accordance with Rule 2.3 of the Rules of Procedure with respect to proxy votes, he had received authorization from Estonia, Lithuania and Poland, and as of 5 June 1997 Korea, to record their abstentions during any voting procedures.

In considering the Provisional Agenda, the Council noted that the item IX.1b on precautionary measures is scheduled to be addressed on 6 June 1997, with a view that the discussions may have bearing on STACFIS stock assessments. The provisional agenda was **adopted** as presented (see Agenda I, Part D, this volume).

In introducing the plan of work, the Chairman described the approach being taken by the Council, as in the 1996 meetings, will be such that STACFIS will conduct the assessments and provide the Designated Experts guidance on developing advice. The Council will address the tasks of developing prognoses on those assessments, and providing advice and recommendations. Accordingly, the STACFIS report will contain the assessment results and that report will be presented for consideration by the Council.

The opening session was adjourned at 1035 hours on 4 June 1997.

The Council reconvened at 0910 hours on 6 June 1997 to address the issues of precautionary measures and criteria for reopening fisheries as requested by the Fisheries Commission (Agenda item IX.1b). Six presentations relevant to the subject were discussed. The Council debated on the possible approaches for the assessment of stocks during this meeting. It was agreed that a small working group should draft some guidelines for the Council to consider for this meeting and into the future.

The Council, noting K. Nygaard (Denmark-Greenland) had stepped down from STACPUB membership, had requested STACPUB to consider its membership. The Council received the nomination of F. Serchuk (USA), and was pleased to appoint him as the new member of STACPUB. The Council extended its appreciation to K. Nygaard for his services in STACPUB.

The session was adjourned at 1640 hours on 6 June 1997.

The Council reconvened briefly at 1625 hours on 10 June 1997 to review a progress report from the Working Group on Precautionary Approach and criteria for re-opening of fisheries (see Agenda I in Part D, this volume, Item IX.1b). A general summary of the conditions used for closures and potential criteria for re-opening fisheries was presented. The Council agreed the group should present a paper on guidelines for the Council to review.

The session was adjourned at 1655 hours on 10 June 1997.

The Council reconvened at 1030 hours on 13 June 1997 to review the Working Group report on the Precautionary Approach (PA). The report prepared by the group composed of F. M. Serchuk (USA), D. Rivard (Canada), J. Casey (EU-United Kingdom), and R. Mayo (USA) (SCS Doc. 97/12) was reviewed, and the Council accepted its general framework and time frames for the development of a PA. The Council looked forward to a finalized report incorporating the views expressed by Council members at this session. The Council endorsed the concepts and agreed to conduct a Workshop of the Scientific Council to study the PA in the context of NAFO requirements.

The session was adjourned at 1245 hours on 13 June 1997.

The Council reconvened at 1240 hours on 16 June 1997 to receive a proposal for a Symposium in 1999. The Council extended it appreciation to P. A. Koeller (Canada) for presenting a comprehensive proposal. The Council agreed with the proposal (see Annex 1), and the decisions were reported in the relevant section below under Agenda item VI. Having also considered the progress on the Symposia set for 1997 and 1998, the session was adjourned at 1300 hours.

The Council reconvened at 1430 hours on 17 June 1997 to consider management advice on various stocks. These discussions and other outstanding matters on the agenda were continued in sessions through to 19 June 1997. At its sessions on 19 June 1997, the Council received nominations for officers (see Section VIII below), and considered its future meetings (see Section VII below).

The concluding session was convened at 0930 hours on 19 June 1997.

The Council then considered and **adopted** the Reports of the Standing Committee on Fisheries Environment (STACFEN), STACFIS, STACREC and STACPUB.

The Council then considered and **adopted** the Report of the Scientific Council of this meeting of 4-19 June 1997, noting minor changes as discussed during the review would be made by the Chairman and the Assistant Executive Secretary.

The meeting was adjourned at 1015 hours on 19 June 1997.

The Reports of the Standing Committees are appended as follows: Appendix I. STACFEN, Appendix II. STACFIS, Appendix III. STACREC and Appendix IV. STACPUB. The approved report of the Working Group on the Precautionary Approach is included in this Report (see Section IX.1b below).

The Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Participants of the meeting are given in Part D, this volume.

The Council's considerations on the Standing Committee Reports, and the other matters addressed by the Council follow in Sections II-X.

II. FISHERIES ENVIRONMENT (see STACFEN Report, App. I)

1. Opening

The Council welcomed the STACFEN report as presented by the Chairman, M. Stein (EU-Germany). The Council was pleased to receive a summary of the Committee's deliberations as presented below.

2. Summary of the Committee Report

a) Invited Lecture

The Council noted that an invited lecture was given by Dr. Johanne Fischer of Memorial University of Newfoundland entitled *'Niche space occupied by common fish species off Newfoundland'*. Data from groundfish scientific surveys on the continental shelf of northeast Newfoundland (Div. 2J and 3KL) were used to examine the relationship between abundance of fish species at individual stations, bottom temperature, and depth in the period 1978 to 1993. This period was one of declining sea temperatures and heavy fishing pressure over the Newfoundland Shelf. Environmental stress (described as decrease in abundance and/or average size of fish) during this time appeared to influence shape and width of the realized niche space. Preliminary results indicate that an examination of shift in niche space might serve not only as an additional indicator for environmental stress but also help in predicting fish distribution over large areas.

b) Marine Environmental Data Service (MEDS) Report

The Council noted that MEDS had been involved, along with other commitments, in developing an Atlantic Coastal Monitoring Proposal, a database on toxic chemicals and products. They also have been responsible for the management and archiving of data collected in the Canadian Joint Global Ocean Flux Study (JGOFS) and have begun an Ocean Data Rescue Project to identify and obtain data sets not presently held by MEDS.

c) Review of Environmental Studies in 1996

The Council noted that 11 scientific documents dealing with environmental issues were reviewed. In contrast to the very cold winter conditions during the early-1990s, air temperatures around Greenland during the first four months of 1996 were warmer than the long-term mean. High interannual variability has been common in Greenland air temperatures, thus the return to above normal temperatures for the first time in almost a decade should not necessarily be taken as the beginning of a long-term warming trend. Sea temperatures on Fylla Bank showed significant warming with the deviation from the mean for the 0-200 m layer being almost +1.6K, the second highest value since the record began in the early-1960s. This warming is believed to be associated not only with the increase in air temperatures but also with increased advection of warm water by the Irminger Current into the Labrador Sea region along the West Greenland slope. The air temperature and sea ice trends are related to the North Atlantic Oscillation (NAO) Index.

During the spring of 1997, 4 standard sections were occupied off Newfoundland. In contrast to the warm conditions in 1996, air temperatures were mostly below normal around Newfoundland during 1997. Temperatures at Station 27 were warmer than average in January continuing the conditions observed in 1996 but the waters cooled through and into the spring. Salinities were fresher than normal during the late winter and early spring. Ocean temperatures on the Grand Bank and along the east coast of Newfoundland were generally below normal (up to 1K) in the upper 100 m of the water column. On the Bonavista Line, the Cold Intermediate Layer (CIL) contained temperatures below -1.5°C, but the CIL area was near normal. In general, meteorological and ice conditions during late autumn of 1996 and early 1997 resulted in a continuation of moderate oceanographic conditions during early 1997.

Russian observations on the interannual and seasonal variability of the thermal fronts between the shelf and slope waters and of the northern edge of the Gulf Stream revealed that these fronts have generally been moving northward in recent years. Relationships between frontal movements and fish stock abundance are being examined.

Monthly monitoring of surface and bottom temperatures on a transect across the Middle Atlantic Bight revealed the lowest values in the 21 year record. The annual average anomaly was -1.9K at the surface and -0.8K near bottom. Surface salinities along this same transect were also at a minimum (1.17 psu below the 1978-92 mean). Near-surface temperatures across the Gulf of Maine transect were also cooler than normal by 1.1K but in contrast the near-bottom water was 0.2K above normal.

Changes in the demersal fish assemblages off Greenland and their relationship with changes in near-bottom temperatures were explored based upon groundfish surveys during 1982-96. The near average or warmer near-bottom temperatures (using stratum means) did not indicate any unfavourable environmental conditions for fish growth and reproduction during the 1990s.

d) **Overview of Environmental Conditions in 1996**

The Council was pleased that the annual overview paper was presented based on several long-term oceanographic and meteorological data sets. The overview presentation reported that annual air temperatures were above normal in 1996 in the Labrador Sea region and at their highest level in over a decade. At the southern boundary of NAFO, air temperatures were slightly colder than normal.

The atmospheric circulation pattern weakened resulting in the anomaly of the NAO index being negative. The annual decrease in the NAO index was the largest in the over 100-year record.

As observed in the later months of 1995, above normal temperatures were observed throughout most of the water column at Station 27 during 1996. Temperatures were the warmest in over a decade.

The volume extent of the CIL water off Newfoundland during the summer was below the long-term mean and was near its lowest value. There was, however, a slight increase compared to 1995. A below normal amount of CIL water was observed everywhere from southern Labrador to the Grand Bank. The CIL waters in the Gulf of St. Lawrence remained cold and their horizontal extent over the bottom of the Magdalen Shallows continued to be relatively large. Some moderation was observed as temperatures rose slightly and the area of ocean bottom covered by temperatures <0 and <1°C declined.

Cold waters were observed near-bottom and at intermediate waters over the northeastern Scotian Shelf and off southwestern Nova Scotia continuing a trend that began in the mid- to late-1980s. There was evidence of slight warming relative to past years.

e) **Conclusions Drawn from the STACFEN Meeting**

The Council noted that following the presentation of the overview of 1995 environmental conditions to the Fisheries Commission at its meeting in September 1996, by STACFEN Chairman, it was decided by the Chairmen of the Fisheries Commission and the Scientific Council that the presentation of highlights from the STACFEN Meeting should be repeated at five-year intervals. This would require the next presentation by STACFEN Chairman be during the September 2001 Fisheries Commission Meeting.

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

1. **Opening**

The Council accepted the report of STACFIS as presented by Chairman, H. P. Cornus (EU-Germany). The Council noted the Committee addressed the assessments and other requests referred to it by the Council.

2. **General Review of Catches and Fishing Activity**

The Council was pleased with the completion of the review conducted by STACFIS on its first day. Noting again that STATLANT data were not available in many cases, the Council agreed with the estimates of catches derived by STACFIS.

The Council again expressed serious concerns with the non-availability of STATLANT 21A data for the assessment work. These concerns and the statements made by STACREC will be conveyed to the Fisheries Commission and its Standing Committee on International Control (STACTIC) during its meeting of 24-26 June 1997 in Copenhagen. The Council once again regretted that the general review of fishery trends could not be adequately completed at this meeting, and the usual long-term summary by Division will be omitted from this report.

3. Stock Assessments

The Council noted the stock assessments referred to STACFIS were completed. The assessment reports are given in the Report of STACFIS in Appendix II. The Council observed that all assessments were **unanimously agreed to by the Committee**. The Council extended its appreciation to STACFIS for providing guidelines for the Council's advice on a stock-by-stock basis. The summaries and the conclusions of these assessments as agreed by the Council are presented in Section IX of this report, along with the other special advice in respect to the other requests by the Fisheries Commission and the Coastal States Canada and Denmark (in respect of the Faroe Islands and Greenland).

4. Ageing Techniques and Validation Studies

a) Joint NAFO/ICES Workshop on Ageing of Greenland Halibut

The Council extended it appreciation to K. Nedreaas (Norway) (who was co-Chairman of the Workshop along with W. R. Bowering (Canada)), for the detailed presentation on this Workshop which was held in Reykjavik, Iceland during 26-29 November 1996. The Council noted interim results based on the Workshop recommendations were presented at this meeting.

5. Other Matters

a) Report on Comparative Trawl Surveys

The Council noted STACREC considered a report on analysis of the 1996 comparative fishing trial between the *Alfred Needler* with the Engel 145 trawl and the *Wilfred Templeman* with the Campelen 1800 trawl. The results were examined for six groundfish species.

Conversion factors were length-based, and showed high values at small fish sizes (i.e. the ratio of Campelen catch to Engel catch was largest at small sizes), generally declining to values less than 1 at larger sizes. The Council noted the conversions were used in the assessments of cod in Div. 3NO and Div. 2J+3KL at this meeting, and will be used for other species in the 1998 assessments.

b) Report on Seal Consumption

The Council noted a report on prey consumption by seals in the Northwest Atlantic was reviewed by STACFIS. It was noted the estimates derived for diet consumption remained stable from 1990 to 1997, however, there have been large increases in population sizes of seals and large changes have occurred in the population sizes of fish that occur in the diet of seals. The Council noted the difficulties experienced by STACFIS in incorporating seal consumption data in the natural mortality rates of the fish estimates.

c) Gear Studies

The Council noted STACFIS reviewed a research report on varying fishing power of Canadian survey trawls. It was observed the different vessel sizes and horsepower induce changes in the trawl and thus variation in swept area for each individual trawl could bias the estimates of abundance due to changes in catchability.

d) **Review of SCR Documents**

The Council noted two other research documents (SCR Doc. 97/2 and 97/32) were deferred for consideration during the 7-19 September 1997 Meeting of the Council.

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

1. **Opening**

The Council welcomed the report of STACREC as presented by the Chairman, D. Power (Canada), observing that the matters referred by the Council were addressed.

2. **Fishery Statistics**

a) **Progress report on Secretariat activities in 1996/97**

i) **Acquisition of STATLANT 21A and 21B reports for recent years**

Recognizing that under Rule 4.4 of the Rules of Procedure of the Scientific Council, the deadline dates for submission of STATLANT data for the preceding year are 15 May for 21A data and 30 June for 21B data, the Council stressed that timely submission of STATLANT data is of paramount importance to the Scientific Council, since they are used extensively during its June Meetings for stock assessments and other scientific evaluations. Noting the STACREC tabulations of data not received, the Council endorsed the STACREC **recommendation** and agreed to submit the text of STACREC report regarding this matter to the Fisheries Commission.

ii) **Publication of statistical information**

The Council noted that publication of *NAFO Statistical Bulletin* Vol. 43 containing 1993 data had not been completed since statistical information from Faroe Islands and the United States were still outstanding. Volumes 44 and 45 are also similarly delayed. The Council agreed the publication of these data should be achieved as soon as possible with every effort made to obtain the data.

iii) **Considerations on internet site for statistical data**

The Council endorsed the STACREC **recommendation** for the establishment and operation of a website at the Secretariat for dissemination of statistical information. While agreeing with STACREC on the general structure and logistics for the website, the Council considered it should provide a cost effective tool for the dissemination of Scientific Council information.

b) **Report of the CWP 17th Session, March 1997**

The Council was pleased the Assistant Executive Secretary, T. Amaratunga, Chairman of STACREC, D. Power (Canada), and the Japanese representative, H. Matsunaga, National Research Institute of Far Seas Fisheries (K. Yokawa was unable to attend) represented the NAFO Scientific Council at the 17th Session of the Coordinating Working Party of Fisheries Statistics (CWP), in Hobart, Tasmania, Australia, in March 1997 as recommended. It was noted an extensive agenda was covered and NAFO contributed in many areas of discussions in addition to the NAFO reports prepared for the meeting.

The Council noted that CWP recognized the importance of agency websites for the exchange and dissemination of data. The Council also registered its concern with respect to inter-agency discrepancies in published data and that the FAO Yearbook of Fishery Statistics is published and circulated worldwide well before regional agencies such as NAFO finalize (or receive) their data. The Scientific Council endorsed the STACREC and CWP **recommendation** that reconciliation exercises of data for the Northeast and Northwest Atlantic be undertaken at a CWP intersessional meeting in mid-1998.

3. **Biological Sampling**

The Council noted that the Provisional List of Biological Sampling for 1996 was prepared by the Secretariat. Data from commercial fisheries pertinent to stock assessments were also tabulated, and National Representatives reported their sampling programs for the 1996 commercial fisheries to STACREC.

The Council noted that the sampling data report submissions lag behind by one year. The Council accordingly endorsed the STACREC **recommendation** to ensure that, starting in 1998, data for the year proceeding will be available in time for the June 1998 Meeting of the Council.

4. **Biological Surveys**

a) **Review of Survey Activities in 1996**

The Council noted an inventory of biological surveys was compiled, and a more detailed account of the survey data available for 1996 relative to their stocks, was tabled by National Representatives and Designated Experts.

b) **Surveys Planned for 1997 and Early-1998**

The Council noted an inventory of biological surveys planned for 1997 and early-1998, as submitted by National Representatives and Designated Experts, was compiled by the Secretariat.

5. **Non-traditional Fishery Resources in the NAFO Area**

a) **Distribution Data from Surveys**

The Council noted there was no documentation at this meeting and accordingly endorsed the STACREC **recommendation** that distribution and abundance for non-traditional species be presented to the Council as soon as possible.

6. **Review of SCR and SCS Documents**

The Council noted that STACREC reviewed six documents.

7. **Other Matters**

a) **Tagging Activities**

The Council noted that the Secretariat had compiled the list of tagging activities undertaken in 1996 (SCS Doc. 97/15). The Council endorsed the STACREC **recommendation** that scientists undertaking any tagging activities inform the Secretariat in order that the information may be widely circulated and hence better returns may be obtained.

b) **Development of Protocol for Scientific Data Collection by Pilot Observer Program**

The Council noted under STACREC discussions of data availability from the NAFO Pilot Observer Program that not all data were available at the Secretariat. The Council considered that such data would be extremely valuable for the work of the Council and the Council **recommended** that *the issue of scientific data availability from the Pilot Observer Program be raised with the Fisheries Commission.*

The Council noted that STACREC had set up a small working group of experts on biological sampling to prepare a draft proposal of protocol for scientific data collection in the Pilot Observer Program. The Council proposed that the protocol be conveyed to the Fisheries Commission and its Standing Committee on International Control (STACTIC).

c) **Conversion Factors**

The Council noted the international interest in the need for increased transparency in the factors used to convert differing fish presentations and fish products to live weight equivalent.

The Council endorsed the view of STACREC that the use of accurate and appropriate conversion factors is essential for the compilation of catch statistics and that a better knowledge of the factors in use is paramount. It was noted that whereas harmonization of factors for relatively unprocessed products might be feasible, other applications of this procedure should be approached with caution because differing national practices in processing fishery products could give rise to justifiably different factors.

d) **Description of Fishing Effort**

The Council was informed that no comments had been received by STACREC on the updating of fishing effort definitions and that if any changes are to be made to definitions for fixed gears or any other gears, it would be timely to do so at the earliest opportunity, for inclusion in the FAO Handbook of Fishery Statistics and the technical annexes of the EU legislation on catch data for the Northwest Atlantic. The Council endorsed the STACREC **recommendation** that members examine current fishing effort definitions in time for the September 1997 Meeting of STACREC.

e) **Canadian Stratification Scheme**

The Council noted that Canada is currently revising its research survey stratification scheme.

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

1. **Opening**

The Council welcomed the STACPUB report as presented by A/Chairman, M. Stein. The Council extended its appreciation for the comprehensive work by M. Stein noting the appointed Chairman, H. P. Cornus, was occupied as STACFIS Chairman during this meeting.

2. **Review of STACPUB Membership**

The Council extended its appreciation to K. H. Nygaard (Denmark/Greenland) for his dedicated work as a member of STACPUB and wished him well with his added responsibilities at his Institute.

The Council welcomed F. M. Serchuk (USA) as a new member of STACPUB and looked forward to his contributions in the work of STACPUB.

3. **Review of Scientific Publications Since June 1996**

The Council was pleased with the progress made in the publication of many Journal issues, particularly noting they carried valuable information in the NAFO field of science.

Three volumes, Volume 19 containing papers presented at the 1993 Symposium on 'Gear Selectivity/Technical Interactions in Mixed Species Fisheries', Volume 20 Special Issue by R. G. Halliday and A. T. Pinhorn titled 'North Atlantic Fishery Management Systems: A Comparison of Management Methods and Resource Trends', and Volume 21 containing miscellaneous papers, were published since June 1996.

The Council looks forward to the publication of the NAFO/ICES 1995 Symposium papers on 'The Role of Marine Mammals in the Ecosystem', expected to be completed by mid-1997.

The Council was pleased to note the large number of Studies publications completed by the Secretariat since its June 1996 Meeting.

Studies Number 24, of the 1994 Symposium on 'Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life', Studies Number 25, containing miscellaneous papers, Studies Number 26, the special issue titled 'Selected Papers on Harp and Hooded Seals', containing papers presented at the Joint ICES/NAFO Working Group on Harp and Hooded Seals of June 1995, Studies Number 27, containing miscellaneous papers, Studies Number 28 titled 'Assessment of Groundfish Stocks Based on Bottom Trawl Survey Results', containing papers from the Workshop of 4-6 September 1996, Studies Number 29 titled 'Selected Studies Related to Assessment of Cod in NAFO Divisions 2J+3KL', containing papers presented at 5-19 June 1996 Meeting of Scientific Council, and Studies Number 30, containing miscellaneous papers, all carry valuable information and were circulated on a timely basis.

The Council took note of the significant delays in publishing the *NAFO Statistical Bulletin* Volume 43, 44 and 45, due to lack of data from some countries/components. The Council conveys the serious concerns of this delay to the Fisheries Commission.

4. **Production Costs and Revenues for Scientific Council Publications**

a) **Review of Cost and Revenues**

The Council endorsed the Secretariat review process of the distribution list for scientific publications, and also agreed with the STACPUB initiative to limit the superfluous distribution of NAFO documents in consultation with National Representatives.

The Council supported STACPUB views to reduce the accumulated stocks of extra copies of the Journal or Studies that are printed, noting that by offering these to Universities and public institutions may contribute to publicizing NAFO scientific work and improving the profile of the Journal and Studies.

The Council agreed with STACPUB that thirty copies of free reprints to authors is an adequate amount, irrespective of the number of authors. The Council considered that this decrease will represent a substantial saving in number of printed pages and costs of mailing them.

b) **Proposal for Publication of 1997 Symposium Proceedings**

The Council agreed that papers to be presented at the Symposium on 'What Future for Capture Fisheries', 10-12 September 1997, should be published in a special issue of the Journal after peer review, and endorsed the **recommendations** with respect to the appearance of the issue, and the disposition of other papers distributed at the Symposium

5. **Promotion and Distribution of Scientific Publications**

a) **Invitational Papers**

The Council looks forward to the invitational paper by S. A. Horsted on an update and evaluation of catch statistics for West Greenland cod, the paper by D. G. Parsons on Flemish Cap shrimp, a paper by E. B. Colbourne on a 5-year review of the Flemish Cap oceanography, and a paper by V. A. Rikhter on silver hake.

b) **Distribution of Abstracts from Research Documents**

The Council noted the progress by STACPUB on the uneven reference to NAFO research paper abstracts in databases like ASFA, and agreed that it was important to establish procedures through the Secretariat. The Council supported that the guidelines for authors preparing research documents should be more strongly imposed, so that future developments in the databases and circulation can be accomplished effectively. In this regard the Council supported STACPUB in encouraging authors to submit electronic versions of their papers.

c) **New Initiatives for Publications**

The Council endorsed the STACPUB **recommendation** that the Journal should be open to accept colour graphics to improve its presentation capacities.

d) **NAFO Website**

The Council endorsed the **recommendation** to establish and manage a website at the Secretariat. Considering the potential for cost savings in printing and circulation of scientific information, the Council agreed steps should be taken as soon as possible by obtaining expertise from outside while also developing expertise in-house.

6. **Editorial Matters Regarding Scientific Publications**

The Council noted there were no changes to the Editorial Board, and the Council was pleased to observe progress in publishing Symposium proceedings in a good turn-around time.

7. **Papers for Possible Publication**

a) **Review of SCR Document Formats**

The Council noted the STACPUB discussion on SCR Documents containing assessment results and agreed special attention should be placed on such document formats.

b) **Procedures for STACPUB Review**

The Council noted that advice was sought from Designated Experts and Committee Chairmen on suitability of some papers.

c) **Review of Proposals**

The Council was pleased with the progress made in publishing many papers proposed through the STACPUB review process, in the Journal and Studies, and welcomed the nominations of papers presented during this meeting.

VI. ARRANGEMENTS FOR SPECIAL SESSIONS

1. **Progress Report on the Special Session in 1997**

The Council was informed that the Convener, H. Lassen (EU-Denmark) had been in close communication with the Assistant Executive Secretary in making arrangements for the Symposium on 'What Future for Capture Fisheries', scheduled for 10-12 September 1997 at the Marine Institute of Memorial University of Newfoundland.

The Council noted a complete program had been developed with invited speakers for the keynote addresses and the topical talks in five sessions. In addition concurrent satellite sessions will include selected short talks, poster displays, website demonstrations, and related video presentations. The Marine Institute's Flume Tank and other demonstrations are also envisaged for an interesting and timely Symposium.

Considering the Symposium takes place in conjunction with the NAFO 19th Annual Meeting and the 500th Anniversary of Cabot's arrival in Newfoundland, and the general interests observed and inquiries received on the Symposium, Council anticipates a good attendance.

2. Progress Report on the Special Session in 1998

The Council was informed that the co-convenor M. J. Morgan (Canada) in consultation with the others, E. Aro (Finland) and J. Burnett (USA), had developed and issued a first announcement of the Symposium on 'Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish' to be held in Lisbon, Portugal during 9-11 September 1998, in conjunction with the NAFO 20th Annual Meeting.

The Council noted the co-convenors are presently contacting potential contributors for the listed subject areas, and hoped that the second announcement to be issued presently will describe the format of the Symposium.

3. Proposal for Special Session in 1999

The Council received a detailed proposal for autumn 1999 for an International Symposium on Pandalid shrimp. The complete proposal is given as Annex 1 to this Council Report. The Council agreed that this meeting would be timely and that it would be valuable to invite both ICES and PISCES with NAFO taking the lead role as proposed, in order that the geographic coverage intended is achieved. The Council welcomed P. A. Koeller to represent the Council as the lead co-convener of the Symposium, and agreed that arrangements for the Symposium will proceed in cooperation with the Secretariat.

VII. FUTURE SCIENTIFIC COUNCIL MEETINGS

1. Annual Meeting in September 1997

The Scientific Council would next meet at the Annual Meeting of NAFO, in September 1997, at the Hotel Newfoundland, St. John's, Newfoundland, Canada.

The Council agreed to meet during 7-9 September 1997, which includes the Sunday, 7 September, to address the assessment of Shrimp in Div. 3M, and the rest of the Meeting will be conducted during 15-19 September 1997.

This would be preceded by the Symposium on 'What Future for Capture Fisheries' during 10-12 September 1997, which will be held at the Marine Institute of Memorial University, Newfoundland, Canada.

2. Special Meeting on Shrimp Assessment in November 1997

The Council agreed to conduct its Special Meeting for the assessment of Shrimp in Subareas 0 and 1 and Shrimp in Denmark Strait, at NAFO Headquarters, Dartmouth, Nova Scotia, Canada, during 14-18 November 1997.

3. Workshop on Precautionary Measures

The Council agreed to schedule its 'Workshop on the Precautionary Approach to Fisheries Management' for 17-27 March 1998 in Dartmouth, Nova Scotia, Canada. This meeting will include work on Saturday, 21 March. The venue will be determined by the Secretariat.

4. Scientific Council Meeting, June 1998

The Council agreed to schedule this meeting for 3-18 June 1998.

5. Scientific Council Meeting and Symposium, September 1998

The Council noted it would meet during the Annual Meeting scheduled for 14-18 September 1998. This would be preceded by the Symposium on 'Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish', during 9-11 September 1998. The Council noted these meetings will be held in Lisbon, Portugal.

6. Scientific Council Meeting, June 1999

The Council agreed on tentative dates of 2-17 June 1999.

VIII. NOMINATION AND ELECTION OF OFFICERS

The Chairman's proposal (4 June 1997) to appoint a Nominating Committee composed of M. Stein (EU-Germany) and D. Power (Canada) was accepted by the Council.

On 18 June 1997, the Chairman requested the Nominating Committee to present its proposal for the nomination of Chairman of the Scientific Council, Vice-Chairman of the Scientific Council who would become the Chairman of STACPUB, and Chairmen of STACFIS and STACREC. M. Stein reported that the Committee, after consulting with representatives, was ready to make nominations.

Noting that the appointments were for two-year terms beginning at the end of the September 1997 Annual Meeting of the Scientific Council, the Chairman called for nomination and election.

For the office of Chairman of Scientific Council, the current Vice-Chairman H. P Cornus (EU-Germany) was nominated by the Committee and the Council elected him by unanimous consent.

For the office of Vice-Chairman of Scientific Council and Chairman of STACPUB, the Committee nominated W. B. Brodie (Canada) and the Council elected him by unanimous consent.

For the office of Chairman of STACFIS, the Committee nominated R. Mayo (USA) and the Council elected him by unanimous consent. Recognizing that the Chairman of STACFIS at this meeting (H. P. Cornus) undertook the task only for this meeting (NAFO Sci. Coun. Rep., 1996, p. 143), the Council agreed the new Chairman (R. Mayo) will undertake the STACFIS Chairmanship of the 7-19 September 1997 Meeting, in advance of his term.

For the office of Chairman of STACREC, the Committee nominated V. Shibanov (Russian Federation), and the Council elected him by unanimous consent.

IX. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. Fisheries Commission

a) Advice for TACs for 1998, and Other Management Measures

For stocks within or partly within the Regulatory Area as requested by the Fisheries Commission, the following are the responses in the requested sequence. The Council agreed to conduct the assessment of shrimp in Div. 3M at its Annual Meeting during 7-9 September and 15-19 September 1997.

Cod in Division 3M

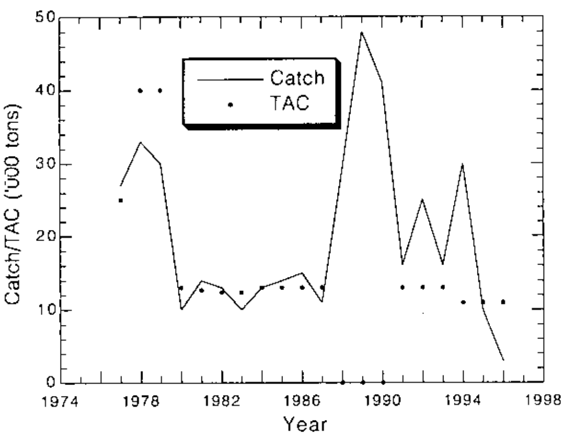
(see also Fisheries Commission requests in Agenda I in Part D, this volume, Annex I, Item 7)

Background: The cod stock on Flemish Cap is considered to be a discrete population.

Fishery and Catches: Catches exceeded the TAC from 1988 to 1994, however, were below the TAC in 1995 and 1996. Large numbers of small fish were caught by the trawl fishery in most recent years. By-catches were estimated to be low in the shrimp fishery since 1993. The 1996 fishery was very small compared with previous years. Most of the fleets traditionally directing for Div. 3M cod did not participate.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	TAC ('000 tons) Agreed
1994	30	0	11
1995	10	0	11
1996	3	0	11
1997		0	6

[1] Provisional



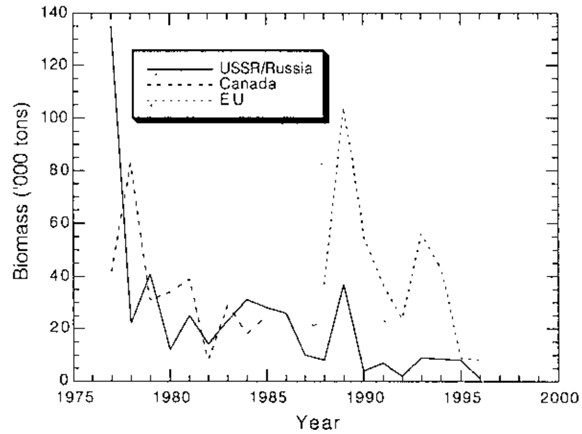
Data: Length and age composition of the catch were available for Portuguese trawlers as well as observed CPUE data. Data were also available from three bottom-trawl surveys (from Canada, EU and Russia) which cover the distribution area of the stock.

Assessment: An analytical assessment was presented.

Fishing mortality: Has been very high in recent years.

Recruitment: The 1985 and 1991 year-classes were the most abundant in recent years. The 1991 year-class was heavily exploited in 1994. The 1992 to 1994 year-classes appear to be weak and were the lowest in the EU time series.

Biomass: Based on SPA results, the stock biomass is at a very low level.



State of the Stock: The total stock biomass in 1996 is the lowest on record. Recruitment at age 3 was poor in 1995 and 1996 and it is also expected to be poor in both 1997 and 1998. The decrease in the age-at-maturity of the stock is interpreted as a reaction of the population to the decline of the stock.

Recommendation: No directed fishery for cod in Div. 3M in 1998. Also, by-catch of cod in fisheries directed to other species on Flemish Cap must be kept at the lowest possible level.

Special Comments: The opportunistic recruitment based fishery for cod in Div. 3M has been the main cause of the present stock status. Catch being less that the TAC in 1995 and 1996 and the substantial reduction of the fleet currently fishing in Div. 3M are signs of depletion of the stock. Scientific Council did not determine if the low level of by-catch in the shrimp fishery only reflects the current low levels of the recruitment of cod stock.

Sources of Information: SCR Doc. 97/7, 18, 28, 42, 50; SCS Doc. 97/3, 4, 9.

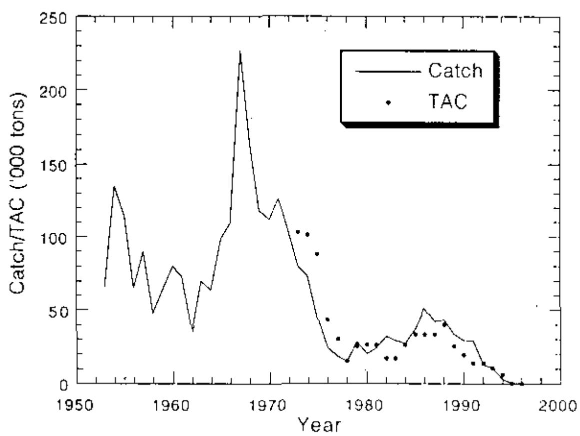
Cod in Divisions 3N and 3O

Background: This stock occupies the southern part of the Grand Bank of Newfoundland. Cod are found over the shallower parts of the bank in summer, particularly in the Southeast Shoal area (Div. 3N) and on the slopes of the bank in winter as cooling occurs.

Fishery and Catches: There has been no directed fishery since mid-1994.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994[2]	2.7	6	6
1995	0.2	0	0
1996	0.2	0	0
1997	-	0	0

[1] Provisional.
[2] No directed fishery after mid-year.

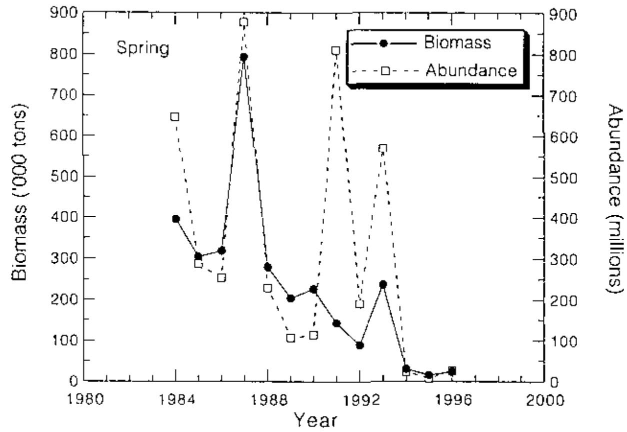


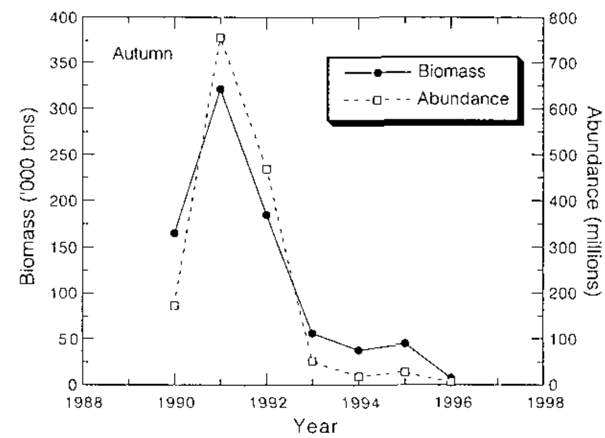
Data: Very limited data were available from Canadian gillnet and long line by-catch. Canadian spring and autumn survey data provided abundance, biomass and age structure information. Spanish spring survey data provided abundance and biomass information. Russian research survey data were available up to 1993.

Assessment: An analytical assessment was not conducted due to a lack of biological sampling.

Recruitment: Until recently, the stock was made up primarily of the 1989 and 1990 year-classes but the most recent surveys suggest that all year-classes are now at a low level.

Biomass: The 1996 biomass is estimated to be at an extremely low level.





State of the Stock: The stock was at an all time low in 1996 with weak representation from all year-classes.

Recommendation: There should be no directed fishing for cod in Div. 3N and 3O in 1998. By-catches of cod in fisheries targeting other species should be kept at the lowest possible level.

Sources of Information: SCR Doc. 97/25, 68, 70, 73; SCS Doc. 97/9, 10.

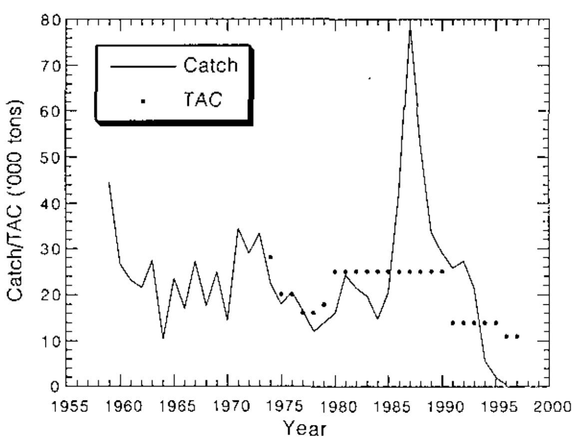
Redfish in Divisions 3L and 3N

Background: There are two species of redfish, *Sebastes mentella* and *Sebastes fasciatus* which occur in Div. 3LN and are managed together. These are very similar in appearance and are reported collectively as redfish in statistics. The relationship to adjacent NAFO Divisions, in particular to Div. 3O, is unclear and further investigations are necessary to clarify the integrity of the Div. 3LN management unit.

Fishery and Catches: The 1996 catch was about 500 tons, the lowest historically. This was only the third consecutive year since 1985 that the TAC was not exceeded. The reduction was primarily due to reduced effort. A portion of the catches, in some years substantial, have been taken by non-Contracting Parties from 1987 to 1994. These countries have not fished in Div. 3LN since 1994.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994	6	14	14
1995	2	14	14
1996	0.5	14	11
1997		14	11

[1] Provisional.



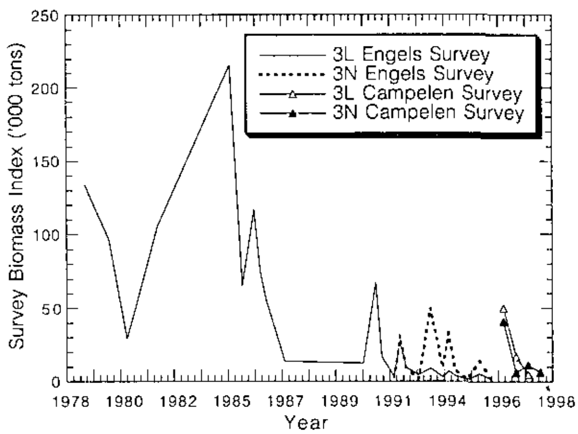
Data: CPUE series based on commercial database (1959-95) and Portuguese Observer data (1988 to 1994) are of little value in determining current stock status. Bottom trawl surveys conducted by Russia from 1984 to 1994, and by Canada from 1978 to 1997 are the basis for the assessment of stock status.

Assessment: Not possible to provide an estimate of the absolute size of stock.

Fishing Mortality: Assumed to have declined again in 1996 due to reduced effort. In late-1980s large catches likely generated high fishing mortalities.

Recruitment: Little or no sign of good recruitment since the 1986 and 1987 year-classes which are recruiting to some fisheries.

State of the Stock: Based on the available data, the stock appears to be at a very low level.



Recommendation: No directed fishing and by-catches be kept at the current low level.

Recognizing that there was unanimous agreement on all other aspects of this assessment report, the Council noted the scientists of the Russian delegation did not agree with this **recommendation**, and requested the inclusion of their views as an annex to this note (see Annex A below).

Special Comments: At present, the relationship between redfish in Div. 3LN and 3O remains unresolved. If such a relationship exists, unregulated fishing in the Regulatory Area of Div. 3O could seriously impact the resource in Div. 3LN including its rate of recovery.

The most recent relatively good year-classes, those of 1986-87, are recruiting to the SSB. These same year-classes will make up the greatest proportion of the SSB in the near future. Because of the slow growth of redfish, it will be 8-10 years before any future recruitment will contribute to SSB.

Sources of Information: SCR Doc. 97/64; SCS Doc. 96/3, 97/8, 9.

ANNEX A. A Basis for Conservation and Limited Fishery for Divisions 3LN Redfish in 1998

by

Scientists of the Russian Delegation

Since autumn 1995 until the present time, STACFIS does not have new data on Div. 3LN redfish abundance, i.e. from the time when Canadian surveys began using a new Campelen shrimp trawl as a survey gear. The comparison of redfish abundance indices obtained with Campelen trawl and those with the Engels trawl are still not available (SCR Doc. 97/64). Unfortunately, conversion factors of abundance indices from the Engels trawl and the Campelen trawl have not been presented to the Scientific Council in June 1997.

The reduction in fishing effort in 1995-96 (as well as in the first half of 1997) in directed Div. 3LN redfish fishery appears to be a positive factor contributing to the recovery of the stock and conservation of relatively strong 1986 and 1987 year-classes, which at the age of 11 and 12 may contribute to a limited directed redfish fishery.

Standardized catch rates (both in tons per hour and tons per day) in Div. 3N are increasing since 1993 (SCR Doc. 97/64).

During Russian surveys carried out in 1983-93 in Div. 3N and Div. 3O, it has been recorded that when redfish abundance began declining in Div. 3N the abundance of redfish in Div. 3O increases and vice versa. A high level of similarity of length frequencies from the two areas has been also recorded (SCR Doc. 91/6, 94/13).

These data support the possibility of movement of fish from one area to another.

Therefore, there is no sufficient evidence to propose the closure of a directed fishery for Div. 3LN redfish in 1998.

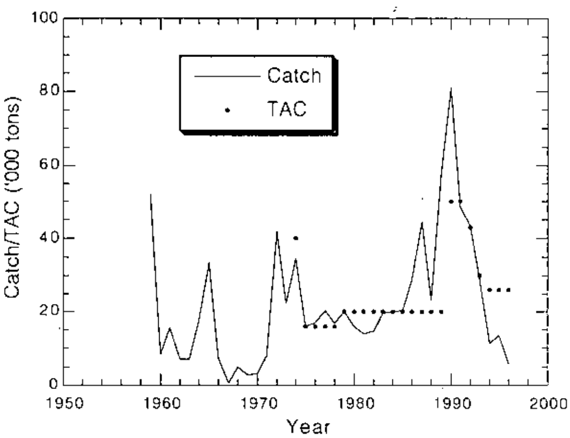
Redfish in Division 3M

Background: There are three species of redfish which are commercially fished on Flemish Cap: deep water redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The term beaked redfish is used for *S. mentella* and *S. fasciatus* combined. All redfish species are reported combined in the commercial fishery.

Fishery and Catches: Directed fishing on redfish in Div. 3M in 1996 was mainly conducted by non-Contracting Parties (Korean crewed), EU-Portugal and Japan. From 1987 to 1992 (excluding 1988) annual catches were greater than 40 000 tons. Catches have since declined to 5 800 tons in 1996. The declines observed in the fishery from 1990 to 1996 has been influenced by the decline of fishing effort deployed in this fishery. The Portuguese fleets were primarily aimed at Greenland halibut and cod.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1993	29	20	30
1994	11	20	26
1995	13	20	26
1996	6	20	26

[1] Provisional.



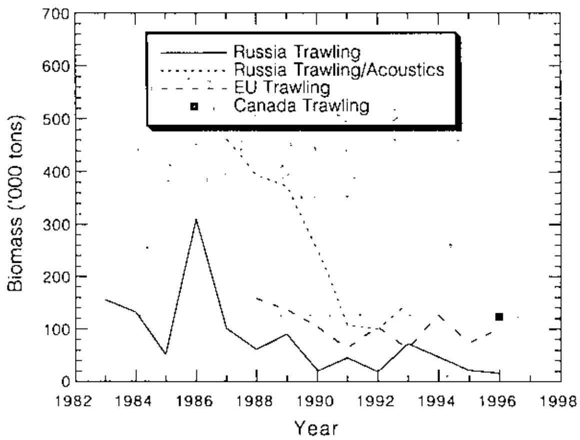
Data: Length and age data and observed CPUE data were available for Portuguese bottom trawlers. However these data represent only a small part of the catches which were dominated by unreported catches from non-Contracting Parties. Results from three bottom trawl surveys (EU, Russia and Canada) were available for estimation of trawlable biomass.

Assessment: Due to insufficient data, an analytical assessment could not be done.

Fishing Mortality: Fishing mortality is expected to have been reduced due to the reduction of effort from 1993 onwards.

Recruitment: The year-classes of the early-1990s, were relatively strong. There are no indications of subsequent good recruitment.

Biomass:



The size of spawning stock biomass is unknown.

State of the Stock: Since 1991, biomass and abundance estimates from the EU survey suggests stability for the golden and Acadian redfish, and a continuous increase of the deep sea redfish stock since 1993.

Recommendation: The level of catches in the period 1975 to 1985, when stable conditions were observed, was about 20 000 tons. Scientific Council recommended that total catches of redfish in Div. 3M not be allowed to exceed 20 000 tons in 1998 and by-catch of juvenile redfish in the shrimp fishery should be kept at the lowest possible level.

Special Comments: Catching the recommended TAC of 20 000 tons would result in a significant increase in fishing effort targeted on redfish. Scientific Council is not able to evaluate the effect of such a development. The survey trawlable biomass now consist mainly of immature fish. It would not be prudent to allow an increase in the exploitation of these young redfish as they will not reach maturity for another few years.

The recovery of these stocks will be severely jeopardized if uncontrolled exploitation by the fleet of non-Contracting Parties continues.

Updated yield-per-recruit analysis confirms that about 23 000-25 000 tons of potential yield was lost as a result of by-catches in the shrimp fishery during 1993-95.

Sources of Information: SCR Doc. 97/ 8, 9, 11, 28, 42, 44, 79, 80; SCS Doc. 97/3, 8, 9.

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

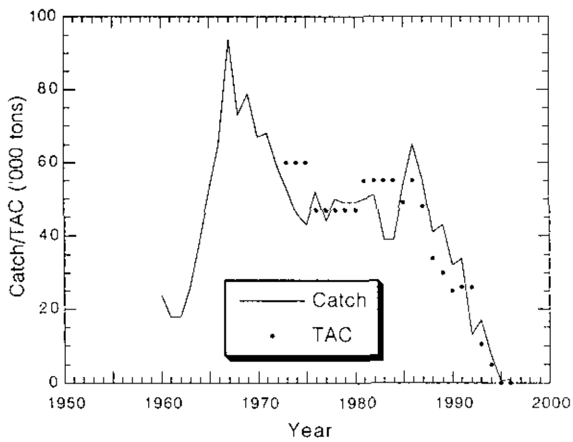
(see also Fisheries Commission requests in Agenda I in Part D, this volume, Annex 1, Item 6)

Background: Historically, American plaice in Div. 3LNO has comprised the largest flatfish fishery in the Northwest Atlantic.

Fishery and Catches: In most years the majority of the catch has been taken by offshore otter trawlers. There was no directed fishing in 1994 and there has been a moratorium from 1995 to 1997.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994	7	4.8[2]	4.8[2]
1995	0.6	0	0
1996	0.9	0	0
1997		0	0

[1] Provisional
[2] No directed fishery

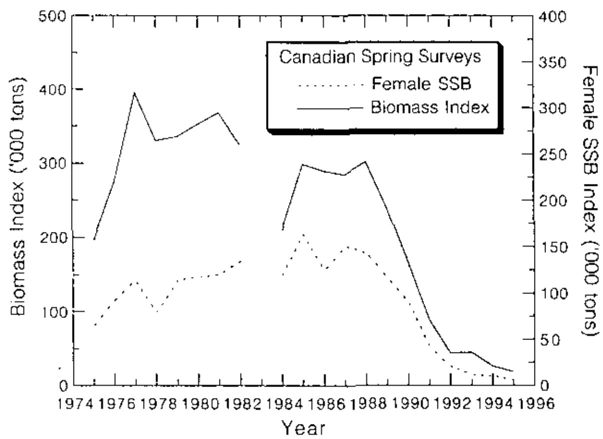


Data: Biomass and abundance data were available from several survey series. Limited sampling data from by-catch by Portuguese and Spanish vessels were available.

Assessment: No analytical assessment was possible due mainly to uncertainties with catch and catch-at-age data.

Recruitment: There have been no good year-classes since 1987.

Biomass and Spawning Stock Biomass:



State of the Stock: Canadian spring and autumn surveys showed a large decline in biomass since the mid-1980s. Spanish surveys in the Regulatory Area of Div. 3NO showed a large decline in biomass from 1996 to 1997. Total mortality remains high and the stock is composed mainly of fish that are less than 6 years old. The stock is at a low level.

Recommendation: No fishing on American plaice in Div. 3LNO in 1998.

Special Comments: Scientific Council cautions that by-catches of American plaice continue in the Greenland halibut fishery and are likely to increase if a directed fishery for yellowtail flounder occurs in Div. 3NO.

Sources of Information: SCR Doc. 97/25, 60; SCS Doc. 97/9, 10.

American Plaice in Division 3M

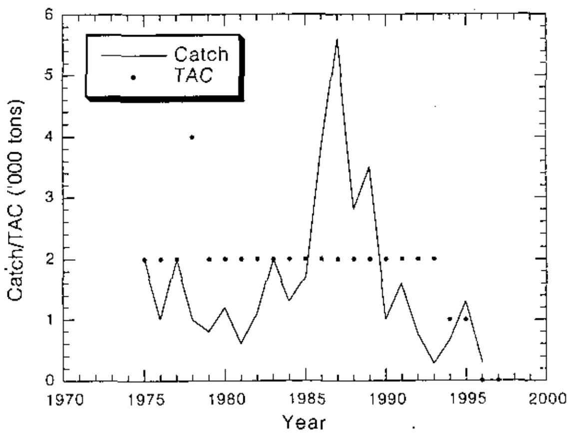
(see also Fisheries Commission requests in Agenda I in Part D, this volume, Annex 1, Item 6)

Background: The stock occurs mainly at depths shallower than 400 m on Flemish Cap.

Fishery and Catches: Catches are taken mainly by otter trawl, primarily in a by-catch fishery of the Contracting Parties since 1992. About half of the catch was taken by non-Contracting Parties in 1996.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994	0.7	1	1
1995	1.3	1	1
1996	0.3	0	0
1997	-	0	0

[1] Provisional.

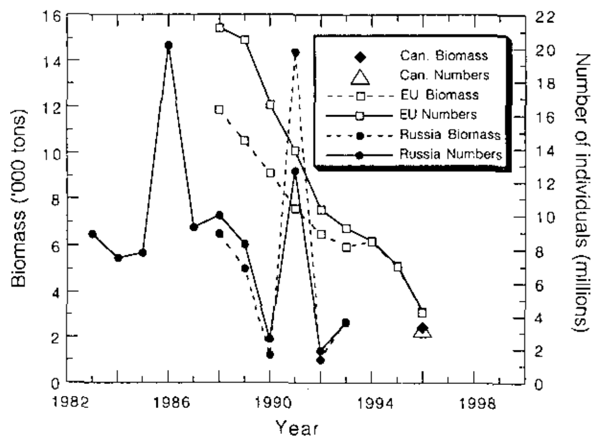


Data: Abundance and biomass indices from surveys were available from USSR/Russia (1983-93), EU (1988-96) and Canada (1996).

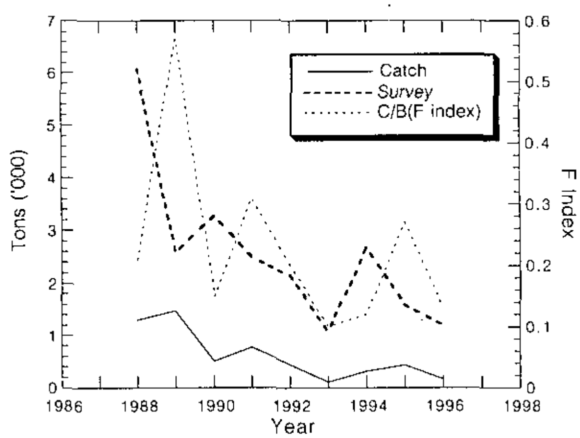
Assessment: No analytical assessment was possible. A comparison of catch levels with EU survey biomass indicated that the exploitation level decreased between 1988 to 1993, after which there was a slightly increasing trend.

Recruitment: Only weak year-classes were recruited to the EU survey since 1990.

Biomass and Abundance:



The SSB index remained more or less stable during 1990-94 and has been declining since 1995. The level in 1996 was the lowest observed (34% of the 1988 level).



State of the Stock: The stock appears to be at a very low level. It is anticipated that SSB will not increase in the near future because of recent poor recruitment.

Recommendation: There should be no directed fishery on this stock in 1998. By-catch should be kept at the lowest possible level.

Sources of Information: SCR Doc. 97/28, 42, 45; SCS Doc. 97/9, 10.

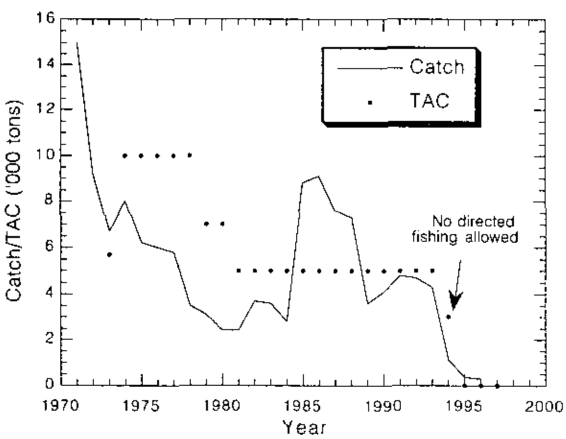
Witch Flounder in Divisions 3N and 3O

Background: The stock mainly occurs in Div. 3O along the deeper slopes of the Grand Bank. It has been fished mainly in winter- and spring-time on spawning concentrations.

Fishery and Catches: Catches exceeded the TAC by large margins during the mid-1980s, but since then have been near the level of the TAC. The catches in 1994 and 1995 were 1 100 tons and 300 tons, respectively, including unreported catches. Estimated catch in 1996 was about 300 tons.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	Agreed
1994	1.1	3	3[2]
1995	0.3	0	0
1996	0.3	0	0
1997	-	0	0

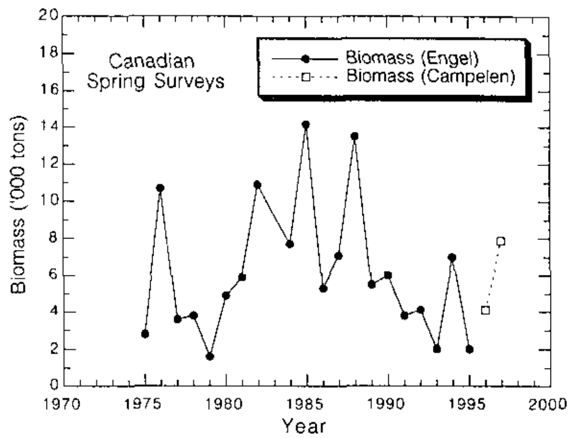
[1] Provisional.
[2] No directed fishing allowed.



Data: Abundance and biomass data were available from Canadian spring surveys during 1971-97 and autumn surveys during 1990-96 as well as Spanish surveys during spring 1995-97. No ageing data were available since 1993. Some commercial by-catch data were also available from EU-Spain from 1992-96.

Assessment: No analytical assessment was possible.

Biomass:



State of the Stock: Stock appears to remain at a low level although there may have been some slight improvement between 1996 and 1997.

Recommendation: No fishing on witch flounder in 1998 in Div. 3N and 3O to allow for stock rebuilding. By-catches be kept at the lowest possible level.

Sources of Information: SCR Doc. 97/24, 25, 65.

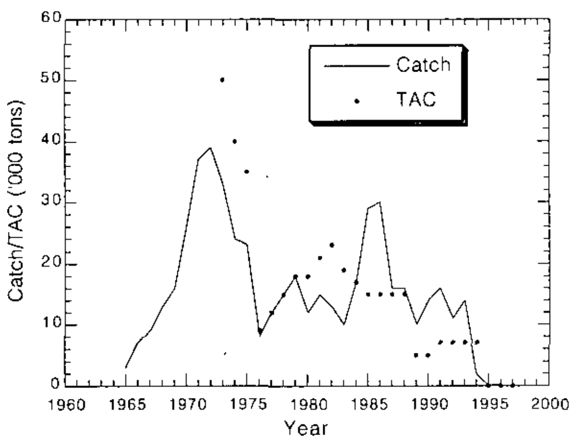
Yellowtail Flounder in Divisions 3L, 3N and 3O

Background: The stock is mainly concentrated on the southern Grand Bank and is recruited from the Southeast Shoal area nursery ground, where the juvenile and adult components overlap in their distribution.

Fishery and Catches: There was a moratorium on directed fishing from 1994 onward and small catches were taken as by-catch in other fisheries. Prior to the moratorium TACs had been exceeded each year from 1985 to 1993.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994	2	7	7[2]
1995	0.1	0	0[2]
1996	0.3	0	0[2]
1997		0	0[2]

[1] Provisional.
[2] No directed fishery.



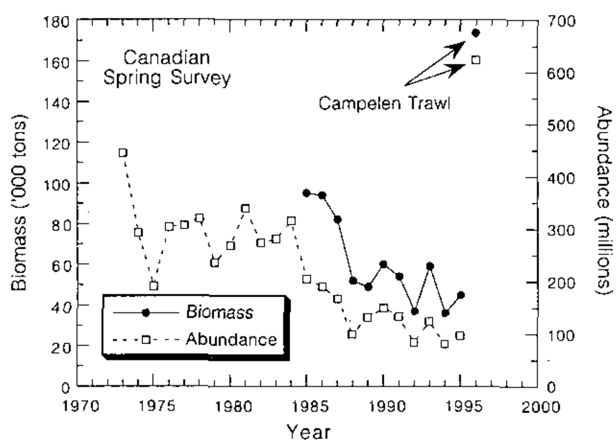
Data: Catch-at-age and CPUE were available from 1965 to 1993 but not for 1994 or 1995. Abundance and biomass indices were available from annual Canadian spring (1975-97) and autumn (1990-96) bottom trawl surveys, cooperative DFO/fishing industry seasonal surveys from 1996-97 and Spanish surveys in the NAFO Regulatory Area of Div. 3NO (1995-97).

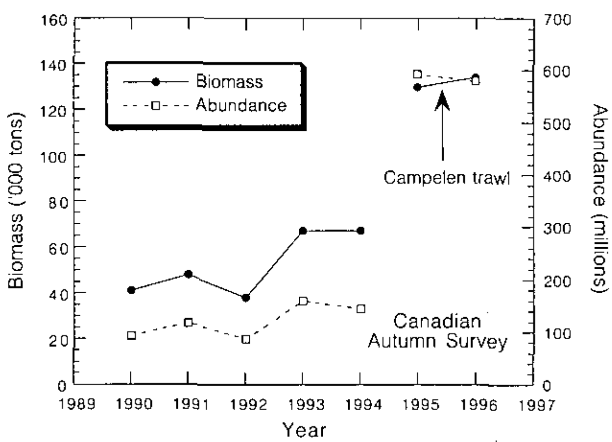
Assessment: No analytical assessment possible due mainly to uncertainties with catch and catch-at-age data.

Fishing Mortality: Has been reduced on all ages due to the moratorium.

Recruitment: The relative cohort strengths from the 1975-95 time series show that recent cohort strengths were below average. However, the age structure has remained stable in all surveys and many age-classes were contributing to the 1996 biomass index.

Biomass:





State of Stock: Based on 6 additional surveys since the 1996 assessment, the current view is that the stock size has increased since 1994 although the level of this increase could not be quantified. The stock is perceived to be lower than the levels of the 1980s.

Recommendation: The stock should be able to sustain a limited fishery in 1998. Scientific Council noted that any directed fishery for yellowtail flounder will result in a by-catch of American plaice and cod. A precautionary approach would be to limit the size of the yellowtail flounder fishery to minimize by-catches. Based on an average estimate of fully recruited age 7+ biomass from the autumn surveys of 1995 and 1996 and using the lowest exploitation rate (6%) on record from the commercial fishery, Scientific Council recommends that the TAC for 1998 not exceed 4 000 tons.

Scientific Council also recommends that this fishery should be carefully monitored and sampled. Scientific Council further recommends that such a fishery should take place only after the peak spawning period of June-July in 1998 to allow the full spawning potential of the stock to be realized. Because the stock size in Div. 3L is low, the fishery should be confined to the main component of the stock in Div. 3NO.

Sources of Information: SCR Doc. 97/25, 31, 71, 72; SCS Doc. 97/7.

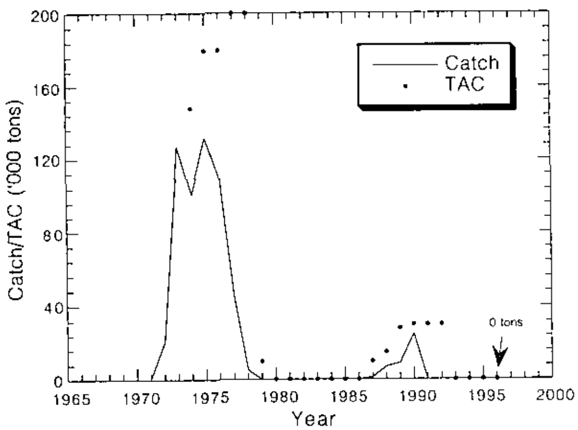
Capelin in Divisions 3N and 3O

Background: Spawning occurs in the area of the southeast shoal in Div. 3N.

Fishery and Catches: The fishery was closed during 1979-86 and again since 1993.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	Agreed
1994	+	0	0
1995	-	0	0
1996	-	0	0
1997	-	0	0

[1] Provisional.



Data: No recent data available.

Assessment: No assessment was possible without up-to-date information particularly on recruitment.

Recommendation: No advice possible.

Sources of Information:

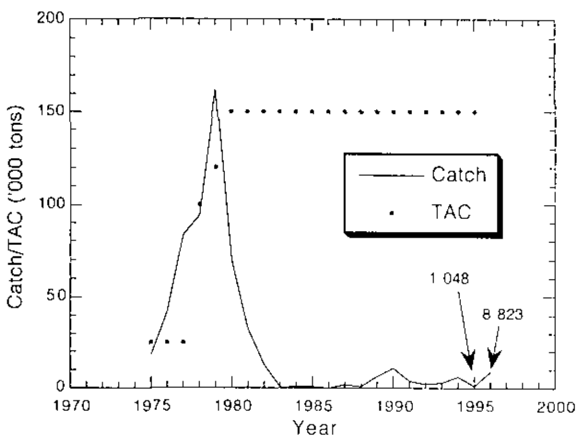
Squid in Subareas 3 and 4

Background: This stock extends to Subarea 6 and further south.

Fishery and Catches: Catches were taken mainly in Subarea 3 in 1996.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994	6.0	-	150
1995	1.0	-	150
1996	8.8	-	150

[1] Provisional.



Data: No recent data available.

Assessment: No assessment was possible without up-to-date information particularly on recruitment.

Recommendation: No advice possible.

Sources of Information:

Greenland Halibut in Subarea 2 and Divisions 3KLMNO

(see also Fisheries Commission requests in Agenda I in Part D, this volume, Annex 1, Item 9)

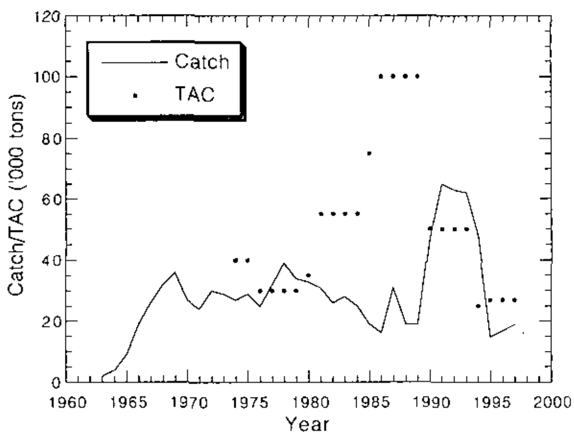
Background: The Greenland halibut stock in Subarea 2 and Div. 3KLMNO is considered to be part of a biological stock complex which includes Subareas 0 and 1.

Fishery and Catches: Catches increased sharply in 1990 due to a developing fishery in the Regulatory Area in Div. 3LMN and continued at high levels during 1991-94. The catch was only 15 000 tons in 1995, and 19 000 tons in 1996 as a result of lower TACs under new management measures introduced by the Fisheries Commission. This catch is 75% lower than the average of the previous 5 years. Canadian catches in 1992-96 were at the lowest levels since the fishery began in the 1960s.

Catches show best estimates, and range of possible estimates in brackets.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed[2]
1993	(42-62)	50	50
1994	(48-53)	-	25
1995	15	<40	27
1996	19	-	27
1997	-	-	27

[1] Provisional.
[2] Established autonomously by Canada in 1993-94 and NAFO Fisheries Commission in 1995-97.



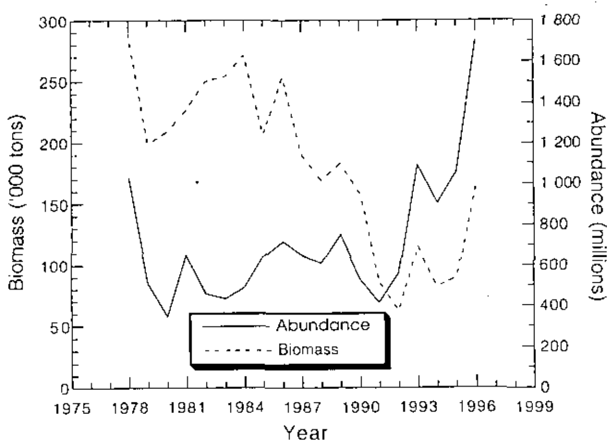
Data: CPUE data were available from otter trawl fisheries in Canadian zone and the Portuguese otter trawl fishery in the Regulatory Area of Div. 3LMN. Abundance and biomass indices were available from research vessel surveys of Canada, EU, Spain, Japan, and Russia. Two new surveys were available for Div. 2GH, and the Canadian autumn survey in 1996 covered most of the stock distribution.

Assessment: Analytical assessments are not available for this stock.

Fishing Mortality: Not precisely known, but believed to be above sustainable levels during 1990-94. Substantially lower in 1995-96 as a result of significant reductions in fishing effort.

Recruitment: The 1990 and 1991 year-classes were estimated to be better than average. Survey data suggest that the 1992-1995 year-classes may also be above average. However, additional estimates at older ages are necessary to establish confidence in these observations, particularly for the most recent year-classes.

Biomass:



State of the Stock: Available stock indicators in the current assessment (survey results and catch rates in commercial fisheries) suggest a significant decline in fishable stock size from the late-1980s up to 1995, particularly among the older age groups (10+). Most indices showed some improvement in 1996, primarily due to above average recruitment for all year-classes from 1990 to 1995. However, fishable biomass remains low.

Recommendation: The Council is unable to advise on a specific level of TAC for 1998. However, the TAC should not exceed the current level until it is clear that the fishable stock is increasing at that catch level. With the substantial reduction in F experienced in 1995-96 and anticipated in 1997, combined with improved recruitment prospects, this stock should continue to show signs of recovery over the next several years.

The Council reiterates its concern that the catches taken from this stock consist mainly of young, immature fish of ages several years less than that at which sexual maturity is achieved, thereby increasing the risk of over exploitation. It is noted also that such exploitation results in foregoing much potential yield. The Council again recommended that measures be considered to reduce, as much as possible, the exploitation of juvenile Greenland halibut.

Sources of Information: SCR Doc. 97/10, 16, 23, 25, 27, 28, 30, 34, 35, 36, 52; SCS Doc. 97/3, 4, 8, 9, 10.

Other Requests for Management Advice by the Fisheries Commission

The following are the responses to other requests by the Fisheries Commission:

i) **Stock Separation of Cod in Div. 2J+3KL and Proportion of Biomass of the Cod Stock in the Regulatory Area** (see Agenda I in Part D, this volume, Annex 1, Item 3) (SCR Doc. 97/57)

The Scientific Council was again requested to: *provide information, if available, on the stock separation in Div. 2J+3KL and the proportion of the biomass of the cod stock in Div. 3L in the Regulatory Area and a projection if possible of the proportion likely to be available in the Regulatory Area in future years. Information was also requested on the age composition of that portion of the stock occurring in the Regulatory Area.*

The stock separation issue has been reviewed previously (NAFO Sci. Coun. Rep., 1986) and it was then concluded that it was appropriate to assess cod in Div. 2J, 3K and 3L as a single stock complex. There is currently no additional information to change this conclusion. The general issue of stock definition is being addressed by research using a suite of genetic techniques (nuclear DNA gene probes). To date this work has been able to define distinct north-south differences within the Div. 2J+3KL stock complex. Work continues with goals of identifying inshore or bay stocks and other distinct populations in the offshore if they exist. The ability to identify distinct elements of the stock complex may have implications on how this stock is managed in the future.

Estimates of the proportion of the cod biomass in Div. 3L in the Regulatory Area were updated to include the 1996 research vessel survey data. It should be noted that the trawl used in the Canadian research vessel surveys changed in the autumn of 1995 from the Engel 145 to the Campelen 1800. Data presented have not been converted to Campelen equivalents. The gear change should result in an increase in the percentage of smaller cod. The results from autumn surveys showed biomass in 1994 in the Regulatory Area (9.7%) to be the highest in the time series. In the autumn of 1996 the estimate was 0.2% the lowest in the time series. The 1996 spring survey estimate was 2.4%, down from the 1994 estimate of 63%, the highest in the time series. The results from the survey series used are as follows:

Season RV survey conducted	Year RV survey conducted	Range of proportions of Div. 3L biomass occurring in the Regulatory Area (1996 value in brackets)	Average proportion (%)
Winter	1985-86	23.8-26.8	25.3
Spring	1977-96	0.4-63.1 (2.4)	10.7
Autumn	1981-96	0.2-9.7 (0.2)	3.2

The proportions observed are estimates for the months in which the surveys were conducted and may not represent distributions in non-surveyed months. Although only two winter surveys have been conducted, the proportion of biomass in the Regulatory Area at that time appeared to be substantially higher than at other times.

Results of the autumn surveys conducted in all three Divisions (2J, 3K and 3L) by Canada from 1981 to 1996, showed that the proportion of the cod stock in the Regulatory Area at that time of year was less than 1%, on average, of the total Div. 2J+3KL biomass. In the past, year-specific percentages ranged from 0.10% to a high of 1.52%, but these increased in recent years to 5.17% in 1993 and was 4.4% in 1994. In both 1995 and 1996 the proportion of the Div. 2J+3KL stock in the Regulatory Area was less than 1% and the total stock biomass was still at an extremely low level.

Survey data indicated that the proportion of total stock biomass occurring in the Regulatory Area was less than 10% in winter and less than 5% on average in spring and autumn.

The average breakdown of biomass by Division was as follows:

Division	Mean relative proportion of Div. 2J and 3KL biomass (%)	1996 Autumn %
2J	29	17
3K	33	25
3L	38	58

Age compositions derived from spring and autumn surveys in Div. 3L indicated that for most years there was a higher proportion of younger cod in the Regulatory Area. Estimates for winter surveys showed that age compositions were similar in both areas. Cod age compositions from autumn research vessel surveys combined for Div. 2J+3KL were similar to those which occurred in Div. 3L inside the 200-mile fishing zone.

ii) **Request on American Plaice**

With respect to the request from the Fisheries Commission on American plaice (see Agenda I in Part D, this volume, Annex I, Item 6), the Council was asked: *to carry out a thorough analysis of the time series of juvenile abundance and other relevant biological data of American plaice in Div. 3LNO and Div. 3M, with a view to assessing the possibility to reopen the fishery.*

a) **American Plaice in Divisions 3LNO**

The Council reviewed trawlable biomass and abundance from Canadian spring, autumn and juvenile surveys and surveys conducted by EU-Spain. Total mortality, age composition of the population and trends in recruitment were also examined.

Most indices suggest that the stock is at a low level. There has been no good recruitment since 1987 and total mortality is high. The population is made up mainly of fish less than 6 years of age. Based on the information reviewed there is no indication of stock improvement and therefore no basis for reopening the fishery.

b) **American Plaice in Division 3M**

The Council, reviewed the information on: landings (since 1974), age composition of the catches (since 1988), mean weight-at-age in the catch (since 1988), trawlable biomass from the surveys (since 1978), and trends in recruitment and SSB from the survey data (since 1988).

Although only 300 tons were caught during 1996, SSB and total biomass estimated from surveys continued to decline due to the very weak year-classes recruited to the stock since 1993. In 1996, Scientific Council advised there should be no directed fishery, and by-catch be kept at the lowest possible level. Based on the information reviewed, there is no indication of stock improvement and therefore no basis for reopening of the fishery.

iii) **Request on Cod in Division 3M**

With respect to the request from the Fisheries Commission on cod in Div. 3M (see Agenda I in Part D, this volume, Annex I, Item 7), the Council responded as follows:

The Council reviewed all available biological data on cod in Div. 3M, including results from surveys series of Russia (1983-1993 and 1995-1996) and the EU (1988-1996) and the Canadian survey in 1996. Commercial sampling catch results and several studies on feeding and length- and age-at-maturity were also considered.

All indices suggest that the stock is at an extremely low level and that all year-classes of 1992-95 are weak. The Council therefore advises that cod in Div. 3M should be closed to fishing in order to protect the remaining spawning stock and allow for rebuilding.

iv) **Request on Witch Flounder in Divisions 2J and 3KL**

With respect to Fisheries Commission request on the status of the Div. 2J+3KL witch flounder resource (see Agenda I in Part D, this volume, Annex 1, Item 8), the Council responded as follows:

The Scientific Council evaluated the status of the resource based on a Canadian assessment supplemented by some commercial by-catch fishery data from EU-Spain. Canadian survey data throughout Div. 2J, 3K and 3L (including the NAFO Regulatory Area) indicated that this stock had been declining rapidly since about 1984 and had now reached an extremely low level. According to results of the Canadian survey during the autumn of 1996 the stock had declined by about 95% compared to the 1981-84 average when the stock was stable.

An evaluation of distribution patterns indicated that during the late-1970s and early-1980s witch flounder were widely distributed throughout the continental shelf area in the deep channels around the fishing banks primarily in Div. 3K and a depth range of 200-500 m. By the mid-1980s, however, they were rapidly disappearing and by the early-1990s had virtually disappeared from this area entirely, except for some very small catches along the continental slope in southern Div. 3K. By autumn of 1996 they were mainly located (although in very low numbers) along the deep continental slope area in Div. 3L both inside and outside the Canadian 200-mile fishery zone. Most fish were caught in depths between 550-1 100 m with none observed between 1 100-1 500 m.

Based on the data examined here, the Scientific Council advises that from a biological perspective this stock should be treated as a single unit throughout the entire range of Div. 2J and 3KL and managed accordingly. The Scientific Council noted that this stock has been under moratorium in the Canadian zone since 1994 but has been unregulated in the NAFO Regulatory Area.

v) **Request on Greenland Halibut in Subarea 2 and Divisions 3KLMNO**

With respect to the Fisheries Commission request on Greenland halibut (see Agenda I in Part D, this volume, Annex 1, Item 9), the Council was asked: *to assess possible changes in yield and spawning stock biomass of Greenland halibut in Subarea 2 and Div. 3KLMNO based on the assumption of a dome-shaped exploitation pattern and a different age of maturity and mortality rates for males and females, for the following scenarios:*

a) the current situation, and
b) a minimum landing size of 60 cm,

the Council responded as follows:

In 1995 the Scientific Council analyzed the effect on yield and SSB of banning fishing before Greenland Halibut reached 60 cm while maintaining the present level of effort. The result suggested that the potential long term yield would increase three times and the SSB would be in the order 6-7 times higher.

The calculation assumed constant natural mortality by age, a *status quo* fishing mortality level derived from catch curves for sexes combined and a flat topped selection by age as well as the same growth by sexes.

In order to respond to the request, new analyses were performed based on the following assumptions:

- equal growth pattern for both sexes
- natural mortality to be constant for all age groups or higher for males older than 6-year-old
- exploitation pattern as flat topped and dome shaped

- spawning stock comprised of only females
- selection curve of 205 mm derived from the curve given for 130 mm
- no escapement mortality

The effect on long-term yield, SSB and effort needed to generate the yield at fishing mortality of $F_{0.1}$ are presented below as changes relative to 130 mm mesh, for each combination of natural mortality and partial recruitment options.

	130 mm mesh size		205 mm mesh size		205 mm mesh size relative to 130 mm mesh size		
	Y/R	SSB/R	Y/R	SSB/R	Y/R ratio	SSB/R ratio	effort ratio
FLAT							
M constant	507	1 646	665	2 236	1.31	1.36	1.15
M different	309	1 375	349	2 050	1.13	1.49	1.07
DOME							
M constant	343	1 338	530	1 665	1.55	1.24	2.19
M different	264	1 056	311	1 423	1.18	1.35	2.16

The result revealed how sensitive the estimated changes are to the assumptions in the analysis. The highest increase in yield is achieved when assuming dome shaped exploitation pattern and constant natural mortality, but the results are similar in magnitude for both options of natural mortality. When using 205 mm mesh size, and in the case of different natural mortality, the Y/R and the female SSB/R will increase by a factor of 1.2. If the exploitation pattern is dome shaped, the level of effort has to be doubled to reach the new reference of $F_{0.1}$ of the 205 mm mesh size in relation to the 130 mm mesh size. This brings about the long-term increases in Y/R ranging from 1.18 to 1.55 times, depending on the differences in natural mortality by sexes. If differences in natural mortality are the case, the expected long-term increase in Y/R does not exceed 18% and the SSB/R increase is between 35% and 49%.

The differences in effects compared to the 1995 result is partly due to the fact that the reference fishing mortality is lower than that used in the 1995 analysis and also influenced by the use of only females in the 1996 analysis for SSB/R. Larger effects can be expected at higher fishing mortalities. The results should be considered as tentative as the selection pattern used for 205 mm is not based on actual measurements and the analysis assumes no escapement mortality nor does it consider the effect of discarding.

The Scientific Council agreed that a dome shaped partial recruitment pattern in the trawl fishery and differences in mortality by sexes are the most likely scenario for Greenland halibut.

If the 60 cm minimum landing size is implemented and the mesh size is not changed, a high level of discards would occur in the fishery. Even with a change to the 205 mm mesh size, more than 50% of the catches would have to be discarded if the exploitation pattern was dome shaped and the natural mortality was different by sexes. However, the 60 cm length does not correspond to the length of 25% retention (L_{25}) of the 205 mm mesh size but corresponds to the length of 50% retention (L_{50}).

vi) **Ongoing request on Greenland halibut stock component**

In the past several years, the Fisheries Commission has asked for advice on the split of the TAC for Greenland halibut within the stock area into components for Subarea 2 + Div. 3K, and Div. 3LMNO. Prior responses to these requests indicated that until survey coverage was extended throughout the stock area, estimates of proportional distribution of biomass would not be available. In 1996, the Canadian autumn groundfish survey covered almost all of the stock range, although coverage in deepwater areas of Div. 2G and Div. 3O was minimal. This survey indicated that about 17% of the surveyed biomass was located in Div. 2GH, about 65% in Div. 2J+3K, and about 18% in Div. 3LMNO (SCR Doc. 97/52). About two-thirds of the estimated biomass was comprised of fish smaller than 36 cm, and the proportion of small fish in the biomass varied by Division.

b) **Precautionary Measures and Criteria for Reopening Fisheries**

The Scientific Council was requested by the Fisheries Commission (see Agenda I in Part D, this volume, Annex 1, Item 4) to: *comment on Article 6 [Application of the Precautionary Approach] and Annex II [Guidelines for Application of Precautionary Reference Points in Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks] of the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks; and provide the following information for the 1997 Annual Meeting of the Fisheries Commission, a report that includes for all stocks under the responsibility of the Fisheries Commission (i.e. cod in 3M and 3NO, American plaice in 3M and 3LNO, yellowtail flounder in 3LNO, witch flounder in 3NO, redfish in 3M and 3LN, Greenland halibut in SA 2+3, capelin in 3NO, shrimp in 3M and squid in SA 3+4):*

i) recommendation for the limit and target precautionary reference points described in Annex II indicating areas of uncertainty;

ii) information including medium term consideration and associated risk or probabilities which will assist the Commission to develop the management strategies described in paragraphs 4 and 5 of Annex II in the Agreement;

iii) information on the research and monitoring required to evaluate and refine the reference points described in paragraphs 1 and 3 in the Agreement Annex II; these research requirements should be set out in order of priority considered appropriate by the Scientific Council; and,

iv) any other aspect of Article 6 and Annex II of the Agreement which the Scientific Council considers useful for the implementation of the Agreement's provisions regarding the precautionary approach to capture fisheries.

An *ad hoc* Working Group of the Scientific Council was formed to develop a conceptual framework for the implementation of the precautionary approach in the NAFO context. The Working Group reported its findings to the Council in the form of SCS Doc. 97/12.

The Council, cognizant that a number of national and international meetings and initiatives have taken place in recent years focusing on the incorporation and application of the precautionary approach in fisheries management, conducted a review of how the precautionary approach - particularly the determination of precautionary reference points and harvest control rules - has been addressed within ICES, and by the USA and Canada. As a prelude to this review, the Council considered the relevant sections of various binding and non-binding agreements embodying the precautionary approach (i.e. the UN Agreement on the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks [*see Annex 1 and 2*]; the FAO Code of Conduct for Responsible Fisheries [*see Annex 3*]; the FAO Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions [*see Annex 4*]). As well, several other documents relating to overfishing definitions (Rosenberg *et al.*, 1994) and sustainable harvesting (FRCC, 1996) were also consulted.

The Scientific Council was also requested by the Fisheries Commission (see Agenda I in Part D, this volume, Annex 1, Item 5) to: *develop criteria to be evaluated during any consideration of possible fisheries reopenings.*

A. Review of Relevant Documentation

Several reports were reviewed and discussed by the Council relative to the Fisheries Commission requests. Highlights of each of these reports are summarized below:

The Council reviewed the following text obtained from the Updated Draft Report of *ICES Study Group on the Precautionary Approach to Fisheries Management* (ICES, MS 1997):

i) "The precautionary approach, sustainable development, rational exploitation and responsible fishing have been given a central place in international conferences and agreements devoted to the environment and fisheries... There can be no disagreement that sustainable, productive fisheries require management approaches which ensure a high probability of stocks being able to replenish themselves. Because of the inherent uncertainty in all aspects of fisheries management (assessment, regulation and enforcement), this can only be achieved by taking a precautionary approach. Such an approach needs to be adopted for all aspects of management, *'from planning through implementation, enforcement and monitoring to re-evaluation'* (FAO, 1995a, page 7), not just in the scientific basis for advice."

ii) Article 7.5 of the FAO Code of Conduct for Responsible Fisheries (FAO, 1995b), and Article 6 and Annex II of the UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN 1995) are of particular relevance in the interpretation of the precautionary approach. "These international instruments call for the following technical developments: (1) the determination of reference points, with a priority for limit reference points that define the constraints on long-term sustainability, both in theory and as applicable to each stock; (2) improvements in the methods for dealing with uncertainties, notably in relation to evaluating the risk of either approaching or exceeding the limit reference points; (3) the evaluation of how well alternative harvest control rules either maintain stocks in, or restore them to, healthy states. These developments come in addition to assessments of the size, productivity and state of the stocks, and to improved understanding of their biology, which constitute essential pre-conditions of progress in these new directions."

iii) The scientific advisory implications of the precautionary approach suggest that fisheries scientists should: "(1) explicitly consider and incorporate uncertainty about the state of the stocks into management scenarios; explain clearly and usefully the implications of uncertainty to fishery management agencies; (2) propose thresholds which ensure that limit reference points are not exceeded, taking into account existing knowledge and uncertainties; (3) encourage and assist fishery management agencies in formulating fisheries management and recovery plans. To do this effectively may require assisting fishery management agencies in the development of coherent, measurable objectives; (4) quantify and advise on the effects of fisheries on target and non-target species, and on biodiversity and habitats; (5) provide advice on fishing fleets and multispecies fisheries systems as well as on single stocks; and (6) evaluate fisheries management systems incorporating biological, social and economic factors as appropriate."

iv) Implementation of the precautionary approach has a number of significant implications for fishery management agencies and the fishing industry. Among these are: (1) most of the current fishery management regimes were established before the formulation of the precautionary approach and are not fully in accordance with the precautionary approach. Management agencies will therefore need to implement the precautionary approach to numerous aspects of current practice; (2) the precautionary approach requires that uncertainty be allowed for in both the understanding of the state of the stocks and the effects of future management actions. "This implies that when less is known, fishery management agencies should adopt a more cautious choice. This may require a change in culture towards a management approach less focused on and influenced by short-term considerations, and more concerned with long-term sustainability"; (3) all desirable management objectives cannot usually be met simultaneously and in the precautionary approach fishery management agencies would derive trade-offs between competing objectives in consultation with interested parties, and translate these into measurable factors such as levels of fishing mortality; (4) the way that fishery management agencies attempt to restrict and manage fisheries exploitation (e.g. TAC, effort controls, technical measures, etc.) has implications on the way scientific advice is provided and also for the quality of data acquired and the subsequent use of these data in assessments; "it should be obvious that the precision of the advice decreases when the quality of data deteriorates"; and (5) the precautionary approach requires that fishery management agencies find effective means to restrict fishing mortality within safe biological limits. If there are no means to effectively implement precautionary management advice, the advice itself cannot ensure resource sustainability.

v) Based on the distinctions between target and limit reference points given in Annex II of the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks (see Annex 2), reference points stated in terms of fishing mortality rates or biomass, or in other units, should be regarded as signposts giving information on the status of the stock in relation to predefined limits that should be avoided or targets that should be aimed at in order to achieve the management objective. "The introduction of the concept of limit reference points to be avoided with a high probability may in some cases complicate the utilization of target reference points, especially when the precision of the data is low and the uncertainties are high. In such cases, it may be necessary to aim for a fishing mortality rate lower than the target in order to ensure that the limit is not exceeded."

vi) A provisional list of reference points was developed (see Annex 5) which contains a number of reference points which could be considered as limit reference points. Limit reference points are to be avoided, thus the probability of exceeding these values must, by definition, be very low. Within ICES, the precautionary basis for advice given by ACFM will be that, for a given stock, the probability of exceeding the limit reference point will be no greater than 5% in any given year. This implies that ACFM must recommend that fishing mortality stays below a value considerably lower than the fishing mortality limit reference point. This type of upper bound on fishing mortality (which is significantly below the limit reference point) will be known as the precautionary fishing mortality (F_{pa}). When a fishery is managed such that the annual fishing mortality is at or below F_{pa}, there should be only a low probability that the realized fishing mortality is not sustainable. Similar considerations pertain to biomass limit reference points. Thus, a precautionary biomass level B_{pa} will be determined that is sufficiently higher than the limit biomass reference point to assure with high probability that stock biomass is far above the limit biomass level. Target reference points (either in terms of fishing mortality or biomass) should be more conservative than the precautionary reference points.

vii) Limit, precautionary, and target reference points should be stock specific. The distance between the precautionary reference point and the limit reference point will depend on the data available and their precision, as well as the uncertainties of other parameters such as the environment. The greater the uncertainties, the greater the need to be precautionary. Although some guidance on calculating reference points is provided in the Report, it will be the task of the ICES Methods Working Group to provide ICES Assessment Working Groups with complete guidelines for determining these limit and precautionary reference points.

viii) As part of the precautionary approach, control rules should be implemented which relate target and precautionary reference points to stock conditions. These rules can be formulated in terms of fishing mortality, fishing effort, and/or catch - and should be implemented as changes in catch or fishing mortality in relationship to changes in stock biomass. Such decision rules should be established at the outset so that any needed actions are specified in advance of the actual situation. More stringent conservation measures should be applied as stock status worsens. Recovery plans for rebuilding depleted stocks should have control rules to regulate fishing mortality and catches in a pre-agreed way as stock biomass increases. Rebuilding programs are most effective when large reductions in fishing mortality are implemented immediately, rather than when small reductions are phased in over long periods of time. Rebuilding generally proceeds more rapidly when exploitation patterns are improved at the same time. It may also be desirable to restore the stock to (1) a heterogeneous age structure to rebuild population fecundity and buffer against recruitment failure; and (2) a wide spatial distribution to spread risk at spawning over a broad range of environmental conditions.

The document titled '*The Evolution of Precautionary Approaches to Fisheries Management, with Focus on the United States*' (SCR Doc. 97/26), was also reviewed by the Council. The main points raised were:

i) The precautionary approach gained prominence as a result of the Rio Declaration and Agenda 21. Principle 15 of the Rio Declaration, formulated at the 1992 United Nations Conference on Environment and Development (UNCED), states that "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." Subsequently, the precautionary approach has been embodied in: (a) the 1995 FAO Code of Conduct for Responsible Fisheries; (b) the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas; and (c) the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and highly Migratory Fish Stocks. Annex II of the latter requires that target and limit reference points be used and stipulates that "Fishery management strategies shall ensure that the risk of exceeding limit reference points is very low" and target reference should not be exceeded on average. Paragraph 7 prescribes that the fishing mortality rate which generates MSY should be regarded as a minimum standard for limit reference points. This combination of requirements implies that fishing mortality should always be well below F_{MSY}. This is a significant departure from typical fisheries management practice where F_{MSY} is usually treated as a target (and often exceeded), rather than as a limit.

ii) A small number of organizations and nations have already adopted one or more aspects of the precautionary approach and/or have recently conducted studies aimed at interpreting/evaluating the approach as it applies to their fisheries. These include: CCAMLR (Convention for the Conservation of the Antarctic Marine Living Resources); IPHC (International Pacific Halibut Commission); Canada [see FRCC, 1996]; New Zealand; and Australia.

iii) In the United States, recent amendments (September 1996) to the Magnuson Act (the act which governs U.S. marine fishery management activities) have injected many elements of the precautionary approach into the management of marine fishery resources. The amended Act, renamed the Magnuson-Stevens Act, includes new definitions of overfishing, overfished, and optimum yield; requires the establishment of objective and measurable criteria for determining the status of a stock or stock complex; and mandates specific remedial action in the event that overfishing is occurring or if a stock or stock complex is overfished. Sustainability is a key theme in the Magnuson-Stevens Act. Optimum yield [defined as the amount of fish that will provide the greatest benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems] is now prescribed on the basis of MSY (it can never be greater than MSY). In the case of an overfished fishery, the new Act requires rebuilding to the MSY level. "Overfishing" is now defined as a fishing mortality rate that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. "Overfished" is defined as any stock or stock complex subjected to overfishing, or any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding. Thus, "overfished" stocks must be rebuilt.

iv) The Magnuson-Stevens Act further requires that each Fishery Management Plan (FMP) specify objective and measurable status determination criteria for identifying when the stocks or stock complexes covered by the FMP are overfished. A possible interpretation of this requirement is that the stock determination criteria contain two components: a maximum fishing mortality rate and a minimum stock size level. Since the Act mandates that overfished stocks be rebuilt to the MSY level, an MSY control rule will be required to prescribe limits on fishing mortality as a function of stock biomass [so that sustained application of the rules actually results in rebuilding to MSY]. Obviously, any such rule will also define the rate of rebuilding for all other stocks below the MSY level. Choosing an MSY control rule is the key because it establishes the maximum fishing mortality threshold and plays a role in defining the minimum stock size threshold. Given that OY can never be greater than MSY, the MSY control rule would also define an upper bound on any OY control rule that might be specified.

v) Management of the U.S. EEZ portion of the North Pacific (eastern Bering Sea, Aleutian Island Region and the Gulf of Alaska) is a example where the application of the precautionary approach has been very successful. In 1990, an objective and measurable definition of the overfishing level (OFL) was adopted which provided an upper limit on the amount of fish that could be harvested in any given year. Harvest control laws were implemented in 1996 which were organized in six tiers according to the types of data and information available for a given stock. However, irrespective of tier level, catch targets (ABC) are set well below the overfishing level (OFL) thereby maintaining a buffer between the overfishing level and the catch target. When a stock is above the biomass level associated with MSY (i.e. B_{MSY}), neither the ABC nor the OFL harvest rates varies with stock size. However, if the stock size falls below B_{MSY}, both the ABC and OFL harvest rates decrease linearly as a function of stock size, down to a value of zero at a very low stock size level (typically 5% of B_{MSY}). Although the absolute magnitudes of the ABC and OFL rates vary, the ratio between them remains constant. The minimum buffer between the two rates is established by setting the OFL harvest rate at the arithmetic mean (AM) of the probability density function of F_{MSY}, while capping the ABC harvest rate at the harmonic mean (HM). Since the HM is always less than the AM (and the ratio of the HM to the AM decreases as uncertainty increases), greater uncertainty always corresponds to greater caution - a highly desirable feature.

The Council next reviewed a document entitled '*Biological Reference Points Relevant to a Precautionary Approach to Fisheries Management: an Example for Southern Gulf Cod*' (SCR Doc. 97/77). The main points raised in this document were:

i) The precautionary approach guidelines contained in Annex II of the UN Straddling Stocks Agreement calls for the estimation of stock-specific fishing mortality and biomass reference points related to maximum sustainable yield (i.e. F_{MSY} and B_{MSY}). For many stocks, the necessary information to calculate these reference points is not available. Management strategies for these stocks have typically been based on yield-per-recruit (YPR) and spawning stock biomass per recruit (SSB/R) analyses, not stock/recruitment relationships or stock production models.

ii) Using data from the southern Gulf of St. Lawrence cod stock (NAFO 4TVn(N-A)), age-structured production modelling was conducted to estimate F_{MSY} and B_{MSY}, and to evaluate the effects of changes in size at age, partial recruitment at age, and uncertainty in the stock/recruitment relationship on reference points calculated from production models vs YPR models.

iii) Point estimates and median bootstrap estimates of F_{MSY} and B_{MSY} were virtually identical, at 0.23 and 207 000 tons, respectively. Ninety-five percent of the F_{MSY} estimates were between 0.153 and 0.359, while 95% of the B_{MSY} estimates were between 160 000 tons and 325 000 tons. Cumulative frequency distribution curves were calculated and displayed in the form of risk curves. Using these curves and adopting a risk averse approach to select a limit B_{MSY} with a low probability (20%) of exceeding the true B_{MSY} resulted in a B_{MSY} value of about 240 000 tons. Similarly using the same 20% rule to select a fishing mortality limit reference point that would have a low probability of exceeding the true value, resulted in a F_{MSY} of about 0.20.

iv) Management actions implied by changes in size at age or by partial recruitment at age would be quite different depending on whether production models or YPR models were being used. Decreases in size at age had little impact on $F_{0.1}$ [which remained relatively stable] but produced significant declines in F_{MSY} values suggesting that target fishing mortality rates should have been reduced based on the stock production modelling results. Similarly, YPR analyses were relatively insensitive to changes in the age of full recruitment but F_{MSY} markedly declined in the age-structured production analyses as age at full recruitment declined. However, these results need to be tempered by several of the assumptions used in the production analyses (i.e. a rather simple approach was used to estimate equilibrium stock biomass; a constant knife-edge maturity ogive was used; fecundity was assumed to be a simple function of weight).

A demonstration on '*FISHLAB: Software for fisheries evaluation and simulation*' was provided to the Council by John Casey, Lowestoft Laboratory, as this software might be of potential use in calculating precautionary reference points. FISHLAB, developed by M. Smith and L. Kell of the CEFAS Lowestoft Laboratory (UK), consists of a library of Excel and Visual Basic functions, as well as a wide variety of statistical functions, fisheries assessment functions, fisheries prediction functions, and fisheries simulation and evaluation functions. The software is presently available free of charge from the developers.

A document entitled '*Biological Reference Points for New Zealand Fisheries Assessments*' (Mace and Sissenwine, 1989), was brought to the attention of the Council as a possible aid in developing approaches to determining limit and target reference points in both data-rich and data-poor circumstances.

Finally, the experience of the Fisheries Resource Conservation Council (FRCC) in developing criteria for re-opening fisheries was reviewed by the Council (FRCC, 1996). In recent years, the FRCC has been pursuing a process of deliberation and consultation on when and how to re-open fisheries which presently are closed. A detailed account of this process is given in the October 1996 FRCC report '*Building the Bridge – 1997 Conservation Requirements for Atlantic Groundfish*' (FRCC, 1996). As background for the FRCC consultations, a list of stock status indicators was developed to characterize the status, growth potential, and exploitability of a stock (e.g. total biomass; spawning biomass; recruitment; growth; stock age composition; geographical distribution; fish condition factor; physical environment; etc).

There was agreement that any indicators used for decision-making should be (a) simple; (b) reliable; and (c) and widely understood. Indicators which relate directly to stock abundance (biomass, recruitment, age structure) were considered to be more closely linked to stock status than indicators such as habitat or condition factor. Indicators which were easy to calculate and evaluate were desirable to minimize the time lag between information acquisition and decision-making in order for decisions to be made soon enough to have the most impact. It was also recognized all participants in the fishery should be able to understand how indicator values are derived and concur on the utility and reliability of these values.

Once stock status indicators have been identified which satisfy the requirements of clarity, simplicity, and reliability, the question remains how to use them in considering a decision to re-open a fishery. The FRCC acknowledged that the precautionary approach must be used to ensure that fisheries are only re-opened when there is sufficient certainty that (1) fish stocks are in good enough shape; and (2) the re-opened fishery can operate in a conservationist manner, keeping fishing mortality to a low enough level. The FRCC noted that it was "crucial that BOTH of these conditions be satisfied".

A review of the stock conditions that prompted fishery closures indicated that the following conditions generally prevailed at the time of closure:

a) Low stock size (e.g. declining trends followed by lowest survey estimates record);
b) Low recruitment;
c) Low growth, as evidenced by declines in mean weight-at-age in catch and survey samples;
d) Low fish condition, a measure of the physiological state of individual fish which may be important for their reproductive capacity;
e) Loss of spawning components (for some stocks);
f) Contraction of geographical distribution; and
g) Changes in migration patterns.

Given that re-opening of a fishery should not occur until stock conditions have significantly improved from those that existed at the time of closure, an evaluation of stock status indicators is required ("the report card") to decide, guided by the precautionary principle, whether such improvements have occurred for any given stock. For the FRCC discussions, the "half-way point", midway between the low level that existed when the fishery was closed and the average level (over a recent period), was selected as the benchmark level indicative of sufficient improvement.

For each stock status indicator, the "report card" compares past and current values and depicts these in relation to the "half-way point". This framework provides a simple approach to define conditions (criteria) that might be used in decisions to re-open fisheries.

While "reference points or conditions at closure" are NOT a substitute for long-term reference points based on stock dynamics, they serve to capture the conditions that necessitated closure. In essence, they constitute valuable guideposts that - in the context of the Precautionary Approach - delimitate danger zones to be avoided in the future.

B. Endorsement of the Precautionary Approach by the Scientific Council

After reviewing the development, evolution and application of the precautionary approach in fisheries management, the Scientific Council **endorsed** the precautionary approach as described in Article 6 and Annex II of the UN Agreement of the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (i.e. *Annex 1 and 2*). In addition, the Council intends to use the practical guidance given in FAO 1995a (Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions; see *Annex 4* for the precautionary guidelines elaborated for fishery research) on how to exercise such precaution.

The Council recognizes that implementation of the precautionary approach will be a challenging and ongoing process. To address this challenge in a rigorous and objective fashion, the Council has initiated development of a framework and action plan, and arranged for a *Scientific Council Workshop on the Precautionary Approach to Fisheries Management.* This Workshop, to be chaired by the Chairman of the Scientific Council, will meet during 17-27 March 1998 in Dartmouth, Nova Scotia, to address the following terms of reference:

1. Describe procedures for determining limit and target reference points under various levels of stock-specific information,

2. determine the limit and target precautionary reference points for all stocks under the responsibility of the NAFO Fisheries Commission (i.e. cod in Div. 3M and Div. 3NO, American plaice in Div. 3M and Div. 3LNO, yellowtail flounder in Div. 3LNO, witch flounder in Div. 3NO, redfish in Div. 3M and Div. 3LN, Greenland halibut in SA 2+3, capelin in Div. 3NO, shrimp in Div. 3M and squid in SA 3+4),

3. specify decision rules (e.g. courses of action to achieve target reference points and to avoid exceeding limit reference points,

4. develop criteria to be used in consideration of possible fisheries re-openings,

5. identify data collection and monitoring activities required to reliably evaluate resource status with respect to reference points,

6. define research requirements to improve the quantification and evaluation of uncertainty (i.e. risk analysis) as well as methodological developments required to reduce uncertainty, and

7. indicate time frames and funding required to successfully implement the precautionary approach.

C. General Principle of the Precautionary Framework

The Scientific Council, recognizing the need to apply the precautionary approach in providing scientific advice, proposes the following provisional framework. This framework prescribes the requisite actions to be taken for controlling fishing mortality in relation to various levels of spawning stock biomass and pre-determined, stock-specific reference points.

Paragraph 7 of Annex II of the UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (see *Annex 2*) states that:

> "*The fishing mortality rate which generates maximum sustainable yield should be regarded as a minimum standard for limit reference points. For fish stocks which are not overfished, fishery management strategies shall ensure that fishing mortality does not exceed that which corresponds to maximum sustainable yield, and that the biomass does not fall below a predefined threshold. For overfished stocks, the biomass which would produce maximum sustainable yield can serve as a rebuilding target.*"

Given these guidelines, the Scientific Council framework defines three reference points for biomass and three reference points for fishing mortality, *viz*:

Biomass Reference Points

B_{lim} The level of spawning stock biomass that the stock should not be allowed to fall below.

B_{buf} A level of spawning stock biomass, above B_{lim}, that acts as a buffer to ensure that there is a high probability that B_{lim} is not reached. The more uncertain the estimate of B_{lim} is, the higher the value of B_{buf}, and the greater the distance between B_{lim} and B_{buf}. When B_{buf} is reached, immediate action is required to ensure stock rebuilding.

B_{tr} The target recovery level. In accord with Annex II of the UN Agreement of the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, for overfished stocks this is the total stock biomass level which would produce maximum sustainable yield (MSY).

Fishing Mortality Reference Points

F_{lim} The rate of fishing mortality that should not be exceeded. In accord with Annex II of the UN Agreement of the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, this level can be no higher than the fishing mortality rate which generates MSY.

F_{buf} A fishing mortality rate below F_{lim} that acts as a buffer to ensure that there is a high probability that F_{lim} is not reached. As such, on average, F_{buf} should not be exceeded. The more uncertain the estimate of F_{lim} is, the lower the value of F_{buf}, and the greater the distance between F_{lim} and F_{buf}.

F_{target} The target fishing mortality depending on management objectives. This is a level below or equal to F_{buf}.

The general, overall objectives of the precautionary approach to management may then be summarized as follows:

1. Ensure that spawning stock biomass (SSB) is well above the buffer level (B_{buf}) [which by definition is above the biomass limit reference point (B_{lim})];

2. Maintain fishing mortality such that, on average, it does not exceed F_{buf}, and which will allow the stock to increase towards B_{tr} and ultimately be maintained at B_{tr} level.

These objectives may be defined in shorthand as follows:

1. Ensure $SSB >> B_{buf} > B_{lim}$
2. Maintain $F_{target} <= F_{buf} < F_{lim}$

Schematically, this framework is portrayed in Figure 1 which depicts the courses of action to be taken for given combinations of fishing mortality (F) and stock spawning stock biomass (B). Spawning stock biomass is represented on the horizontal axis; the three vertical arrows represent the biomass reference points described above. These reference points divide the figure into 4 biomass regions - labelled from left to right as **Collapse**, **Danger Zone**, **Recovery Zone**, and **Recovered Zone**. The level of fishing mortality is shown on the vertical axis; three zones are delimited by the $\mathbf{F_{lim}}$ and $\mathbf{F_{buf}}$ fishing mortality reference points; these are labelled **Overfishing Zone**, **F-buffer Zone** and **F-target Zone**.

Within each of the joint biomass/fishing mortality zones depicted in Figure 1, a specific course of action is specified by reference to a numerical label from 1 to 4. The courses of action corresponding to these numeric labels are given below:

Course of Action 1

Current Stock Status:	At or above B_{buf}
Current F:	Below F_{buf}
Action:	Continue to fish below F_{buf}.

Course of Action 2

Current Stock Status:	At or above B_{tr}
Current F:	Above F_{buf}
Action:	Reduce F to F_{buf} or below over a predetermined time horizon

Course of Action 3

Current Stock Biomass:	Below B_{tr}; above B_{buf}
Current F:	Above F_{buf}

Action: Reduce F towards F_{buf} or below so as to ensure B increases towards B_{tr} over a predetermined time horizon. Note that F_{buf} is lower in the recovery zone than in the recovered zone.

Course of Action 4

Current Stock Biomass:	Below B_{buf}
Current F:	Level not relevant
Action:	Close fishery; initiate precautionary monitoring of stock, with a view to re-opening the fishery only when predetermined re-opening criteria are satisfied.

D. Determination of Precautionary Reference Points with Respect to Data Availability and Data Quality

The reference points for biomass and fishing mortality should be selected in accordance with the precautionary approach framework (as described above). The specific reference metric, however (as given in Annex 5), may vary according to the quantity and quality of the data available for a given stock. As well, the quantification of uncertainty associated with the reference points will vary with data quality and quantity.

Therefore, the association of the three precautionary reference points ($_{lim}$, $_{buf}$, and $_{tr}$) with the appropriate candidate metrics must take account of the available data. The following discussion illustrates the derivation of each precautionary reference point with respect to three levels of data richness - from very rich (e.g. age-structured population model) to very poor (only catch and/or survey data).

The three levels of information considered, each with a varying amount of richness, are given below.

Level 1: Data-Rich Environment. Age-structured population model incorporating catch at age with auxiliary information provides reliable estimates of current F, recruitment, and biomass. The uncertainty of the limit and threshold reference points, and the risk of exceeding thresholds is determined. Limit reference points may be derived from production models, stock-recruitment analyses, and yield and spawning stock biomass per recruit analyses. The uncertainty associated with estimates of current F and biomass may be derived from the precision of annual population parameter estimates. The reference points, F_{buf} and B_{buf} are defined in relation to F_{lim} and B_{lim}, respectively; the difference between the limit and the buffer reference point is a function of the uncertainty associated with annual estimates of F and biomass.

As examples, the following candidate measures may be used to determine limit reference points:

$$F_{lim} = (F_{MSY}, F_{max}, F_{med})$$
$$F_{buf} = F_{lim}e^{-2s}$$
$$B_{lim} = (MBAL, B_{loss})$$
$$B_{buf} = B_{lim}e^{+2s}$$
$$B_{tr} = B_{MSY}$$

Level 2: Data-Moderate Environment. Non-age-structured (production) population model with auxiliary information provides reliable estimates of current biomass. Information on exploitation pattern, growth and natural mortality are available. Limit reference points may be derived from production models, relative stock-recruitment analyses (based on survey data) and yield and spawning stock biomass per recruit analyses. The uncertainty associated with estimates of current F and biomass may be not be available. Biomass trends and recruitment patterns may be derived from research vessel surveys.

As examples, the following candidate measures may be used to determine limit reference points:

$$F_{lim} = (F_{MSY}, F_{max}, F_{30\%})$$
$$F_{buf} = (M, 0.5*F_{MSY})$$

$$B_{lim} = B_{loss}$$
$$B_{buf} = 2/3\ B_{MSY}$$
$$B_{tr} = B_{MSY}$$

Level 3: Data-Poor Environment. Information on catch trends is available with some auxiliary information. Information on exploitation pattern, and growth may not be available. Limit reference points may be derived from relative stock-recruitment analyses (based on survey data). Estimates of current F and biomass as well as the uncertainty associated with these estimates are not likely to be available. Biomass trends and recruitment patterns may be derived from research vessel surveys.

As examples, the following candidate measures may be used to determine limit reference points:

$$F_{lim} = F_{30\%}\ \text{SPR}$$
$$F_{buf} = M$$

$$B_{lim} = 0.2 * B_{max}\ \text{(survey index)}$$
$$B_{buf} = 0.5 * B_{max}\ \text{(survey index)}$$

The Scientific Council evaluated various reference points applicable to each stock for which advice was requested. Results were collated and are summarized in Table 1. Data for each stock were collected using the data forms presented in Tables 2 and 3. Results for each stock in the NAFO Regulatory Area are given in SCS Doc. 97/12.

Reference points vary among stocks, depending on information richness. For those stocks under moratorium (e.g. Div. 3NO cod, Div. 3LNO plaice and Div. 3LNO yellowtail flounder), biomass indices are given in terms of survey biomass estimates. Similar treatment was used in the derivation of precautionary reference points for stocks where fisheries are open but where data are minimal (e.g. Div. 3M cod, Div. 3M redfish, and Div. 3LN redfish).

E. Action Plan for the Development of a Framework on the Precautionary Approach

The Scientific Council proposes the following action plan for implementing the Precautionary Approach to Fisheries Management for stocks in the NAFO Regulatory Area.

June 1997

At its June Meeting, the Scientific Council: (a) reviewed the evolution and application of the precautionary approach in fisheries management throughout the world; (b) developed a draft framework for consideration by the NAFO Fisheries Commission; and (c) identified possible candidates for limit and target reference points.

Summer 1997

ICES Comprehensive Fisheries Evaluation (COMFIE) Working Group Meeting. Members of STACFIS and the Scientific Council will work by correspondence to review the results of the ICES COMFIE WG meeting and evaluate the applicability of various precautionary reference points for stocks in the NAFO Regulatory Area.

September 1997

At the September 1997 meeting of the Fisheries Commission, the Chairman of the Scientific Council will propose that the Fisheries Commission: (a) adopt the draft framework for implementation of the Precautionary Approach; (b) note the Action Plan developed during the June 1997 Meeting of the SC meeting; and (c) note the *Scientific Council Workshop on the Precautionary Approach to Fisheries Management* in March 1998.

September 1997 (and/or November 1997)

Scientific Council to discuss the draft framework for implementing the Precautionary Approach with respect to shrimp stocks in the NAFO area.

September 1997

ICES Annual Science Conference (Baltimore, USA). The 1997 ICES Annual Science Conference will include a Theme Session (Session V) on the "Application of the Precautionary Approach in Fisheries and Environmental Management". Members of STACFIS and the SC take note of the information discussed at this Session, and review these findings at the March 1998 *Scientific Council Workshop on the Precautionary Approach to Fisheries Management.*

March 1998

Scientific Council Workshop on the Precautionary Approach to Fisheries Management - 17-27 March 1998 in Dartmouth, Nova Scotia, Canada. The NAFO Secretariat will finalize the venue.

June 1998

Meeting of the Scientific Council. The Council will implement the Precautionary Approach in formulating advice for 1999 for stocks in the NAFO Regulatory Area and specify precautionary reference points wherever possible.

September 1998

Meeting of the Fisheries Commission. The Chairman of the Scientific Council will table a report at the September 1998 meeting of the Fisheries Commission entitled "Framework for Implementing the Precautionary Approach to Fisheries Management within NAFO".

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TABLE 1. Possible candidates for reference points under the Precautionary Framework for stocks under the responsibility of the NAFO Fisheries Commission.

Source	Reference Point	Cod - 3M	Cod - 3NO	Plaice - 3M	Plaice 3LNO	Yellowtail - 3LNO	Witch - 3NO	Redfish - 3M	Redfish - 3LN	G. halibut - 2+3LMNO	Capelin - 3NO	Squid - 3-4	Shrimp - 3M
Catches	**% LTA**						P	P	P		P	P	P
Indices	B_{loss}	L	L	L	L	L	L		L	L			
	% Max. (e.g. 20%)	L	L	L	L	L	L		L	L			
	% Max. (e.g. 50%)	T	T	T	T	T	T		T	T			
	$B_{at\ closure}$		L	L	L	L	L						
	$R_{at\ closure}$		L	L	L	L	L						
Y/R	$F_{0.1}$	T	T		T	T		T	T	T			
	F_{max}	L	L		L	L		L	L	L			
	Age at F_{max}	L	L		L	L		L	L	L			
SSB/R	$F_{\%\ SPR\ (e.g.\ 20\%)}$	L	L		L	L				L			
	$B_{\%\ Bvirgin\ (e.g.\ 20\%)}$	L	L		L	L				L			
S/R plot	F_{low}	T	T		T	T							
	F_{med}	L	L		L	L							
	F_{high}	L	L		L	L							
	F_{loss}	L	L		L	L							
	MBAL	L	L		L	L							
S/R model	$B_{\%\ R\ (e.g.\ 50\%)}$	?	?		?								
Production	B_{MSY}	T	T		T	T				T			
	F_{MSY}	L	L		L	L				L			
	2/3 F_{MSY}	T	T		T	T				T			
	F_{crash}	L	L		L	L				L			
Other	**Geographic range**	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Migration pattern	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Spawning season	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Loss of component	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Age/size structure	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Maturity	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Fish condition	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Environment	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	

P = Provisional Reference Point; L= Limit Reference Point; T= Target Reference Point; Q= Qualitative Consideration

Footnote: These candidates for precautionary reference points are provided here as examples only of the types of reference points that could be provided; this list is not meant to be all encompassing. For shrimp in 3M, candidates for reference points are to be identified at the fall assessment meeting.

TABLE 2. Sample form to summarize available data on various stock status indicators that may be useful in determining reference points.

STOCK

Indicator		Long-Term Average (19 - 19)	Max/Min Values & Years		Status at Closure (19)	Present Status (19)	Comments on Stock Status
			Max (19)	Min (19)			
Calculated Indicators from last analytical assessment (19)	Total Biomass (mt)						
	Spawning Biomass (mt) (Age +)						
	Recruitment Levels Age ; Millions of Fish						
Data from Scientific Surveys (Mean #/wt Per Tow)	Total Abundance Index (#/tow)						
	Total Biomass Index (wt/tow)						
	Recruitment Index (#/tow) Age ;						
Changes in Spatial/Temporal Distributions of the Stock and/or Fishery							
Changes in Recruitment Levels or Indices							
Changes in Catch Age/Size Composition							
Changes in Fishery Exploitation Pattern							
Changes in Survey Age/Size Composition							
Changes in Natural Mortality Rate							
Changes in Diet and Feeding Patterns							
Changes in Prey and/or Predator Abundance							
Changes in Average Size Length/Weight at Age							
Changes in Average Length/Age at Maturity							
Changes in Spawning Patterns (Time/Duration/Area)							

TABLE 3. Sample form to list data availability for calculation of reference points.

Stock:

Designated Expert:

Data available for stock assessments

Commercial fishery data	Data available now	Data available some time ago	Year data/assessment
Landings			
Catch			
Effort			
CPUE			
Catch-at-length			
Catch-at-age			
Weight-at-age			
Maturity-at-age			
Survey data			
Abundance indices			
Biomass indices			
Density index (e.g. mean CPUE)			
Length composition			
Age composition			
Weight-at-age			
Maturity data			
Length-weight conversion factor			

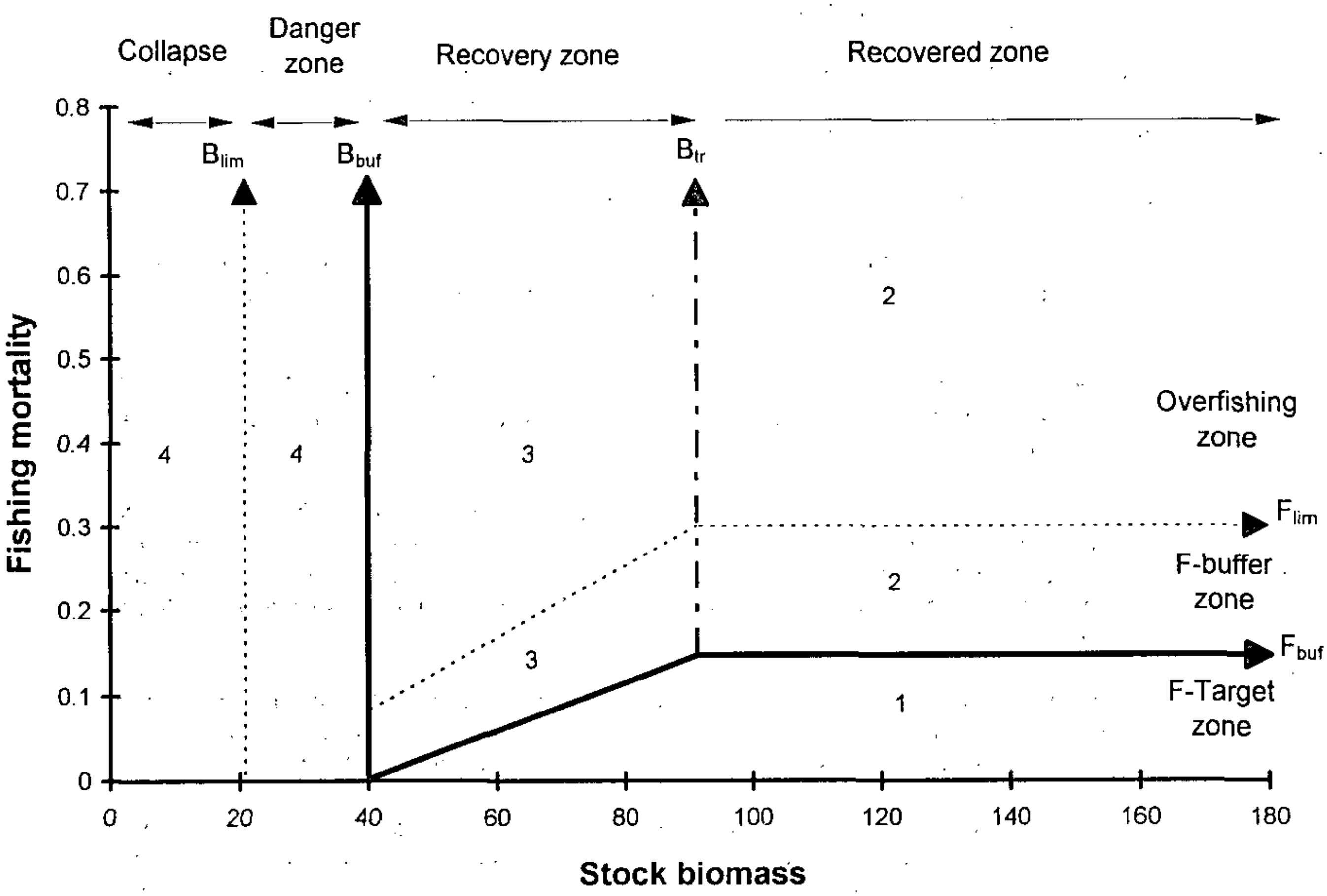


Fig. 1. Schematic of the framework for implementation of the precautionary approach.

ANNEX 1

UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (Article 6. Application of the Precautionary Approach)

"1. States shall apply the precautionary approach widely to conservation management and exploitation of straddling fish stocks and highly migratory fish stocks in order to protect the living marine resources and preserve the marine environment.

2. States shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.

3. In implementing the precautionary approach, States shall:

   (a) improve decision-making for fishery resource conservation and management by obtaining and sharing the best scientific information available and implementing improved techniques for dealing with risk and uncertainty;

   (b) apply the guidelines set out in Annex II and determine, on the basis of the best scientific information available, stock-specific reference points and the action to be taken if they are exceeded;

   (c) take into account, *inter alia*, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities on non-target and associated or dependent species, as well as existing and predicted oceanic, environmental and socio-economic conditions; and

   (d) develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment, and adopt plans which are necessary to ensure the conservation of such species and to protect habitats of special concern.

4. States shall take measures to ensure that, when reference points are approached, they will not be exceeded. In the event that they are exceeded, States shall, without delay, take the action determined under paragraph 3 (b) to restore the stocks.

5. Where the status of target stocks or non-target or associated or dependent species is of concern, States shall subject such stocks and species to enhanced monitoring in order to review their status and the efficacy of conservation and management measures. They shall revise those measures regularly in the light of new information.

6. For new or exploratory fisheries, States should adopt as soon as possible cautious conservation and management measures, including *inter alia*, catch limits and effort limits. Such measures should remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment shall be implemented. The latter shall, if appropriate, allow for the gradual development of the fisheries.

7. If a natural phenomenon has a significant adverse impact of the status of straddling fish stocks or highly migratory fish stocks, States shall adopt conservation and management measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impact. States shall also adopt such measures on an emergency basis where fishing activity presents a serious threat to the sustainability of such stocks. Measures taken on an emergency basis shall be temporary and shall be based on the best scientific evidence available."

ANNEX 2

UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (ANNEX II. Guidelines for the Application of Precautionary Reference Points in Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks)

"1. A precautionary reference point is an estimated value derived through an agreed scientific procedure, which corresponds to the state of the resource and of the fishery, and which can be used as a guide for fisheries management.

2. Two types of precautionary reference points should be used: conservation, or limit, reference points and management, or target, reference points. Limit reference points set boundaries which are intended to constrain harvesting within safe biological limits within which the stocks can produce maximum sustainable yield. Target reference points are intended to meet management objectives.

3. Precautionary reference points should be stock-specific to account, *inter alia*, for the reproductive capacity, the resilience of each stock and the characteristics of fisheries exploiting the stock, as well as other sources of mortality and major sources of uncertainty.

4. Management strategies shall seek to maintain or restore populations of harvested stocks, and where necessary associated of dependent species, at levels consistent with previously agreed precautionary reference points. Such reference points shall be used to trigger pre-agreed conservation and management action. Management strategies shall include measures which can be implemented when precautionary reference points are approached.

5. Fishery management strategies shall ensure that the risk of exceeding limit reference points is very low. If a stock falls below a limit reference point or is at risk of falling below such a reference point, conservation and management action should be initiated to facilitate stock recovery. Fishery management strategies shall ensure that target reference points are not exceeded on average.

6. When information for determining reference points for a fishery is poor or absent, provisional reference points shall be set. Provisional reference points may be established by analogy to similar and better-known stocks. In such situations, the fishery shall be subject to enhanced monitoring so as to enable revision of provisional reference points as improved information becomes available.

7. The fishing mortality rate which generates maximum sustainable yield should be regarded as a minimum standard for limit reference points. For stocks which are not overfished, fishery management strategies shall ensure that fishing mortality does not exceed that which corresponds to maximum sustainable yield, and that the biomass does not fall below a predefined threshold. For overfished stocks, the biomass which would produce maximum sustainable yield can serve as a rebuilding target."

ANNEX 3

FAO Code of Conduct for Responsible Fisheries
(Article 7.5 Precautionary Approach)

Paragraph 7.5.1: States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures.

Paragraph 7.5.2: In implementing the precautionary approach, States should take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities, including discards, on non-target and associated and dependent species as well as environmental and socio-economic conditions.

Paragraph 7.5.3: States and subregional or regional fisheries management organizations and arrangements should, on the basis of the best scientific evidence available, *inter alia*, determine:

a) stock specific target reference points, and, at the same time, the action to be taken if they are exceeded; and

b) stock specific limit reference points and, at the same time, the action to be taken if they are exceeded; when a limit reference point is approached, measures should be taken to ensure that it will not be exceeded.

Paragraph 7.5.4: In the case of new or exploratory fisheries, States should adopt as soon as possible cautious conservation and management measures, including, *inter alia*, catch limits and effort limits. Such measures should remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment should be implemented. The latter should, if appropriate, allow for the gradual development of the fisheries.

Paragraph 7.5.5: If a natural phenomenon has a significant adverse impact of the status of living aquatic resources, States should adopt conservation and management measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impact. States should also adopt such measures on an emergency basis where fishing activity presents a serious threat to the sustainability of such resources. Measures taken on an emergency basis should be temporary and should be based on the best scientific evidence available.

Article 12 Fisheries Research

Paragraph 12.13: States should promote the use of research results as a basis for the setting of management objectives, reference points and performance criteria, as well as for ensuring adequate linkage between applied research and fisheries management.

ANNEX 4

Precautionary Approach to Fisheries
Part 1: Guidelines on the precautionary approach to capture fisheries and species introductions (FAO Fisheries Technical Paper No. 350, Part 1. Rome, FAO. 1995, 52 p.)

Section 4. Precautionary Approach to Fishery Research

51. Application of the precautionary approach to fishery management depends on the amount, type and reliability of information about the fishery and how this information is used to achieve management objectives. The precautionary approach to fishery management is applicable even with very limited information. Research to increase information about a fishery usually increases potential benefits while reducing the risk to the resource. The scientific and research input that is required for the precautionary approach to fisheries is considered under the following headings; management objectives, observations and information base, stock assessment and analysis and decision processes.

Section 4.1 The Role of Research in Establishing Management Objectives

52. There is a valid scientific role in helping managers develop objectives, so that scientific input to the overall management process is as effective as possible in achieving management intent. The precautionary approach requires continuing and anticipatory evaluation of the consequences of management actions with respect to management objectives. Scientific evaluation of consequences with respect to management objectives requires explicit definition of quantifiable criteria for judgement. An important scientific contribution is in the development of operational targets, constraints and criteria that are both scientifically usable and have management relevance.

53. Research is required to help formulate biological objectives, targets and constraints regarding the protection of habitat, the avoidance of fishing that significantly reduces population reproductive capacity, and reduces the effects of fishing on other (e.g. non-target) species. Combined with biological research, research on socio-economics and the structure of fishing communities is needed to formulate management objectives.

54. Until stock specific research leads to the establishment of alternative operational target based on research and practical experiences, a precautionary approach would seek to: (a) maintain the spawning biomass at a prudent level (i.e. above 50% of its unexploited level), (b) keep the fishing mortality rate relatively low (i.e., below the natural mortality rate), (c) avoid intensive fishing on immature fish, (d) protect the habitat.

Section 4.2 Observation Processes and Information Base

55. A precautionary approach to fisheries requires explicit specification of the information needed to achieve the management objectives, taking account of the management structure, as well as of the processes required to ensure that these needs are met. Periodic evaluation and revision of the data collection system is necessary.

56. A precautionary approach would include mechanisms that ensure that, at a minimum, discarded catch, retained catch and fishing effort are accurate and complete. These mechanisms could include use of observers and identification of incentives for industry co-operation.

57. Recognizing that resource users have substantial knowledge of fisheries, a precautionary approach makes use of their experience in developing an understanding of the fishery and its impacts.

58. The precautionary approach is made more effective by development of an understanding of the sources of uncertainty in the data sampling processes, and collection of sufficient information to quantify this uncertainty. If such information is available it can be explicitly used in the management procedure to estimate the uncertainty affecting decisions and the resulting risk, If such information is not available, a precautionary approach to fishery management would implicitly account for the unknown uncertainty by being more conservative.

59. Precautionary fishery monitoring is part of the precautionary approach. It includes collection of information to address issues and questions that are not only of immediate concern but which may reasonably be expected to be important for future generations in case objectives are changed. Information should be collected on target

species, by-catch, harvesting capacity, behaviour of the fishery sector, social and economic aspects of the fishery, and ecosystem structure and function. Measures of resource status independent of fishery data are also highly desirable.

60. The precautionary approach relies on the use of a history of experience with the effects of fishing, in the fishery under consideration and/or similar fisheries, from which possible consequences of fishing can be identified and used to guide future precautionary management. This requires that both data and data collection methods are well documented and available.

61. There are many management processes and decision structures used throughout the world, such as regional management bodies, co-management, community-based management, and traditional management practices. Research is need to determine the extent to which different management processes and decision structures promote precaution.

Section 4.3 Assessment Methods and Analysis

62. Biological reference points for overfishing should be included as part of the precautionary approach.

63. A precautionary approach specifically requires a more comprehensive treatment of uncertainty than is the current norm in fishery assessment. This requires recognition of gaps in knowledge, and the explicit identification of the range of interpretations that is reasonable given the present information.

64. The use of complementary sources of fishery information should be facilitated by active compilation and scientific analysis of the relevant traditional information. This should be accompanied by the development of methods by which this information can be used to develop management advice.

65. Specifically the assessment process should include:

   a) scientific standards of evidence (objective, verifiable and potentially replicable), should be applied in the evaluation of information used in analysis;

   b) a process for assessment and analysis that is transparent, and

   c) periodic, independent, objective and in-depth peer review as a quality assurance.

66. A precautionary approach to assessment and analysis requires a realistic appraisal of the range of outcomes possible under fishing and the probabilities of these outcomes under different management actions. The precautionary approach to assessment would follow a process of identifying alternative possible hypotheses or states of nature, based on the information available, and examining the consequences of proposed management actions under each of these alternative hypotheses. This process would be the same in data-rich and data-poor analyses. A precautionary assessment would, at the very least, aim to consider: (a) uncertainties in data; (b) specific alternative hypotheses about underlying biological, economic and social processes, and (c) calculation of the theoretical response of the system to the range of alternative management actions. A checklist for consideration under these headings is found in the following paragraphs.

67. Sources of uncertainty in data include: (a) estimates of abundance; (b) model structure; (c) parameter values used in models; (d) future environmental conditions; (e) effectiveness of implementation of management measures; (f) future economic and social conditions; (g) future management objectives, and (h) fleet capacity and behaviour.

68. Specific alternative hypotheses about underlying biological, economic and social processes to be considered include: (a) depensatory recruitment or other dynamics giving rapid collapse; (b) changes in behaviour of the fishing industry under regulation, including changes in coastal community structure; (c) medium-term changes in environmental conditions; (d) systematic under-reporting of catch data; (e) fishery-dependent estimates of abundance not being proportional to abundance; (f) changes in price or cost to the fishing industry; and (g) changes in ecosystems caused by fishing.

69. In calculating (simulating) the response of the system to a range of alternative management actions, the following should be taken into account:

    a) short-term (1-2y) projections alone are not sufficient for precautionary assessment; time frames and discount rates appropriate to inter-generational issues should be used, and

    b) scientific evaluation of management options requires specification of operational targets, constraints and decision rules. If these are not adequately specified by managers, then precautionary analysis requires that assumptions be made about these specifications, and that the additional uncertainty resulting from these assumptions be calculated. Managers should be advised that additional specification of targets, constraints and decision rules are needed to reduce this uncertainty.

70. Methods of analysis and presentation will differ with circumstances, but effective treatment of uncertainty and communication of the results are necessary in a precautionary assessment. Some approaches that could prove useful are:

    a) when there are no sufficient observations to assign probabilities to different states of nature that have occurred, decision tables could be used to represent different degrees of management caution through Maximin and Minimax criteria;

    b) where the number of different states of nature and the number of potential management actions considered are small, but probabilities can be assigned, decision tables can be used to show the consequences and probabilities of all combinations of these, and

    c) where the range of states of nature is large, the evaluation of management procedures is more complex, requiring integration across the various sources of uncertainty.

71. A precautionary approach to analysis would examine the ability of the data collection system to detect undesirable trends. Where the ability to detect trends is low, management should be cautious.

72. Since concern regarding the reversibility of the adverse impacts of fishing is a major reason for the precautionary approach, research on reversibility in ecosystems should be an important part of developing precautionary approaches.

ANNEX 5

Some Commonly Used Reference Points

(Extract from: Updated Draft Report of the ICES Study Group on the Precautionary Approach to Fisheries Management, ICES CM 1997/Assess:7)

RP	Definition	Data Needs	Possible PA-Usage
$F_{0.1}$	F at which the slope of the Y/R curve is 10% of its value near the origin	Weight at age, natural mortality, exploitation pattern	
F_{max}	F giving the maximum yield on a Y/R curve	Weight at age, natural mortality, exploitation pattern	LIMIT [1]
F_{low}	F corresponding to a SSB/R equal to the inverse of the 10% percentile of the observed R/SSB	Data series of spawning stock size and recruitment, weight and maturity at age, natural mortality, exploitation pattern.	
F_{med}	F corresponding to a SSB/R equal to the inverse of the 50% percentile of the observed R/SSB	Data series of spawning stock size and recruitment, weight and maturity at age, natural mortality, exploitation pattern.	LIMIT [1]
F_{high}	F corresponding to a SSB/R equal to the inverse of the 90% percentile of the observed R/SSB	Data series of spawning stock size and recruitment, weight and maturity at age, natural mortality, exploitation pattern.	
F_{MSY}	F corresponding to Maximum Sustainable Yield from a production model or from an age-based analysis using a stock recruitment model	Weight at age, natural mortality, exploitation pattern and a stock recruitment relationship or general production models	LIMIT [1]
2/3 F_{MSY}	2/3 of F_{MSY}	as above	
$F_{20\% SPR}$	F corresponding to a level of SSB/R which is 20% of the SSB/R obtained when F=0	Weight and maturity at age, natural mortality, exploitation pattern.	LIMIT [1]
F_{crash}	F corresponding to the higher intersection of the equilibrium yield with the F axis as estimated by a production model; could also be expressed as the tangent through the origin of a Stock-Recruitment relationship.	Weight at age, natural mortality, exploitation pattern and a stock recruitment relationship	LIMIT [1]
F_{loss}	F corresponding to a SSB/R equal to the inverse of R/SSB at the Lowest Observed Spawning Stock -LOSS	Weight at age, natural mortality, exploitation pattern and a stock recruitment relationship	LIMIT [1]
F_{comfie}	F corresponding to the minimum of F_{med}, F_{MSY} and F_{crash}		LIMIT [1]
F >= M	Empirical (for top predators)	M and sustainable F:s for similar resources	
F < M	As above (for small pelagic species)	M and sustainable F:s for similar resources	
Z_{mbp}	Level of total mortality at which the maximum biological production is obtained from the stock	Annual data series of standard catch rate and total mortality	
B_{MSY}	biomass corresponding to Maximum Sustainable Yield from a production model or from an age-based analysis using a stock recruitment model	Weight at age, natural mortality, exploitation pattern and a stock recruitment relationship or general production models	LIMIT [1]
MBAL	A value of SSB below which the probability of reduced recruitment increases	Data series of spawning stock size and recruitment (not necessarily from an VPA)	LIMIT [1]
$B_{50\% R}$	The level of spawning stock at which average recruitment is one half of the maximum of the underlying stock-recruitment relationship.	Stock recruitment relationship (not necessarily from an VPA)	LIMIT [1]
$B_{90\% R, 90\% Surv}$	Level of spawning stock corresponding to the intersection of the 90th percentile of observed survival rate (R/S) and the 90th percentile of the recruitment observations	Data series of spawning stock size and recruitment	LIMIT [1]
$B_{20\% B\text{-}virg}$	Level of spawning stock corresponding to a fraction (here 20%) of the unexploited biomass. Virgin biomass is estimated as the point where the replacement line for F=0 intersects the stock-recruitment relationship or as the biomass from a spawning stock per recruit curve when F=0 and average recruitment is assumed	Weight at age, natural mortality, exploitation pattern and a stock recruitment relationship	LIMIT [1]
B_{loss}	Lowest observed stock size	Data series of spawning stock size	LIMIT [1]

[1] Not all limit reference points are intrinsically equal, and their interpretation depends on the specifics of each particular case they are applied to. For example, F_{max} can in some cases be considered as a target, when it is well defined and corresponds to a sustainable fishing mortality, while it would be a limit when it is ill defined and/or corresponds to unsustainable fishing mortality. Similarly F_{MSY}, that is suggested as a minimal international standard for a limit reference point in the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks, could in some particular cases be considered a target. F_{crash} on the other hand is an extremely dangerous level of fishing mortality at which the probability of stock collapse is high. The probability of exceeding F_{crash} should therefore be very low.

2. Coastal States

a) Advice for TACs for 1998, and Other Management Measures

For stocks within the 200-mile fishery zone in Subareas 1-4, the Coastal States, Canada and Denmark (in respect of Faroe Islands and Greenland), requested advice from the Scientific Council (see Agenda I in Part D, this volume, Annexes 2 and 3).

The following are the responses which address these particular stocks.

The Council agreed to conduct the assessments on northern shrimp in Subareas 0+1 and Denmark Strait at a Council Meeting during 14-17 November 1997.

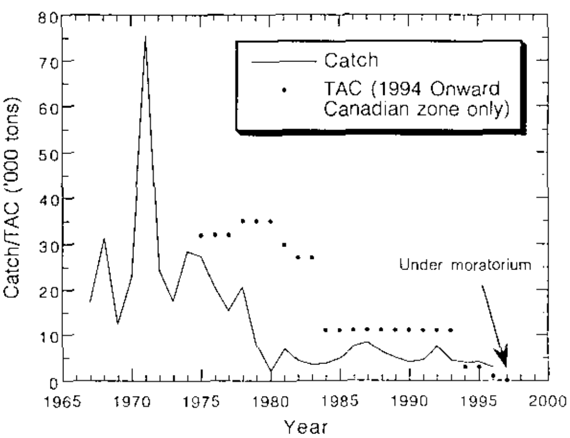
Roundnose Grenadier in Subareas 2 and 3

Background: Roundnose grenadier are found throughout Subareas 2 and 3 although the request for advice applies only to that portion of the resource lying within Canada's 200-mile economic zone. It is believed that only one stock occupies the entire area including the Regulatory Area, although there are different areas of concentration.

Fishery and Catches: Before the extension of jurisdiction by Canada, catches averaged about 26 000 tons annually, but have only averaged about 4 000 tons since then. Although the traditional fishery was inside the Canadian zone, catches in recent years have primarily been from the Regulatory Area taken as by-catch in the Greenland halibut fishery. It has been reported that by-catches by EU-Portugal and EU-Spain listed as roundnose grenadier in NAFO statistics since 1987 are actually roughhead grenadier. Actual roundnose grenadier catches of between 50 to 60 tons were taken in 1995 and 1996.

	Catch[1] ('000 tons)	TAC[2] ('000 tons)
1994	4	11
1995	4	3
1996	3	3
1997	-	0[3]

[1] Provisional reported catches.
[2] Canadian Zone only.
[3] Under moratorium.



Data: Limited sampling of the by-catch discarded in the EU-Spain Greenland halibut fishery. Surveys conducted by Canada (Div. 2G to Div. 3O) and Japan (Div. 2GH) in 1996.

Assessment: Not possible to provide an estimate of the absolute size of stock.

State of the Stock: Due to limited data not possible to determine.

Recommendation: Not possible to provide any advice for this stock.

Sources of Information: SCR Doc. 97/74; SCS Doc. 96/10, 13.

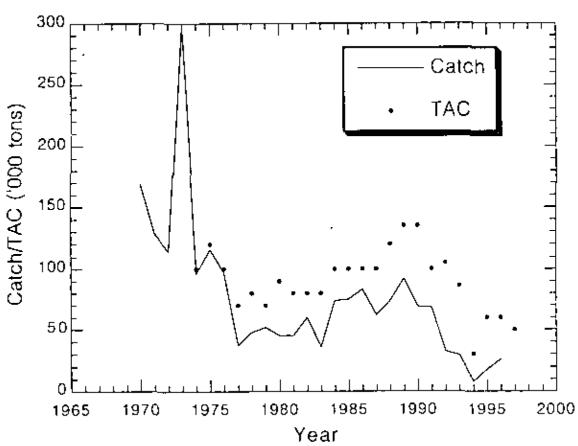
Silver Hake in Divisions 4V, 4W and 4X

Background: Silver hake in these Divisions are found in deep, warmer waters of the central Scotian Shelf, generally off the continental slope and in deep basins. This stock is considered to be separate from those of Georges Bank and Gulf of Maine Areas.

Fishery and Catches: The 1996 catch was substantially below the TAC due to allocations to parties which did not participate in the fishery. Under regulations implemented in 1994 to minimize cod, haddock and pollock by-catches, the non-Canadian fishery was restricted through modifications to the Small Mesh Gear Line to water deeper than 190 m, but as a result of exemptions the distribution of fishing in 1994-96 was closely similar to that in 1990-93. Use of a separator grate in codends was mandatory, and was estimated to have reduced catch rates by about 5%. Catch by the non-Canadian fleet was 22 000 tons. A Canadian small vessel fishery operated in the vicinity of Emerald and LaHave basins in 1996, and caught 3 500 tons.

	Catch ('000 tons)	TAC Set ('000 tons)	Projected catch at $F_{0.1}$ ('000 tons)
1994	8[1]	30	51 (40)[2]
1995	18[1]	60	79 (59)[3]
1996	27[1]	60	64
1997	21[4]	50	49

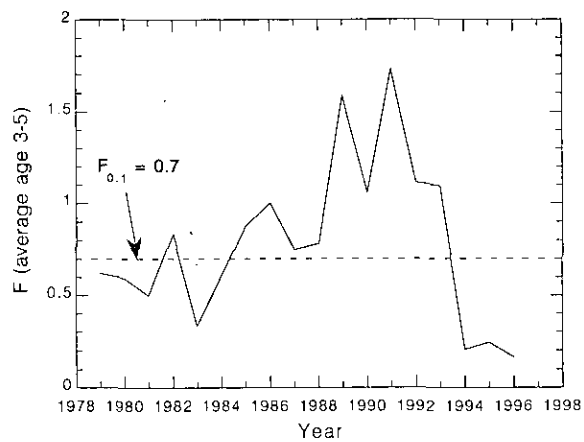
[1] Provisional
[2] See special comments, NAFO Sci. Council. Rep., 1993
[3] See special comments, NAFO Sci. Council. Rep., 1994
[4] Estimated



Data: Catch, effort and sampling data were collected from the non-Canadian fishery by Canadian observers. Data for the Canadian fishery came from both observers and the Canadian statistical system. Abundance and biomass by age were derived from the Canadian July Div. 4VWX research vessel survey. An estimate of the 1996 year-class strength was obtained from the October Canada/Russia 0-group survey.

Assessment: Catch-at-age from 1979 to 1996 were included in a bias correcting formulation of ADAPT using research vessel surveys (0-group and July survey for ages 1+) and age disaggregated non-standardized CPUE as tuning indices. A retrospective pattern where F was systematically underestimated and numbers overestimated was present in the results of the population analysis. The degree of overestimation ranged between 15 and 50%, with a tendency to increase with age. To correct this, numbers from the population analysis were adjusted, on an age-by-age basis, for projection purposes.

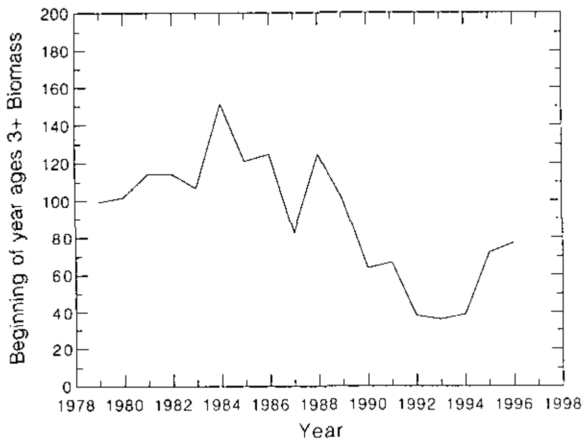
Fishing Mortality: Average F for ages 3-5 (the main age groups in the fishery) was estimated to be 0.2 in 1996, but given the observed retrospective pattern may have been as high as 0.4.



Recruitment: Both the 1995 and 1996 year-classes are thought to be above the 10 year geometric mean from SPA of 0.8 billion, at 1.0 and 1.8 billion respectively.

Mean weights-at-age: Commercial mean weight-at-age dropped in 1993 and has stabilized at lower levels in 1995 and 1996. Research vessel mean weight-at-age showed a similar declining trend, and the year-classes presently exhibiting low weights-at-age are expected to continue this pattern throughout their lifespan.

Biomass: Total fishable biomass (beginning of year ages 3+) showed a declining trend from 1984 to 1992, but has increased in more recent years.



State of the Stock: Estimates of fishing mortality from 1994 to 1996 were well below the $F_{0.1}$ level. Survey estimates of numbers and biomass have shown an increase, while the reductions in weights-at-age noted since 1992 have stabilized. Strengths of the incoming 1995 and 1996 year-classes are estimated to be above average, and fishable biomass has increased since 1992. Based on these factors, the stock appears to be rebuilding.

Forecast:

Option Basis	Predicted catch
$F_{0.1} = 0.70$	65 000

assuming a catch of 20 500 tons in 1997.

Recommendation: For silver hake in Div. 4VWX the calculated catch at a target fishing level of $F_{0.1}$ in 1998 is 65 000 tons.

Special Comments: Although the 1998 catch at $F_{0.1}$ is calculated at 65 000 tons, about 20 000 tons of this is contributed by the 1996 year-class. The high level of uncertainty about the estimated size of this year-class should be taken into account by discounting its calculated contribution, to some extent, when determining an appropriate TAC level for 1998.

Sources of Information: SCR Doc. 97/1, 3, 47, 51, 54, 69, 75; SCS Doc. 97/3.

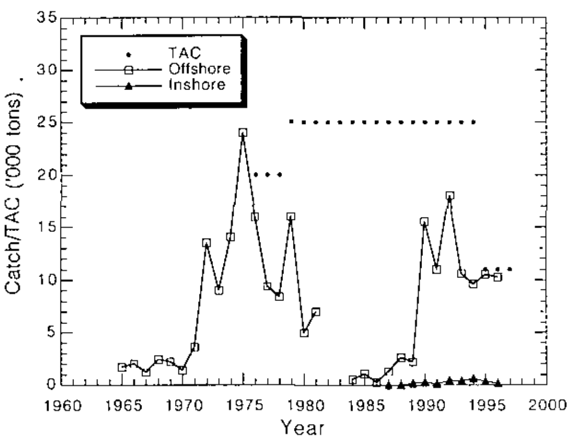
Greenland Halibut in Subarea 0 + Divisions 1B-1F

Background: The Greenland halibut stock in Subarea 0 + Div. 1B-1F is part of a common stock distributed in Davis Strait and south to Subarea 3.

Fishery and Catches: Due to an increase in offshore effort, catches increased abruptly from 2 000 tons in 1989 to 16 000 tons in 1990 and have remained above 10 000 tons annually since.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Autonomous
1994	10	25[2]	11
1995	11	11	11
1996	10	11	11
1997	-	11	11

[1] Provisional.
[2] Including Div. 1A inshore.

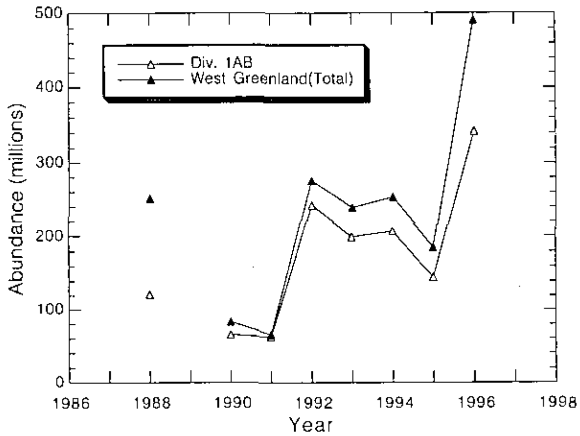


Data: Catch-at-age data were available for assessment from Div. 0B and SA 1. Standardized and unstandardized catch rates were available from Div. 1CD. Recruitment data were available from Div. 1AB.

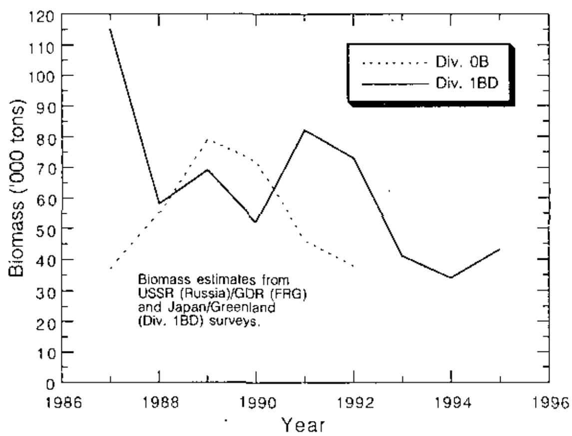
Assessment: No analytical assessment could be performed. Standardized catch rates have decreased since 1992 and continued to decrease in 1996. Unstandardized catch rates increased slightly in 1996 but is still only about half the level of 1991.

Fishing Mortality: Level not known.

Recruitment: Population estimates at age 1 of the 1992-94 year-classes have declined in recent years compared to the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class is estimated to be the best in the time series.



Biomass:



State of the Stock: Data from 1996 were limited but indicated no changes compared to 1995 i.e. the decline in the stock observed until 1994 seems to have stopped and the stock has apparently stabilized at a lower level compared to the late-1980s and early-1990s.

Recommendation: The TAC for 1998 should not exceed the current level of 11 000 tons for Subarea 0 + Div. 1BCDEF based on the relative stability of the stock.

Special Comments: The possibility of the existence of an isolated inshore population in Cumberland Sound (Div. 0B) is under investigation.

Sources of Information: SCR Doc. 97/21, 38, 39, 48, 53; SCS Doc. 97/3, 4, 7, 8, 11.

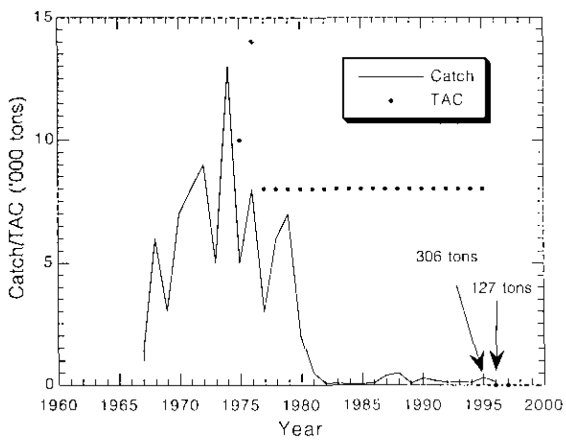
Roundnose Grenadier in Subareas 0 + 1

Background: The roundnose grenadier stock in Davis Strait is probably connected to other stocks in the North Atlantic. The stock component found in Subareas 0+1 is at the margin of the distribution area. Canadian and Russian surveys that covered both SA 0 and 1 showed that most of the biomass generally was found in SA 1.

Fishery and Catches: Recommended TACs have been at 8 000 tons in the period 1977-95. The advice for 1997 was that the catches should be restricted to by-catches in fisheries targeting other species. There has been no directed fishery for this stock since 1978.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Autonomous[2]
1994	0.1	8.0	
1995	0.3	8.0	5.5
1996	0.1	0	3.4
1997		0	3.4

[1] Provisional
[2] Set by Greenland for SA 1

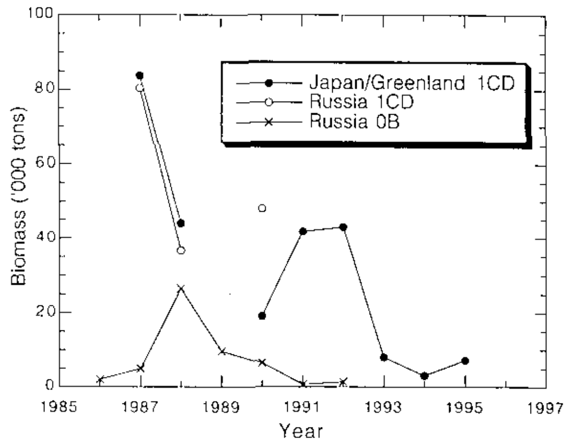


Data: Biomass estimates from surveys in Div. 0B during the period 1986-92 and Div. 1CD during the period 1987-95 were available.

Assessment: No analytical assessment could be performed.

Fishing Mortality: Exploitation level considered to be low in recent years.

Biomass: There are no recent estimates of biomass for the entire stock area.



No roundnose grenadier were observed in Div. 1B.

State of the Stock: The stock seems to be at a very low level. The reason for the changes in the stock is not known.

Recommendation: There should be no directed fishing for roundnose grenadier in 1998. Catches should be restricted to by-catches in fisheries targeting other species.

Sources of Information: SCR Doc. 97/11, 22; SCS Doc. 97/3, 4, 11.

The Council was requested by Canada to: *review the status of the cod stock in Divisions 2J+3KL and to provide estimates of the current size of the total spawning stock biomass, together with a description of recent trends* (see Agenda I in Part D, this volume, Annex 2, Item 3). The Scientific Council response is as follows:

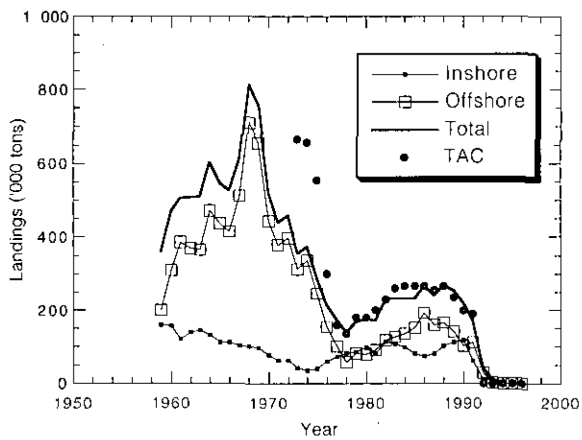
Cod in Divisions 2J, 3K and 3L

Background: Cod in these Divisions are considered a single stock complex. However, genetic and tagging data suggest the existence of relatively discrete sub-components. Extensive migrations occur, particularly between the inshore and the offshore. Some fish overwinter inshore. The relationship between inshore and offshore fish is poorly understood.

Fishery and Catches: The rapid decline in the resource in the early-1990s led to reduced TACs and eventually to a moratorium on commercial fishing in 1992. Some non-commercial fishing was permitted in 1993 and 1994, not in 1995, but again in 1996.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1994	1.3	0	0
1995	0.3	0	0
1996	1.7	0	0
1987	-	0	0

[1] Provisional.



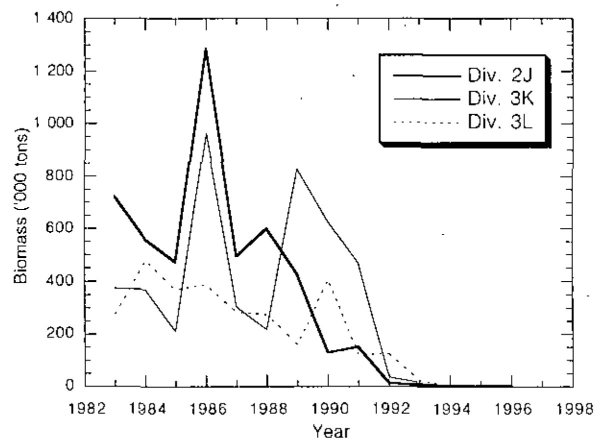
Data: 9 SCR documents addressing various aspects of the stock form the basis for this assessment.

Assessment: Stock status was estimated based on survey abundance indices, biological data and an analytical assessment.

Fishing Mortality: Based on SPA, fishing mortality on fully recruited age groups was relatively stable at about 0.5 from 1977 to 1987, but increased rapidly to 1989. Fishing mortality rose above 1.0 in 1990 and continued to increase until the moratorium was introduced in 1992.

Recruitment: The number of 3 year olds estimated by the SPA indicates that recruitment has been very low since 1987. There is some evidence from the inshore that the 1990 year-class may have been less weak, however, very few survivors from this year-class appeared in the offshore at age 3 and older based on research survey data.

Pelagic juvenile fish surveys carried out in August-September during 1994-96 provide an index of year-class strength. The abundance of pelagic juvenile cod decreased by a factor of eight from 1994 to 1996. Year-class strength from these surveys predict that recruitment at age 3 for the 1996 year-class will be extremely low.



Biomass: Autumn research vessel survey index of biomass in Div. 2J+3KL declined abruptly in the early-1990s. The 1996 estimate is slightly higher than the previous year but remains extremely low.

Sequential population analysis estimates suggest that the age 3+ biomass remains extremely low.

State of the Stock: The stock remains at a very low level with only very weak year-classes entering the mature population and very few older fish. It is possible that marine mammal consumption of juvenile cod is impeding recovery.

Recommendation: Stock rebuilding requires that the moratorium be maintained and that fishing-related mortality be kept to the lowest possible level.

Special Comments: Ocean conditions continue to moderate relative to the early-1990s. This may be beneficial to biotic factors such as growth rates.

Sources of Information: SCR Doc. 97/40, 41, 43, 46, 49, 57, 59, 62, 63.

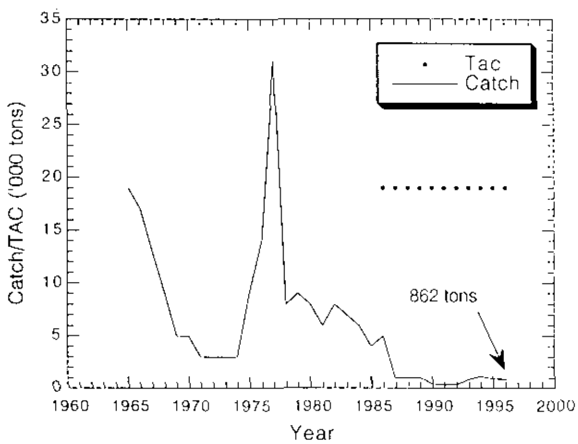
Redfish in Subarea 1

Background: There are two species of commercial importance in Subarea 1 - golden redfish (*Sebastes marinus* L.) and deep sea redfish (*Sebastes mentella* Travin). Relationships to other north Atlantic redfish stocks are unclear.

Fishery Development and Catches: During the last decade, redfish were taken mainly as by-catch in the trawl fisheries for cod and shrimp. Both redfish species were mixed in the catch statistics since no species specific data or information to precisely split the catches by species were available. Recent catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Autonomous
1994	1	+	19
1995	0.9	0	19
1996	0.9	0	19
1997		0	19

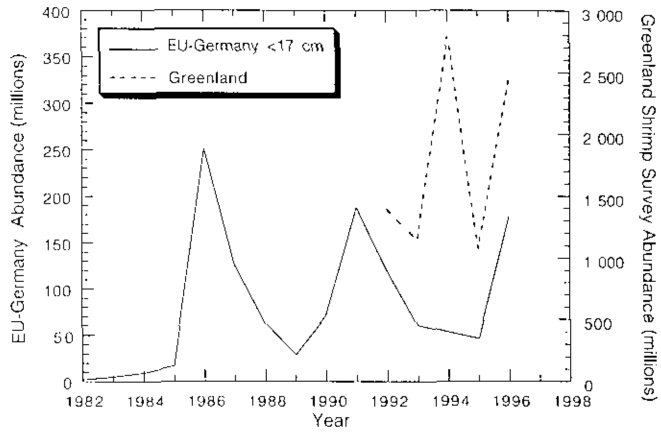
[1] Provisional.
\+ no TAC recommended, catches should be limited to by-catches and kept at lowest possible level.



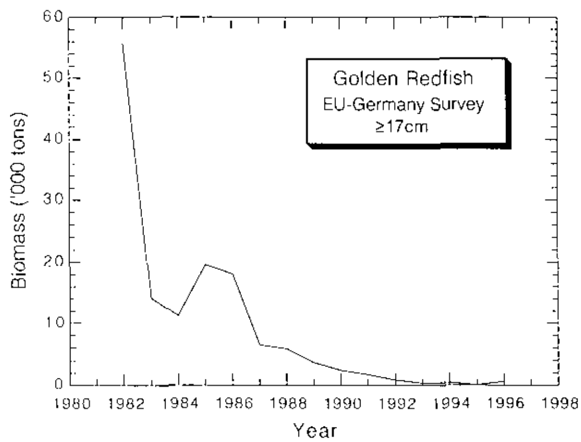
Data: No data on commercial CPUE were available. During the period 1962-90, the mean fish size in the catches declined from 45 to 35 cm, with the biggest reductions occurring during the 1970s. Length frequencies derived from the Greenland bottom trawl survey using a shrimp trawl revealed that the shrimp trawl selects all fish sizes <20 cm representing the present size composition of the stocks. Recent stock abundance, biomass and length structure were derived from annual bottom trawl surveys.

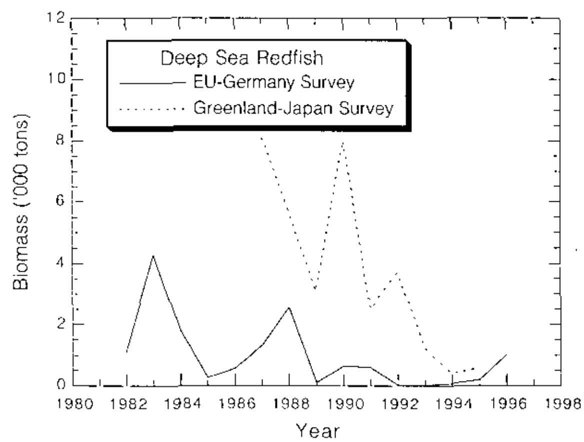
Assessment: No analytical assessment was possible.

Recruitment: Pre-recruits (<17 cm) were found to be very abundant as indicated by the surveys.



Biomass: Survey results revealed dramatic declines in survey abundance and biomass indices of golden and deep sea redfish (≥17 cm) to an extremely low level.





State of the Stock: The stocks of golden and deep sea redfish remain severely depleted. Short term recovery is very unlikely.

Recommendation: No directed fishery should occur until the stocks have recovered substantially. By-catches in the shrimp fisheries should be limited to the lowest possible level.

Special Comments: Long-term recovery of golden and deep sea redfish stocks in Subarea 1 from their severely depleted status depends on future recruitment. Any catches will reduce the probability of this event. Concern is expressed about the continued lack of recruitment to the fishable biomass. However, the extent of the impact of by-catch in the shrimp fishery is still unknown.

Sources of Information: SCR Doc. 97/5, 39, 56; SCS Doc. 97/4, 11.

Other Finfish in Subarea 1

Background: The resource of other finfish in Subarea 1 are mainly Greenland cod, American plaice, Atlantic and spotted wolffishes, starry skate, lumpsucker, Atlantic halibut and sharks.

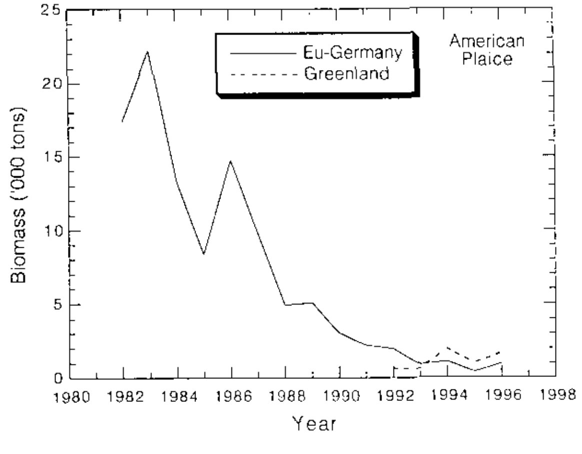
Fishery Development and Catches: Total combined annual catches of theses species varied around 3 500 tons (mainly Greenland cod) over the last 10 years. They were taken by offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut, by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. In 1996, reported catches of other finfishes amounted to 3 367 tons and were dominated by Greenland cod (63%) and the category of non-specified finfish (18%). Recent catch figures do not include the weight of substantial numbers of small finfish discarded by the trawl fisheries directed to shrimp.

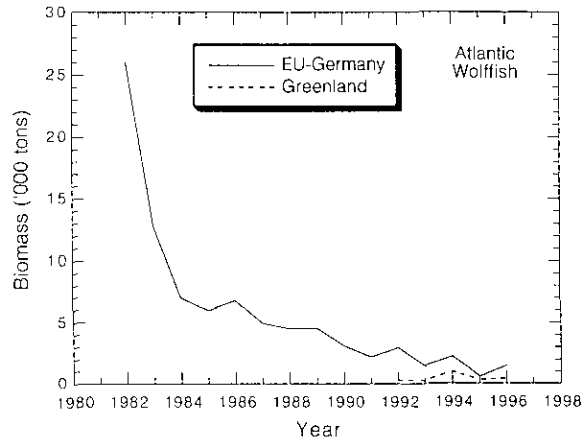
Data: No data on CPUE, length and age composition of the catches were available. Length frequencies derived from the Greenland bottom trawl survey using a shrimp gear revealed that the shrimp trawl was capable of catching all predominant fish sizes in the stocks of American plaice, spotted and Atlantic wolffish and starry skate. Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland.

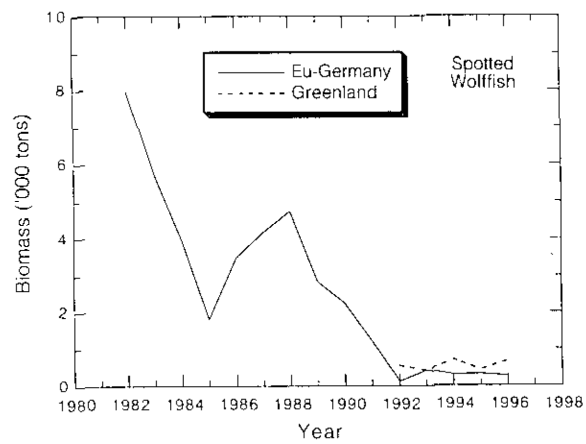
Assessment: No analytical assessment was possible for any of these stocks.

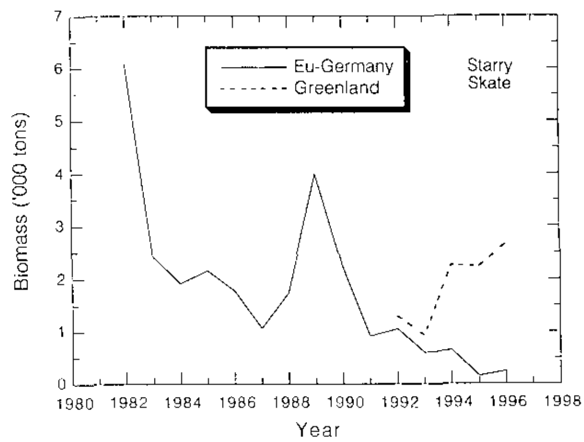
Recruitment: There are presently no indications of strong recruitment in the stocks of American plaice, Atlantic and spotted wolffishes and starry skate.

Biomass Indices: Survey results revealed dramatic declines in survey abundance and biomass indices for American plaice, Atlantic and spotted wolffishes and starry skate to an extremely low level.









State of the Stock: The stocks of American plaice, Atlantic and spotted wolffish and starry skates remain severely depleted. Short term recovery of the stocks is very unlikely.

Recommendation: No directed fishery should occur until the stocks have recovered substantially. By-catches in the shrimp fisheries should be limited to the lowest possible level. No information can be provided for Greenland cod, lumpsucker, Atlantic halibut and sharks.

Special Comments: Recovery of the stocks of American plaice, Atlantic and spotted wolffishes and starry skate in Subarea 1 from their severely depleted status depends on future recruitment. Any catches will reduce the probability of this event. Concern is expressed about the continued recruitment failure. However, the extent of the impact of by-catch in the shrimp fishery is still unknown.

Sources of Information: SCR Doc. 97/5, 39, 55; SCS Doc. 97/4, 11.

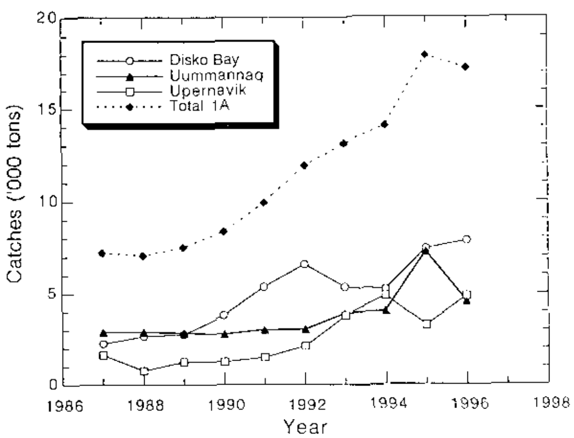
Greenland Halibut in Division 1A

Background: The population occurs inshore in Div. 1A, and is considered to be recruited from the nursery grounds south-southwest of Disko Island and in the Disko Bay. Mature individuals do not contribute back to the spawning grounds. No TACs have been established for this population.

Fishery and Catches: The fishery is mainly conducted with longlines and to a varying degree gillnets. Effort has increased in Disko Bay and Upernavik, and decreased in Uummannaq. There was no offshore catch in 1996.

Catches[1] ('000 tons)	1994	1995	1996	TAC-97[2] Recomm.
Disko Bay[3]	5.2	7.4	7.8	-
Uummannaq	4.0	7.2	4.6	-
Upernavik	4.8	3.3	4.8	-
Total 1A	14.0	17.9	17.3	-

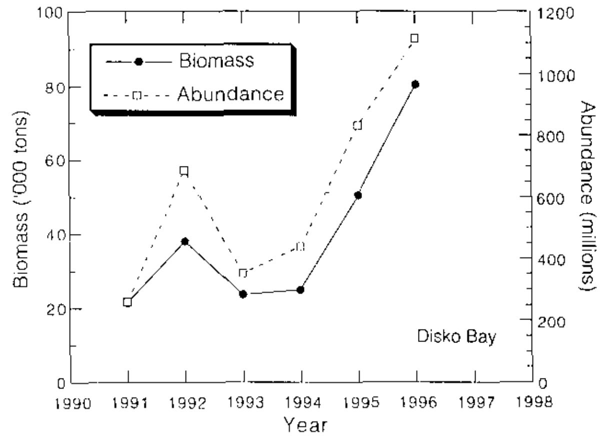
[1] Provisional.
[2] No TAC advised
[3] Formerly named Ilulissat.

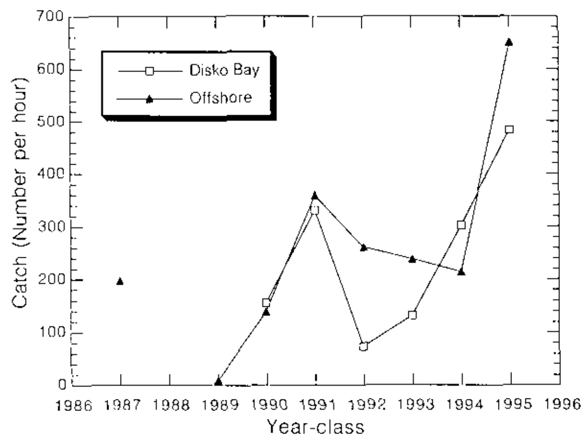


Data: Catch-at-age data were available for years 1988-96 at Disko Bay, and for most years in this period at Uummannaq and Upernavik. Data on mean length in commercial catches and on weight categories in landings were available. A recruitment index for age 1 and biomass as well as abundance estimates for the stock were available from trawl surveys. Catch rates and mean length were available from inshore longline survey.

Assessment: The recent level of fishing mortality could not be estimated. Indications of overfishing at Uummannaq were suggested by analysis of catch composition which has changed significantly towards a higher exploitation of younger age-groups. Survey results in 1996 in Disko Bay did not indicate major changes in total abundance or catch composition and the stock still seems to be growth overfished.

Recruitment: Recruitment after the 1991 year-class has declined but was high relative to previous years. The 1995 year-class seems to be the highest on record in the inshore as well as offshore areas. Large numbers of the 1995 year-class were also observed outside the traditional nursery area, especially north of Disko Island.





State of the Stock: There were no signs of collapse of age-structure. However, the stock at Disko Bay and Uummannaq appeared to be growth overfished.

Recommendation: It is recommended that the fishery is not increased above the recent catch level. Separate TACs should be considered for each of the three inshore areas.

Special Comments: Because the stock is dependent on recruitment from Davis Strait, exploitation of the spawning stock and by-catches taken in the shrimp fishery should be taken into account when managing the fishery in the fjords.

A more cautious harvest strategy for the stock components should be adopted because of the lack of information on effort from the inshore commercial fishery.

Sources of Information: SCR Doc. 97/21, 39, 53, 78; SCS Doc. 97/11.

b) **Special Requests for Management Advice on Fish and Invertebrate Stocks**

i) **Responses to Request by Denmark (Greenland)**

Denmark (on behalf of Greenland) made a special request with respect to Greenland halibut in Subareas 0 and 1 (see Agenda I in Part D, this volume, Annex 3, Item 2) as follows:

The Council is asked to provide further information on the following topics:

a) Allocation of TACs to appropriate Subareas (within Subareas 0 and 1).
b) Allocation of TAC for Subarea 1 inshore areas.

Concerning a), no new data were available since Div. 0B has not been surveyed in recent years; see STACFIS report (Greenland halibut Subarea 0 + Div. 1B-1F) and *NAFO Scientific Council Reports*, 1994, page 110. The possibility of the existence of an isolated inshore population in Cumberland Sound (Div. 0B) is under investigation.

Concerning b), 99% of the inshore catches in Subarea 1 are taken in Div. 1A inshore areas. The Council **recommended** (see assessment report on Greenland halibut in Div. 1A), that *with respect to Greenland halibut in Div. 1A, separate TACs be considered for each inshore area (Disko Bay, Uummannaq and Upernavik) but could not calculate appropriate levels*. The stocks in Disko Bay and Uummannaq appear to be growth overfished.

X. OTHER MATTERS

The Scientific Council had no other matters to address.

XI. ADOPTION OF REPORTS AND RECOMMENDATIONS

At its concluding session on 19 June 1997, the Council received summary presentations by the Chair of each Standing Committee. The Council then considered and **adopted** the reports of STACFEN, STACFIS, STACREC and STACPUB noting that minor editorial changes would be done as appropriate before the reports were issued as Appendices to the Council Report.

XII. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 19 June 1997, the Council considered the draft report of this meeting and this Report of the Scientific Council was **adopted** on the understanding that the Chairman of the Council will make the minor editorial changes as appropriate, with the Assistant Executive Secretary.

XIII. ADJOURNMENT

There being no further business, the Chairman thanked the participants, particularly the Designated Experts, the Chairmen of the Standing Committees, members of the *Ad hoc* Working Group on Precautionary Approach and the Nominating Committee for their dedicated work and support. He also extended his congratulations to the newly elected members of the Scientific Council Executive. After thanking the Secretariat for their help, the meeting was adjourned.

ANNEX 1. PROPOSAL FOR THE 1999 SPECIAL SESSION: PANDALID SHRIMP SYMPOSIUM

Prepared by: P. Anderson[1], J. Angel[2], J. Boutillier[3], P. A. Koeller[4] and S. Tveite[5]

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[2] Canadian Association of Prawn Producers, 15 Dartmouth Rd., Bedford, Nova Scotia, Canada B4A 3L9,
[3] Pacific Biological Station, Nanaimo, British Columbia, Canada V9T 2S6,
[4] Bedford Institute of Oceanography, P. O. Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2,
[5] Institute of Marine Resources, P. O. Box 1870, N-5024, Bergen, Norway

Presented to Council by: P. A. Koeller

Introduction

Pandalid shrimp are nearly circum-boreal in distribution, with major fisheries from California to the Bering Sea in the NE Pacific, the North Sea to the Barents Sea in the NE Atlantic, and the Gulf of Maine to Greenland in the NW Atlantic. Smaller fisheries are also found in the NW Pacific from Japan to the Sea of Okhotsk (Fig. 1, FAO Yearbook).

Globally, *Pandalus borealis* is by far the most important Pandalid in landed weight and value, although other closely related species are of significance locally, particularly in areas of the North Pacific. In 1994 the world Pandalid shrimp catch amounted to 270 000 metric tons with landed value of about $500M, U.S.

Some Pandalid shrimp populations have shown large and rapid fluctuations in abundance due to environmental and ecological influences, fishing pressure, or a combination of these factors. Indeed, the 1st International Pandalid Shrimp Symposium (Frady, 1981) was prompted by large decreases in the Alaska fishery in the late-1970s which continued to the mid-1980s (Fig. 1). Hypotheses on the cause of the downturn focused on environmental effects, especially temperature changes. Recent increased catches in some parts of the Northwest Atlantic may be due to decreased predation pressure by depressed groundfish stocks, in combination with favourable environmental conditions. These interacting factors greatly complicate stock assessments. The lack of reliable recruitment predictors is one of the main bottlenecks to predictive analytical assessments for many Pandalid stocks.

Review of Recent Meetings

The 1979 Alaska Symposium reviewed all Pandalid fisheries, discussed assessment methodologies with emphasis on quantitative models, and described environmental influences on abundance. The desirability of multispecies assessments was emphasized. Since then scientific meetings have been more restricted in focus both by subject and area. NAFO sponsored two meetings on shrimp ageing to fill an important knowledge gap at a time when fisheries for *Pandalus borealis* were developing in the Northwest Atlantic: a 1981 workshop held in Nova Scotia and Quebec (Fréchette and Parsons, 1981) concentrated on the interpretation of length frequency distributions; the follow-up working group meetings held in Iceland during 1989 focused on the potential application of various length-based population models in the analysis of specific stocks. Geographic representation was relatively wide (Gulf of Maine, Davis Strait, Gulf of Alaska, Icelandic and Scandinavian stocks were discussed), but the report (Parsons, MS 1989) regretted the absence of representatives from the USSR and Japan. A Canadian Atlantic Fisheries Scientific Advisory Committee workshop in Ottawa during 1989 (Mohn *et al.*, 1992) was prompted by the lack of quantifiable management objectives in new Canadian fisheries. The research issues identified included analysis of historical data sets to identify predator-prey or environmental effects; and work on assessment methods such as survey trawl selectivity, CPUE corrections, SPA and yield-per-recruit applications and stock definition. In 1991 the ICES Working Group on Assessment of *Pandalus* Stocks introduced a notable group of papers at the Statutory meeting in La Rochelle (Anon., 1991). In addition to distribution, abundance changes and geographical comparisons of biological parameters, papers were presented on the consumption of *Pandalus* by groundfish in the North Sea, the Canadian Northwest Atlantic, the Barents Sea, and off Iceland. In 1994, the ICES Study Group on Life Histories and Assessment of *Pandalus* Stocks in the North Atlantic met in Reykjavik and reviewed *Pandalus* biology and assessment methods on a broad scale i.e. both sides of the North Atlantic (Anon., MS 1994). It focused on stock identification, growth (including time at sex reversal), and natural (especially predation) mortality as the most important aspects of Pandalid biology pertinent to stock management. The review of assessment methods focused on current abundance indices, analytical assessments and management objectives. The meeting's main recommendation was that the parameters for species interaction models be determined. Significantly, the report also noted the absence of members from North America and recommended future participation from Canada and the U.S. Other meetings of note are associated with the development of specific fisheries e.g. recent NAFO meetings on the Flemish Cap fishery (NAFO, 1994, 1996), or ongoing cooperative investigations e.g. Russian (PINRO) and Norwegian (IMR) symposia on the Barents Sea and Svalbard area surveys and associated research (Aschan *et al.*, MS 1996)

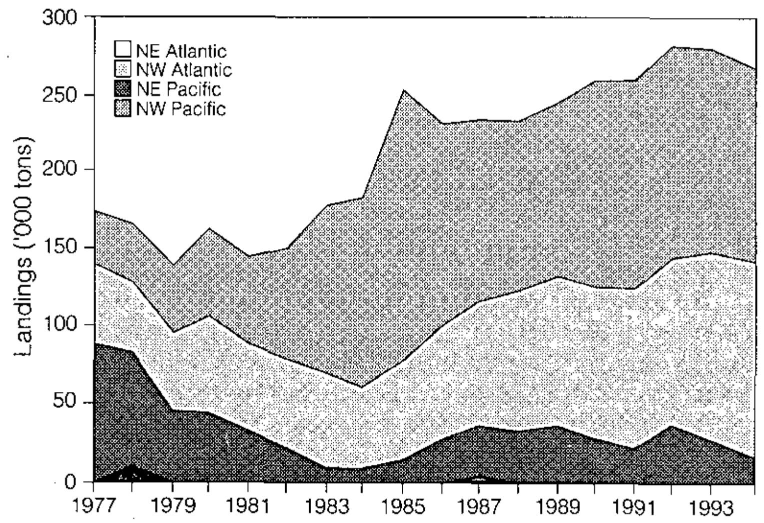

Fig. 1. World Pandalid shrimp catches, 1977-94. Source: FAO Yearbook 1996.

The plea for wider geographical representation at regional meetings in the reports noted above has been reiterated on an individual basis by many shrimp biologists who feel their work would benefit from a broader exchange of ideas than is facilitated by current organizational constraints. Despite a vast amount of discussion in the "grey" literature, much of which was produced for the meetings noted above, there is a regional disparity in stock assessment methodologies, for example: only a few stocks are assessed "quantitatively" i.e. using length-based VPA, recruitment and fishing mortality estimation, projections; etc. Some regions have made considerable advances in defining predator-prey interactions and applying this information to multispecies assessments; survey methodologies vary in sophistication, and management objectives are poorly defined in may areas. A well organized international meeting could draw on the most advanced research and methods in these topics and make them available to all. The current interest in the "precautionary" approach to fisheries management and consideration of "forage" species in managing fish predators, together with the apparent response of Pandalids to decreased predation pressure noted in some areas, makes the shrimp-groundfish system an ideal candidate for further development in multispecies assessment methods and a good keynote topic for the proposed symposium. The meeting would come at a time when most Pandalid stocks are healthy - any knowledge gained could then be applied to prevention and maintenance rather than the "what went wrong?" hindsight approach often taken by meetings of this nature. Previous meetings have often been restricted to, or dominated by, discussions of *P. borealis* biology and assessment methods - an international meeting of this scope would allow the presentation of original research on other Pandalids which, while not as important economically, would provide valuable information that could have wider applications.

From the above, it is apparent that a major Pandalid Shrimp Symposium is highly desirable. The main objectives of such a meeting should be to:

1. Provide a forum and venue that crosses present organizational boundaries (e.g. NAFO, ICES, PISCES, national assessment review processes, co-operative agreements, marketing agencies).

2. Present original research and review progress in stock assessment methods and management over the past 20 years with emphasis on:

   - the key ecological role of Pandalid shrimp as a food source for many commercial finfish species and the need for multispecies stock assessments,

   - the importance of environmental influences as determinants of shrimp stock abundance from a predictive viewpoint,

   - current management issues, including management objectives, biological reference points, and fishing technology and economics in relation to conservation.

We propose that, for administrative convenience, NAFO be identified as the *lead agency*. We believe that the *co-sponsorships* of ICES and PISCES are essential to the success of the Symposium, because omission of any one of the 3 proposed co-sponsoring organizations would result in a regionalization of participation and a degree of exchange already provided by existing fora. Consequently, this proposal is considered the first step in the process of acceptance and further development of the concept. If approved by the NAFO Scientific Council, a similar proposal will be presented to the ICES Statutory Meeting this September in Baltimore. Approval through the PISCES review process will be sought concurrently. If successful on all counts, each organization will then nominate a *co-convenor* (target date October 1, 1997).

September 1999, and Halifax, Nova Scotia is being considered as the date and location because: Halifax is well situated for travel from both North Pacific and North Atlantic locations, as well as being the headquarters for the proposed lead agency; lead time of 2 years should allow researchers, managers and industry enough time to prepare original analyses and include budget considerations; NAFO shrimp stock assessment meetings are held in the autumn, and the symposium could be planned to coincide.

We propose that the symposium be self-financed through a participation fee. However, government agencies and industry groups will be asked to sponsor appropriate aspects such as keynote speaker travel expenses and social events. It is expected that costs associated with distribution of announcements and publication of proceedings will be covered by the 3 sponsoring organizations.

The attached draft program is intended for discussion purpose only, and to indicate the envisaged scope and emphasis of the proposed meeting. The symposium theme, topics, session design, list of invited speakers, meeting logistics, etc. will be developed further and finalized by the co-convenors.

References

ANON. 1992. Report of the Shellfish Committee. ICES Annual Report, 79th Statutory Meeting, 1991, La Rochelle.

ANON. MS 1994. Report of the Study Group on Life Histories and Assessment of *Pandalus* Stocks in the North Atlantic (Reykjavik, 6-10 September). ICES C.M. 1994/K:8, 35 p.

ASCHAN, M., B. BERENBOIM, and S. MUKHIN. MS 1996. Results of Norwegian and Russian investigations of shrimp (*Pandalus borealis*) in the Barents Sea and the Svalbard area, 1995. ICES C.M. 1996/K:6, 18 p.

FRADY, T. 1981. Proceedings of the International Pandalid Shrimp Symposium, Kodiak, Alaska, February 13-15, 1979. Sea Grant Report 81-3, 519 p.

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NAFO. 1994. Scientific Council Reports, 1994. p. 146, 159-161.

NAFO. 1996. Scientific Council Reports, 1994. p. 146-147, 161-166.

PARSONS, D. G. MS 1989. Report of the Working Group on Progress in Age Determination of Pandalus. NAFO SCS Doc. 89/22, 6 p.

***NOTE**: The following is a draft proposal for discussion only.*

2ND INTERNATIONAL PANDALID SHRIMP SYMPOSIUM - SCIENCE AND MANAGEMENT AT THE MILLENNIUM

General Proposals:

Location:	Halifax, N.S.
Date:	September 15-17, 1999
Possible Venues:	NAFO Headquarters, Bedford Institute of Oceanography, Dalhousie University
Target Number of Participants:	100
Note:	An overview/keynote paper will precede each session and a panel/plenary discussion will conclude each session.

Day 1

Session I. Stock Assessments and Associated Biological Research

- quantitative methods: length based SPA, yield/recruit, CPUE correction, etc.
- stock i.d.: distribution, migration, genetics, morphometrics
- age/growth/reproduction, etc.
- survey methods:survey design/estimation, trawl selectivities, alternative survey methods

Day 2

Session II. Management Strategies

- overview of current management regimes
- biological reference points and conservation limits
- assessment review mechanisms, industry/government cooperation
- management under uncertainties

Session III. Harvesting, Processing and Marketing

- progress with selection grates: by-catch reduction, shrimp size sorting
- bio-economic models
- harvesting strategies

Day 3

Session IV. Environmental and Ecological Influences

- hydrographic factors affecting shrimp populations
- predictive relationships
- predator-prey interactions
- multispecies models

Session V. Summary

APPENDIX I. REPORT OF STANDING COMMITTEE ON FISHERIES ENVIRONMENT (STACFEN)

Chairman: M. Stein Rapporteur: K. Drinkwater

The Committee met at the Keddy's Dartmouth Inn at 9 Braemar Drive, Dartmouth, Nova Scotia, Canada, on 5 and 12 June, 1997, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Scientists attended from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), European Union, Japan, Norway, Russian Federation and the United States of America.

The Committee reviewed the following documents: SCR Doc. 97/4, 5, 6, 12, 13, 14, 17, 29, 63; SCS Doc. 97/3, 4.

1. Chairman's Introduction

The Chairman welcomed the members to the June 1997 Meeting of STACFEN.

2. Invited Lecture

The Chairman introduced Dr. Johanne Fischer of Memorial University of Newfoundland who presented a paper entitled '*Niche space occupied by common fish species off Newfoundland*' which was coauthored with Dr. R. Haedrich. The following is a summary:

> Data from groundfish scientific surveys on the continental shelf of northeast Newfoundland (Div. 2J+3KL) were used to examine the relationship between abundance of fish species at individual stations, bottom temperature, and depth in the period 1978 to 1993. The observed abundance (O) of 18 common fishes within temperature and depth categories (-2 to +5°C, 50 to 1 000 m) were compared with the expected abundance (E) assuming catches to be proportional to the sampling effort. Calculations of the deviation of observed from expected abundance in each cell, (O-E)/E, was used to determine avoided and preferred temperature-depth categories. The individual pattern of preferred categories was considered to represent the realized niche of a species. The width of individual niches (H_t) was also estimated based upon the distance from an expected distribution. The niche shape for all years combined for each fish species was clearly distinct with the depth axis being more restricted than temperature axis for many species, probably a result of the available narrow temperature range. The width of the realized niche was not associated with a species overall abundance.
>
> The period 1978 to 1993 was one of declining sea temperatures and heavy fishing pressure over the Newfoundland Shelf. Environmental stress (decrease in abundance and/or average size) during this time appeared to influence shape and width of the realized niche space. Some species, such as Arctic cod, roughhead grenadier and Greenland halibut, responded by avoidance of formerly preferred niche spaces. Other species, such as American plaice, redfish and capelin, extended their niche space. All of these species showed a shift towards deeper waters. Preliminary results indicate that an examination of shift in niche space might serve not only as an additional indicator for environmental stress but also help in predicting fish distribution over large areas.

3. Marine Environmental Data Service (MEDS) Report for 1996 (SCR Doc. 97/14)

The inventory of oceanographic data obtained by MEDS during 1996 was presented along with information on several new initiatives.

i) Hydrographic data collected in 1996

Data from 4 075 oceanographic stations collected in the NAFO area were sent directly to MEDS in 1996 of which 941 have been archived and the remainder are awaiting to be archived. An additional 4 629 stations were received through IGOSS (Integrated Global Ocean Service System). Data known to have been collected during 1996 but which have not yet been received by MEDS includes over 130 stations off West Greenland occupied by German and Danish scientists. The number of stations received directly by

MEDS decreased by approximately 15% from that obtained in 1995 while the number of stations obtained through IGOSS remained about the same.

ii) **Historical hydrographic data holdings**

Data from 1 325 oceanographic stations collected prior to 1996 were obtained during the year, approximately 5% of those received in 1995. The large number in 1995 was unusual, however, due to a reprocessing of the entire temperature and salinity dataset from the Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

iii) **Drift-buoy data**

A total of 129 drift-buoy tracks were received by MEDS during 1996 representing over 438 buoy months. The total number of buoys is an increase of 16 over 1995 and the number of buoy months is 33% more than during 1995.

iv) **Wave data**

In 1996, 98 769 wave spectra were processed, mostly from the permanent network of moored wave buoys in the area. This represents a decrease of approximately 17 000 compared to 1995.

v) **Tide and water level data**

MEDS processes and archives operational tidal and water level data obtained from the Canadian Hydrographic Service (CHS). The data is derived from the CHS active permanent water level network. A total of 64 stations were processed during 1996.

vi) **Recent activities**

MEDS has been active in five other recent initiatives. They have been involved, along with others, in developing (1) an Atlantic coastal Monitoring Proposal, (2) a distributed database on toxic chemicals, and (3) products from RADARSAT. They also are responsible for (4) the management and archiving of data collected in the Canadian Joint Global Ocean Flux Study (JGOFS) and have begun (5) an Ocean Data Rescue Project to identify and obtain datasets not presently held by MEDS.

4. **Review of Environmental Studies in 1996**

i) **Subareas 0 and 1** (SCR Doc. 97/4, 13; SCS Doc. 97/4)

During the annual German groundfish survey (SCS Doc. 97/4) CTD measurements were taken at 55 fishing stations and along 2 NAFO standard sections off West Greenland (Cape Desolation and Fylla Bank).

Monthly air temperature anomalies at three sites in Greenland and changes in the ice cover in the northern North Atlantic were described (SCR Doc. 97/13). In contrast to the very cold winter conditions during the early-1990s, air temperatures around Greenland during the first four months of 1996 were warmer than the long-term mean. Although the summers were slightly colder than normal, December was relatively warm. On East Greenland at Angmagssalik temperatures throughout the year tended to be warmer than usual. High interannual variability is common in Greenland air temperatures, thus the return to above normal temperatures for the first time in almost a decade should not necessarily be taken as the beginning of a long-term warming trend. Indeed, there has been significant cooling over the past 30 years and only time will tell whether a true reversal in this trend has occurred. As a result of the milder air temperatures in winter and spring, sea ice conditions were near normal around Greenland and off eastern Canada. Sea temperatures on Fylla Bank showed significant warming with the deviation from the mean for the 0-200 m layer being almost +1.6K and the second highest value since the record began in the early-1960s. This layer has been warming since 1992. Temperatures in the deeper depth layers show similar trends to that in the upper 200 m. This warming is believed to be associated not only with the increase in air temperatures but also with increased advection of warm water by the Irminger Current into the Labrador

Sea region along the West Greenland slope. The air temperature and sea ice trends are related to the North Atlantic Oscillation (NAO) Index.

Results from a study of the variability in the influx of the warm Irminger Current during the past four decades was presented (SCR Doc. 97/13). This was part of the Russian-German collaborative climate study (see item 8 below). Data were primarily taken from NOAA World Ocean Atlas. Analysis was performed using a new oceanographic software program under development, the Ocean-Data-View, provided by the Alfred-Wegener-Institute in Bremerhaven, Germany. Changes in the heat supply into the Labrador Sea from the Irminger Current during each decade from the 1950s to present were examined. Warm Irminger water was located on and near the continental slope around the Labrador Sea during the warm 1960s. Cooling of the Irminger water and weaker penetration into the Labrador Sea was observed during the 1980s.

ii) **Subareas 2 and 3** (SCR Doc. 97/17, 29)

Hydrographic data (116 CTD stations) from around Flemish Cap in July 1996 were discussed (SCR Doc. 97/17). The water column was highly stratified with the coldest waters in the cold intermediate layer (CIL) corresponding to the 75-150 m depth range. Horizontally, there was a latitudinal gradient with colder temperatures in the north. Temperatures at mid-depths (50, 100 m) were warmest on the Bank. Waters on the Bank were also fresher than the surrounding waters resulting in their being less dense. Three water types were identified. The central part of the Cap consists of Labrador Current water heated by the sun. Labrador Current water tends to surround the Bank while mixed water containing North Atlantic drift water appeared between 200 and 300 m. The presence of the latter water mass coincided with a break in the distribution of redfish with no fish being found in the warmer waters.

During the spring of 1997, 4 standard sections were occupied off Newfoundland (SCR Doc. 97/29). In contrast to the warm conditions in 1996, air temperatures have been mostly below normal around Newfoundland during 1997. The January ice coverage was less than normal on the Newfoundland Shelf but as temperatures cooled in February and March the ice edge spread beyond the long-term median. By April the offshore ice edge had retracted inshore. Temperatures at Station 27 were warmer than average in January continuing the conditions observed in 1996 but the waters cooled through and into the spring. Salinities were fresher than normal during the late winter and early spring. Ocean temperatures on the Grand Bank and along the east coast of Newfoundland were generally below normal (up to 1K) in the upper 100 m of the water column. On the Bonavista Line, the CIL contained temperatures below -1.5°C, but the CIL area was near normal. In general, meteorological and ice conditions during late autumn of 1996 and early 1997 resulted in a continuation of moderate oceanographic conditions during early 1997. By mid-winter and into early spring air temperatures were below normal which resulted in increased ice cover and colder than normal spring upper layer ocean temperatures, particularly in the inshore regions.

iii) **Subareas 4, 5 and 6** (SCR Doc. 97/6; SCS 97/3)

Russian scientists reported that studies have been continuing on the interannual and seasonal variability of the thermal fronts between the shelf and slope waters and of the northern edge of the Gulf Stream (SCS 97/3). These fronts have generally been moving northward in recent years. Relationships between frontal movements and fish stock abundance are being examined. They also reported that a total of 70 hydrographic stations were occupied during their annual silver hake survey in October 1996.

Monthly monitoring of surface and bottom temperatures on a transect across the Middle Atlantic Bight revealed the lowest values in the 21 year record. The annual average anomaly was -1.9K at the surface and -0.8K near bottom. Surface salinities along this same transect were also at a minimum (1.17 psu below the 1978-92 mean). Near surface temperatures across the Gulf of Maine transect were also cooler than normal by 1.1K but in contrast the near bottom water was 0.2K above normal. No surface salinity data were reported for the Gulf of Maine in 1996, but thermal-salinograph data collected along the transect are undergoing calibration.

iv) **Interdisciplinary studies** (SCR Doc. 97/5)

Changes in the demersal fish assemblages off Greenland and their relationship with changes in near-bottom temperatures were explored based upon groundfish surveys during 1982-1996 (SCR Doc. 97/5). In comparison with the 1980s, the aggregated fish biomass for all species off East Greenland doubled while off West Greenland they decreased by 96%. Fish abundance indices also increased off East Greenland while they decreased slightly off West Greenland. The near average or warmer near bottom temperatures (using stratum means) did not indicate any unfavourable environmental conditions for fish growth and reproduction during the 1990s. Due to the high temporal and spatial variability in temperature especially off East Greenland, a question arose as to the usefulness of stratum means for temperature. However, good correlations between temperature time series at station 4 on the Fylla Bank Section and the stratum means suggest the latter are capturing the long-term trends.

5. **Overview of Environmental Conditions in 1996** (SCR Doc. 97/63)

A review paper was presented based on several long-term oceanographic and meteorological data sets. The highlights follow.

i) Annual air temperatures were above normal in 1996 in the Labrador Sea region and at their highest level in over a decade. Maximum temperature anomalies occurred in winter. Similar warm conditions were observed south to the Scotian Shelf. At the southern boundary of NAFO, air temperatures were slightly colder than normal.

ii) The atmospheric circulation pattern weakened resulting in the anomaly of the NAO index being negative. The annual decrease in the NAO index was the largest in the over 100-year record.

iii) Due to warm air temperatures and weaker winds, ice formed late, was of less areal extent and did not last as long as normal off southern Labrador, Newfoundland and in the Gulf of St. Lawrence. Ice conditions were not as severe as 1995 and the previous years of the 1990s.

iv) During 1996, the number of icebergs to reach south of 48°N fell relative to 1995. It was considered to be an average iceberg year.

v) As observed in the later months of 1995, above normal temperatures were observed throughout most of the water column at Station 27 during 1996. Temperatures were the warmest in over a decade.

vi) The volume extent of the CIL water off Newfoundland during the summer was below the long-term mean and is near its lowest value. There was, however, a slight increase compared to 1995. A below normal amount of CIL water was observed everywhere from southern Labrador to the Grand Bank.

vii) The CIL waters in the Gulf of St. Lawrence remained cold and their horizontal extent over the bottom of the Magdalen Shallows continued to be relatively large. Some moderation was observed as temperatures rose slightly and the area of ocean bottom covered by temperatures <0 and <1°C declined.

viii) Annual coastal sea temperatures at Boothbay Harbor and St. Andrews were above average while those at Halifax were colder-than-normal, a pattern similar to 1995.

ix) Deep water temperatures on the Scotian Shelf (Emerald Basin) and in the Gulf of Maine remained high during 1996 while in Cabot Strait they remained near normal values. The high temperatures on the Scotian Shelf and in the Gulf of Maine were related to the influence of warm slope waters penetrating onto the Shelf.

x) Cold waters were observed near-bottom and at intermediate waters over the northeastern Scotian Shelf and off southwestern Nova Scotia continuing a trend that began in the mid- to late-1980s. There is evidence of slight warming relative to past years.

6. Conclusions Drawn from the STACFEN Meeting

After the Chairman's presentation of highlights from environmental studies in 1995 at the September 1996 Fisheries Commission Meeting, it was decided by the Chairmen of the Fisheries Commission, that the Scientific Council repeat this presentation at five-year intervals. This would require a presentation during the September 2001 Fisheries Commission Meeting. As concerns the invited speaker for the June 1998 STACFEN Meeting, the Chairman will explore the possibility to have a contribution from the National Marine Fisheries Service in Woods Hole, MA, USA.

7. National Representatives

The names of two new national representatives responsible for submitting oceanographic data to MEDS were provided. These were J. Pissarra (Portugal) and J. Gil (Spain). They join the other representatives: G. Glenn (Canada), R. Dominguez (Cuba), E. Buch (Denmark), A. Battaglia (France), F. Nast (Germany), H. Okamura (Japan), R. Leinebo (Norway), A. J. Paciorkowski (Poland), F. Troyanovsky (Russia), L. J. Rickards (United Kingdom) and G. Withee (USA).

8. Joint Russian/German Data Evaluation (ICNAF/NAFO Data, Status Report) (SCR Doc. 97/12)

The Chairman reported on the Joint Russian/German Oceanographic Data Evaluation project whose objective is to examine ocean climate variability through obtaining and evaluating historical hydrographic data, including data collected by the former USSR. The fourth workshop within this project was held during 21-26 April 1997 in Hamburg, Germany. It concentrated upon the writing of a scientific publication (SCR Doc. 97/13, described above). The next and last workshop within the present scope of the project is scheduled for 4-11 August 1997 in Murmansk, Russia. Ideas will be developed in order to continue the cooperative research.

9. Acknowledgements

The Chairman closed the meeting by thanking the Secretariat and the participants for their contributions and cooperation.

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

Chairman: H. P. Cornus Rapporteurs: Various

I. OPENING

The Committee met at the Keddy's Dartmouth Inn, Dartmouth, Nova Scotia, Canada during 4-16 June 1997, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain finfish and invertebrate marine stocks. Representatives from Canada, Cuba, Denmark (in respect of the Faroe Islands and Greenland), European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Norway, Russian Federation and the United States of America. Various scientists assisted in the preparation of the reports considered by the Committee.

The Acting Chairman, H. P. Cornus, opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The Chairman noted there was some new material on the Precautionary Approach and other subjects that may need to be addressed, and suggested this matter be considered under 'Other Matters'. The agenda was accordingly **adopted** as presented in the Provisional Agenda.

II. GENERAL REVIEW

1. General Review of Catches and Fishing Activity

As in previous years STACFIS conducted a general review of catches in the NAFO Regulatory Area of Subarea 3 in 1996. Estimates of catches from various sources were considered and combined with catches reported (available to date) in STATLANT 21A forms in order to derive the most appropriate estimates of catches for the various stocks in Subarea 3. Contrary to the review in 1996 the estimation of the catches for two stocks caused difficulties.

Since 1995 there has been a Pilot Observer Program in effect with total coverage of all ships in NAFO areas operating under the flags of Contracting Parties. In addition landings by EU ships from NAFO area were inspected at the landing site in 1996. Results from the EU-Observer Program in 1996 indicated good agreement with the officially reported landings for EU member countries fishing in the NAFO area.

Estimates from Canadian surveillance, however, deviated significantly in 1996 for cod in Div. 3M and Greenland halibut in Subareas 2 and 3 compared to the officially reported landings. The reason for these differences were unclear and could not be resolved during this June 1997 Meeting. Therefore, STACFIS decided to consider the range of estimated catches/landings for the assessments of stocks for which significant differences between Canadian surveillance and other sources exist.

III. STOCK ASSESSMENTS

1. Cod in Division 3M (SCR Doc. 97/7, 18, 28, 42, 50; SCS Doc. 97/3, 4, 9)

a) Introduction

i) Description of the fishery

The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod is also taken as by-catch in the directed redfish fishery by Portuguese trawlers. Small amounts of cod were taken as by-catch in the shrimp fishery by Canada and Norway, based on observer data from these fleets in 1993-95, and were reported null in the Icelandic fishery in 1995 and 1996. The by-catch of cod in the past Russian pelagic fishery for redfish was also low. The fleet currently operating in Div. 3M includes vessels from non-Contracting Parties, most of them stern-trawlers.

ii) **Nominal catches**

From 1963 to 1979, the mean reported catch was 32 000 tons, with high variations between years. Reported catches declined after 1980, when a TAC of 13 000 tons was established, but Scientific Council regularly expressed its concern about the reliability of some catches in the period since 1963, particularly those since 1980. New estimates of the annual total catch since 1988 were made available in 1995 (Fig. 1), including non-reported catches and catches from non-Contracting Parties.

The 1996 fishery was very small compared with previous years: most of the fleets traditionally directing on Div. 3M cod did not participate. Most of the catch was obtained by the Portuguese trawlers as a directed cod fishery mostly in the second half of the year. Portuguese gillnetters, Spanish pair-trawlers, Faroese longliners and non-Contracting Party vessels reduced substantially their presence and catches.

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	13	0	0	0	13	13	13	11	11	11	6
Catch	11	29[1]	48[1]	41[1]	16[1]	25[1]	16[1,2]	30[1,2]	10[1,2]	3[1,2]	

[1] Includes estimates of misreported catches and catches of non-Contracting Parties.
[2] Provisional.

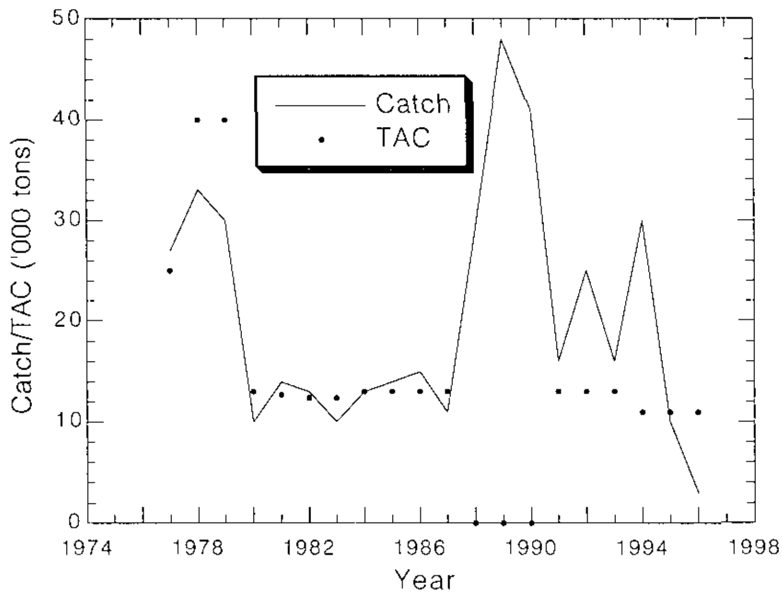

Fig. 1. Cod in Div. 3M: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Length and age composition for 1996 catches were available for Portuguese trawlers for March, May and December. Ages 3 and 5 dominated the catch, as was also reported from the Russian fleet.

ii) **Catch rates**

Portuguese trawl CPUE, derived from catch and effort data from a sample of the fleet, increased since 1990 to a peak in 1994, then declined in 1995 and 1996.

iii) **Research survey data**

Biomass and abundance estimates were available from research vessel bottom trawl surveys conducted by USSR/Russia from 1977 to 1995, with the exception of 1994 (Fig. 2), with a concurrent acoustic survey from 1985 to 1993. The estimates of bottom trawlable biomass in most recent period showed a maximum level of 37 000 tons in 1989, a minimum 2 500 tons in 1992, and declined from 8 300 tons in 1995 to 700 tons in 1996.

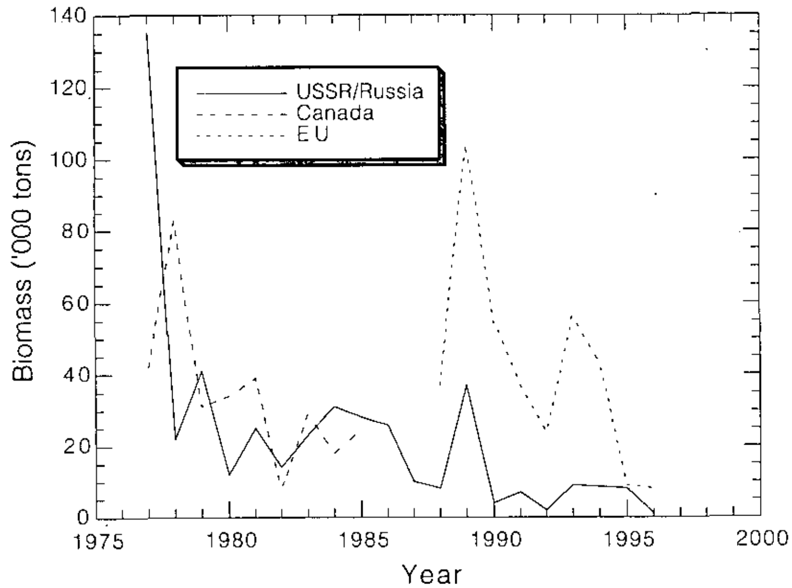

Fig. 2. Cod in Div. 3M: total biomass estimates from surveys.

Stratified-random bottom trawl surveys were conducted by the EU from 1988 to 1996. The surveys also showed a decline of trawlable biomass from a peak of 104 000 tons in 1989 to 24 000 tons in 1992, an increase to 56 000 tons in 1993 and a decrease to 8 800 tons in 1995 and 8 200 tons in 1996.

A stratified-random bottom trawl survey was conducted by Canada in 1996, as part of an overall survey of Div. 2GHJ and 3KLMNO. Trawlable biomass was estimated at 9 300 tons. There was a reasonably good fit between the biomass estimates for cod, American plaice and redfish in Canadian survey and EU-survey in 1996. The comparability of the trawls used in each survey should be investigated.

The peak stock biomass in 1989 indicated by both EU and Russian surveys was produced by the relatively abundant 1985 and 1986 year-classes when aged 4 and 3 years, respectively. The increase of biomass from 1992 to 1993 was attributed to the contribution of the also abundant 1990 and 1991 year-classes.

c) **Estimation of Parameters**

A sequential population analysis (XSA) was carried out for ages 1 to 8+ and years 1988 to 1996. Catch-in-number data corresponded to the estimates of total annual catch (figures for 1994 revised). Natural mortality was set at 0.2. The analysis was tuned with the results of the EU survey from 1988 to 1996.

STACFIS stressed that because of uncertainties associated with the fit of the XSA model, the results of the analysis can only be used to infer trends in biomass and fishing mortalities, and at present could not be used as a basis for any catch prediction.

d) **Assessment Results**

The apparent contradiction between the increase of CPUE from 1990 to 1994 and the decreasing trend of stock size, either from the assessment or the EU survey results, was related to the concentration of the majority of the population in dense shoals. This was observed in the analysis of cod catch distribution of EU surveys. This observation could induce an increase in catchability, and therefore the stock was able to support a fishery with a reasonable yield, even at the lowest biomass level, and at the expense of high fishing mortality.

Estimated fishing mortality was very high throughout the age range of the exploited population in 1992 and 1993. From 1994 onwards, the exploited population has been mainly restricted to the survivors of the 1991 and 1990 cohorts, but fishing mortalities of these cohorts remained at a relatively high level in 1994 and 1995 (Fig. 3). The lowest fishing mortality in 1996 is consistent with the decrease of the fishing effort and the catch in that year.

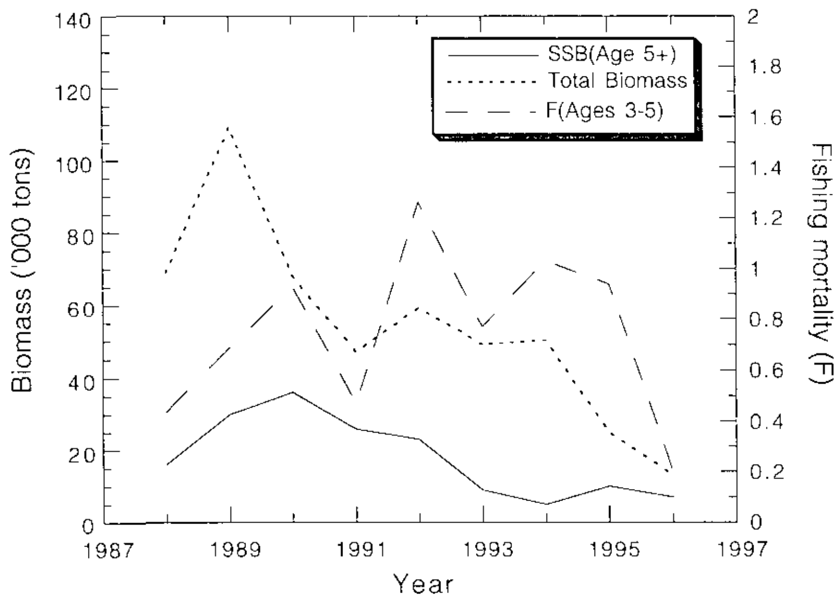

Fig. 3. Cod in Div. 3M: results from Sequential Population Analysis.

Total biomass decreased along the period from a peak value in 1989 and reached a minimum in 1996 reflected in both Russian and EU survey results. The XSA also confirms the relative abundance of the 1985 and 1990-1991 year-classes and the weakness of the 1992 to 1994 year-classes.

Limited data from the shrimp fisheries in Div. 3M indicate only low by-catch of cod. The low levels estimated from the observed shrimp fishery may be due, at least in part, to the low stock size. Furthermore, by-catch data from several fleets fishing shrimp are unavailable.

e) Spawning Stock Biomass

Spawning of cod on Flemish Cap generally begins at age 5. Spawning stock biomass, assumed to be age 5+ biomass, decreased since its record peak in 1990 and reached a record low in 1995 and 1996. New studies on cod maturation indicated that cod age 4 have been mature since 1994. The decrease of one year in the age-at-maturity of the stock is interpreted as a reaction of the population to the decline of the stock.

2. **Cod in Divisions 3N and 3O** (SCR. Doc. 97/25, 68, 70, 73; SCS. Doc. 97/9, 10)

a) Introduction

Nominal catches increased during the late-1950s and early-1960s, reaching a peak of about 227 000 tons in 1967. During the period from 1979 to 1991, catches ranged from 20 000 to 50 000 tons. The continued reduction in recommended TAC levels contributed to reduced catches in recent years to a level of about 10 000 tons in 1993 (Fig. 4). Directed fisheries on this stock ceased about mid-year in 1994. This suspension continued through 1997.

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Recommended TAC					Same as agreed						
Agreed TAC	33	40	25	18.6	13.6	13.6	10.2	6	0	0	0
Reported Catches	42	43	33	18	17	10.1	9[1]	1.9[1]	.17[1]	.17[1]	
Non-reported Catches	-	-	-	11	12	2.5	0.7	0.8	0	0	
Total Landings	42	43	33	29	29	12.6	9.7[1]	2.7[1]	.17[1]	.17[1]	

[1] Provisional.

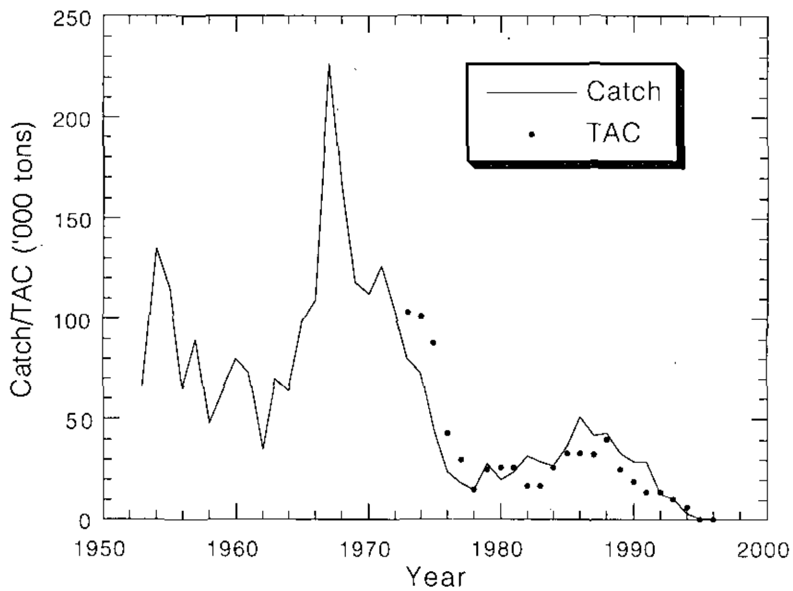

Fig. 4. Cod in Div. 3NO: catches and TACs.

Catches during 1996 totalled approximately 175 tons. All reported catches were by-catch mainly from Canadian long line and gill net fisheries (99 tons) and EU and non-Contracting Parties (76 tons).

b) **Input Data**

i) **Commercial fishery data**

Catch rates. There is no 1996 catch rate information since there were no directed fisheries for cod.

Catch-at-age. Very limited biological sampling data from by-catches were available from Canada only. Consequently, an estimate of the total removals-at-age could not be derived. STACFIS **recommended** that *data from by-catches of cod in Div. 3NO be presented in June 1998.*

ii) **Research survey data**

Canadian spring surveys. Stratified-random research vessel surveys have been conducted in spring by Canada in Div. 3N for the 1971-96 period, with the exception of 1983, and in Div. 3O for the years 1973-96 with the exception of 1974 and 1983.

A new survey trawl (Campelen 1800) was introduced to the Canadian survey starting with the autumn 1995 survey. Extensive comparative fishing with the old survey trawl (Engel 145) and Campelen trawl was conducted and conversions of 1984 to spring 1995 survey data to Campelen equivalents were calculated and used in the current assessment. Consequently, comparisons of data from previous assessments with those in the current assessment should be approached with caution.

A sharp increase in biomass occurred in 1987 but then declined until 1992 when it was the lowest observed since 1982. The biomass increased in 1993 but from 1994 to 1996, estimates declined to very low levels. Abundance estimates for Div. 3NO suggested similar trends to those observed for biomass (Fig. 5).

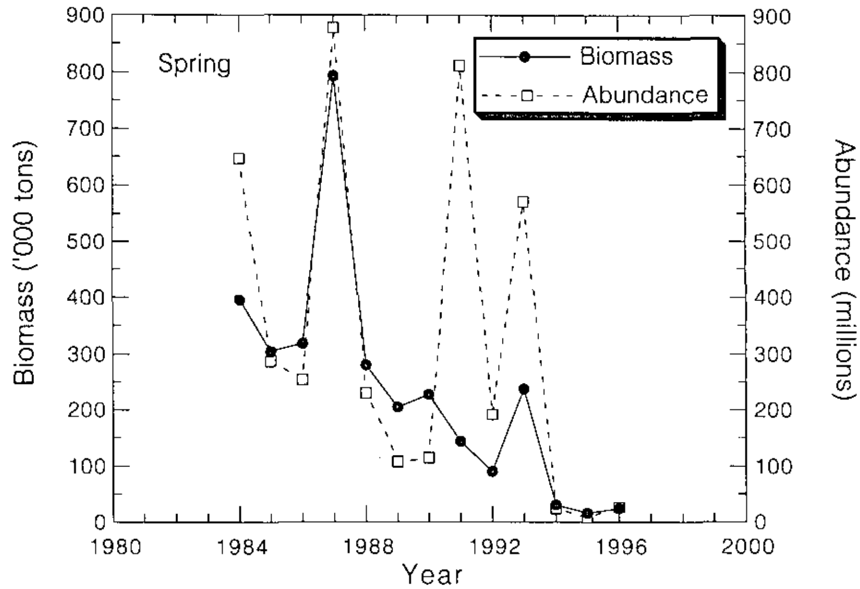

Fig. 5. Cod in Div. 3NO: abundance and biomass estimates from Canadian spring surveys.

Estimates-at-age indicated that the year-classes after 1983 have all been low relative to the year-classes that supported the fishery in the early- 1980s. The dominant year-classes in the 1992 to 1995 surveys were from the 1989 and 1990 cohort. They were present in the 1996 spring survey but all disappeared in the 1996 autumn survey.

Canadian autumn surveys. Additional stratified-random surveys have been conducted by Canada during autumn since 1990. Biomass and abundance estimates for Div. 3NO declined starting in 1991 and have remained low (Fig. 6).

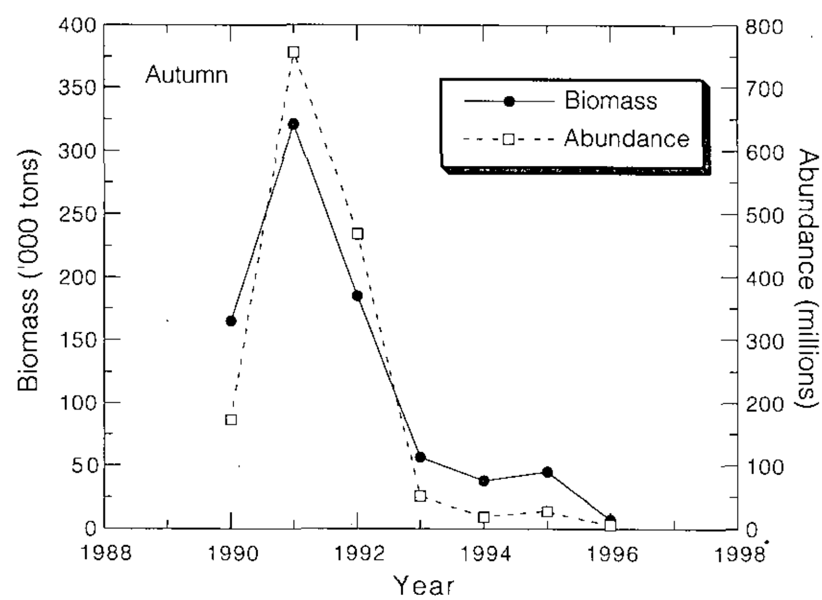

Fig. 6. Cod in Div. 3NO: abundance and biomass estimates from Canadian autumn surveys.

Canadian juvenile surveys. Canadian autumn juvenile survey data were available for the period 1989-94.

Spanish surveys. Stratified random surveys have been conducted by Spain during spring since 1995 in the Regulatory Area of Div. 3NO. Both biomass and abundance indices declined in 1997 from 1996.

Russian surveys. Russian survey data were available for the period 1977-93 but no new data have been available since that time.

c) **Estimation of Parameters**

(i) **Sequential population analysis (SPA)**

Sequential population analysis could not be conducted due to the lack of biological sampling. Consequently, determination of the trends in stock size through SPA was not possible.

d) **Assessment Results**

All available data indicate that there are only weak year-classes in the stock and biomass and abundance are at extremely low levels. Until recently, the stock was made up primarily of the 1989 and 1990 year-classes but the most recent surveys suggest that these year-classes are now at a low level.

3. **Redfish in Divisions 3L and 3N** (SCR Doc. 97/64; SCS Doc. 97/3, 97/8, 97/9)

a) **Introduction**

The average reported catch from Div. 3LN from 1959 to 1985 was about 22 000 tons ranging between 10 000 tons and 45 000 tons (Fig. 7). Catches increased sharply from about 21 000 tons in 1985, peaked at a historical high of 79 000 tons in 1987 and declined to about 27 000 tons in 1992. Catches in 1993 and 1994 could not be estimated precisely because of discrepancies in the available sources of information, however, the likely amount is between 18 000 tons and 24 000 tons for 1993 and 3 600 tons to 7 700 tons for 1994. Since 1994, catches continued to decline to the lowest historically for this fishery at 453 tons in 1996.

From 1980 to 1990 the TAC each year for this stock has been 25 000 tons. The TAC was reduced to 14 000 tons for 1991 and was maintained at that level to 1995. The TAC was reduced further in 1996 to 11 000 tons and maintained at that level for 1997. The estimated catches for 1994-96 are below their corresponding TACs and represents the first time since 1985 that the TAC was not exceeded. In some years catches have been double (1988) and even triple (1987) the agreed TAC.

In the early-1980s the former USSR, Cuba and Canada were the primary fleets directing for redfish. The rapid expansion of the fishery in 1986 was due primarily to the entry of EU-Portugal, taking about 21 000 tons. In 1987 various non-Contracting Parties (NCPs), most notably South Korea (now a Contracting Party), Panama and Caymen Islands began to fish in the Regulatory Area accounting for a catch of about 24 000 tons. From 1988 to 1994 NCPs had taken between 1 000 tons and 19 000 tons annually, however, they have not fished in Div. 3LN since 1994.

During the 1980s most of the Div. 3LN catch was taken in the vicinity of the Div. 3N and Div. 3O border in addition to the slopes of the Grand Bank in Div. 3L. Since the 1990s a considerable amount of activity, primarily by fleets from the Baltic countries, has occurred in the 'Beothuk Knoll' area which is located southwest of the Flemish Cap at the Div. 3M, Div. 3L and Div. 3N border. In 1994 fleets from the Baltic countries returned home early in the year because of a relatively poor fishery in the area and have not directed for redfish since then. In addition, Cuba has not fished its quota since 1993 and EU-Portugal has directed to other redfish fisheries or towards other species in the NAFO Regulatory Area since 1994. Most of the catch from 1994 to 1996 was taken from Div. 3N. The limited directed fishery in 1996 was conducted by Russia in Div. 3N.

STACFIS noted that the reasons for the reduced effort in recent years was varied amongst the fleets involved. The Russian fleet has been affected by economic problems, the Baltic countries have reduced their fleet and have directed to shrimp in Div. 3M. EU-Portugal, as mentioned previously, has directed to other fisheries (Div. 3O) and species (Greenland halibut) because of insufficient quota in Div. 3LN. Cuba has not fished in recent years because of poor yields with the current regulated mesh size of 130 mm. The Canadian fleet has not fished in this area recently because of poor yields.

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	25	25	25	25	14	14	14	14	14	11	11
Catch	79[1]	53[1]	34[1]	29[1]	26[1]	27[1]	21[1,2,3]	6[1,2,3]	2[1,2,3]	0.5[1,2]	

[1] Includes catch estimated by STACFIS.
[2] Provisional.
[3] STACFIS could not precisely estimate the catch (see text for explanation).

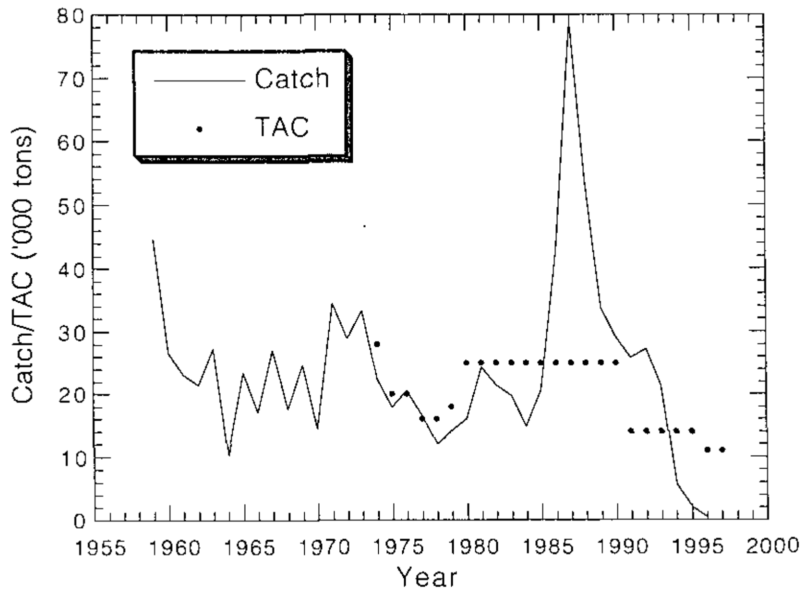

Fig. 7. Redfish in Div. 3LN: catches and TACs.

b) Input Data

i) Commercial fishery data

Updated catch-rate series with effort measured in hours fished and another with effort measured in days fished were derived for each Division separately using a multiplicative model.

As in the past indices using the NAFO data were not considered reflective of year to year changes in population abundance (see NAFO Sci. Coun. Rep., 1996, p. 72), although they may be indicative of trends over longer periods of time. STACFIS considered that no judgement could be rendered from the recent data in the series and these indices of abundance are of little value in determining current stock status.

Limited sampling for 1996 available as by-catch from a Portuguese otter trawl fishery in Div. 3L (SCS Doc. 97/9) suggested sizes between 29-35 cm dominated the catch based on a sample obtained in February to April and December. The overall mean lengths of the samples were 31.2 cm. Sampling of the 1996 Div. 3N Portuguese otter trawl fishery from February and June suggested lengths 28-32 cm dominated the catch. The overall mean length of these samples were identical to Div. 3L at 31.2 cm. The sampling in Div. 3L and Div. 3N is based on low levels of catch.

ii) **Research survey data**

Stratified-random surveys have been conducted by Canada in Div. 3L in various years and seasons from 1978 to 1996 in which strata up to a maximum of 1500 m were sampled. Up until the autumn of 1995 these surveys were conducted with an Engels 145 high lift otter trawl utilizing a small mesh codend liner (29 mm) and tows conducted for 30 minute duration. Beginning in autumn 1995, the survey was conducted with a Campelen 1800 survey gear with a 12 mm codend liner and 15 minute tows. Data from comparative fishing trials between the Engels trawl and protocol, and, the Campelen trawl and protocol were not available prior to this meeting to convert the pre-autumn 1995 Engels data into Campelen equivalents.

Results of bottom trawl surveys for redfish demonstrated a considerable amount of variability. This was realized both between consecutive seasons and years, and amongst tow by tow catches within a single survey. Survey abundance and biomass estimates showed large fluctuations between some adjacent years. Although it was difficult to interpret year to year changes in the estimates, in general, the data suggested that the survey biomass index (Fig. 8) from spring 1992 up to spring 1995 was at its lowest level (average 4 500 tons) relative to the time period prior to 1986 (average 103 000 tons). The autumn 1995 index at 50 000 tons is largely the result of a single large catch in one stratum (about 45 000 tons of this estimate is due to this relatively large catch). Regardless of this caveat, the 1995 estimate is still lower than the unconverted estimates prior to the mid-1980s. The 1996 spring and autumn indices were at 17 000 tons and 5 000 tons, respectively. The average of the Campelen surveys from autumn 1995 to autumn 1996 is 24 000 tons.

Canadian surveys have also been conducted in spring (1991-97) and autumn (1991-96) in Div 3N. These surveys also utilized the Campelen survey trawl beginning in autumn 1995 as described above. Survey abundance and biomass estimates in Div. 3N were generally higher than in Div 3L, but it was also evident that there was greater fluctuation of, and larger variability around the estimates than in Div. 3L. The source of this variability was unclear but was likely due to availability to the trawl gear or migrations to and from Div. 3N rather than real changes in population abundance, and therefore were not considered reflective of year to year changes in population abundance. Survey biomass from autumn 1995 to spring 1997 have averaged about 16 000 tons. The Committee noted that these estimates were within the range of the unconverted estimates of the surveys prior to the Campelen surveys.

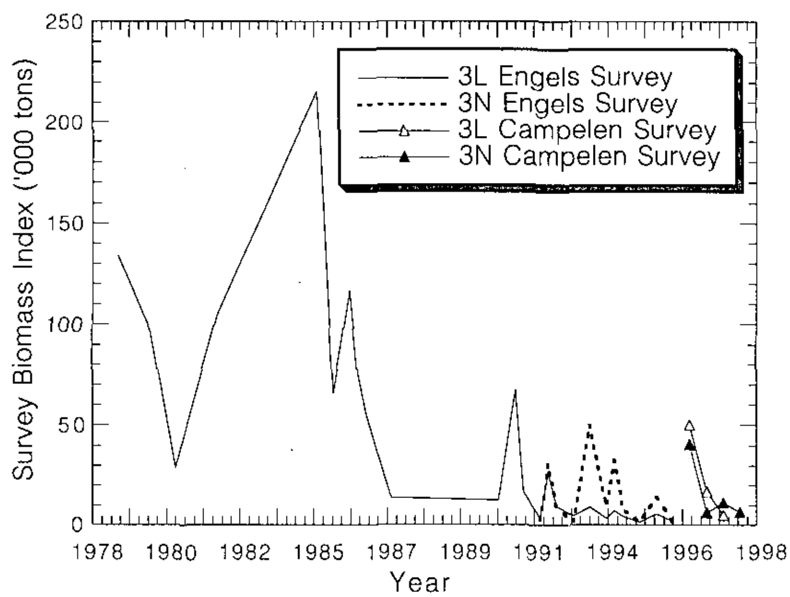

Fig. 8. Redfish in Div. 3LN: survey biomass indices from Canadian surveys in Div. 3L and Div. 3N.

A comparison of the Canadian and Russian bottom trawl surveys in Div. 3L indicated a similar trend of decline in survey biomass indices from 1984 to 1990, and both indices have remained at this relatively low level to 1994. It was noted, however, that the 1994 Russian survey did not cover the entire Div. 3L. The Canadian index continued to be relatively low to the autumn 1996 except for a spike observed in autumn of 1995. The situation was unclear for Div. 3N. The Russian surveys indicated relatively low biomass index from 1989 to 1991 with a dramatic rise in 1993. This large increase in 1993 relative to 1991 was highly influenced by the trawling conducted in one stratum, which accounted for 70% of the biomass but only represented about 9% of the area surveyed. There have been no Russian surveys conducted in Div. 3L since 1994 or Div. 3N since 1993.

iii) **Recruitment**

Length distributions in mean-per-tow and age distributions in number-per-thousand from the regular spring and autumn Canadian surveys in Div. 3L indicated there has been relatively poor recruitment over the time period covered by the surveys. These also indicated the seasonal variability in years where seasons have been covered sufficiently. The 1996 spring and autumn surveys were comprised mostly of fish between 19 cm to 25 cm. There was no sign of any good recruitment in the recent surveys which are more efficient at capturing the smaller sized redfish (<15) cm than the previously used Engels gear.

Length distributions and age distributions from spring and autumn Canadian surveys in Div. 3N from 1991-97 showed different size/age compositions compared with Div. 3L for each corresponding seasonal survey, generally being composed of size/age groups that were much smaller. The 1997 spring survey catch was primarily composed of fish between 13-25 cm. There was a relatively good pulse of recruitment picked up in the 1991 autumn survey in the range of 12-14 cm (1986 and 1987 year-classes) that could be tracked through to the 1995 spring survey at about 19 cm. This mode was also reflected in the 1997 spring survey which had a peak at 21 cm. A mode appeared in the 1997 spring survey at 14-15 cm, which also may indicate a relatively good year-class, but there was no sign of any good year-classes subsequent to this in the surveys.

c) **Assessment Results**

Based on the available data the stock appears to be at a very low level with little or no sign of good recruitment.

d) **Future Studies**

Noting that there was no new information available to address an outstanding recommendation relative to the integrity of Div. 3LN and Div. 3O as management units for redfish, the Committee was informed that work continues within Canada to address questions related to stock structure and migration of redfish. These studies have also included areas north of Div. 3L and that pertinent information would be tabled when analyses are completed. STACFIS regards this issue as important and necessary to resolve. STACFIS concluded that a further look at various databases for redfish in Div. 3LN and 3O is warranted and accordingly **recommended** that *(1) data in Div. 3LN and 3O be analyzed further to determine if a relationship exists between Div. 3O and Div. 3LN that may help in the interpretation of the indices of abundance; and (2) data be examined to evaluate the appropriateness of Div. 3LN and Div. 3O as management units for redfish.*

4. **Redfish in Division 3M** (SCR Doc. 97/ 8, 9, 28, 42, 44, 79, 80; SCS Doc. 95/ 3, 8, 9, 11)

a) **Introduction**

There are three species of redfish which are commercially fished on Flemish Cap: deep sea redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The term beaked redfish is used for *S. mentella* and *S. fasciatus* combined. Because of the difficulties with identification and separation, all three species are reported together under 'redfish' in the commercial fishery.

b) **Description of the fishery**

The redfish fishery in Div. 3M experienced substantial changes from the mid-1980s to the present. These changes are related both to changes in fleet composition, and with the opportunistic behaviour of the remaining fleets. Division 3M redfish has been a second choice target as regards cod and, more recently, Greenland halibut. In other words the declines observed in the Div. 3M redfish fishery from 1990 to 1996 have been influenced by the decline of fishing effort deployed in this fishery.

Recent catches ('000 tons) are as follows (Fig. 9):

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	20	20	20	50	50	43	30	26	26	26	26
Catch	44.4	23.2	58.1[1]	81.0[1]	48.5[1]	43.3[1]	29.0[1,2]	11.3[1,2]	13.5[1,2]	5.8[1,2]	

[1] Includes estimates of non-reported catches from various sources.
[2] Provisional.

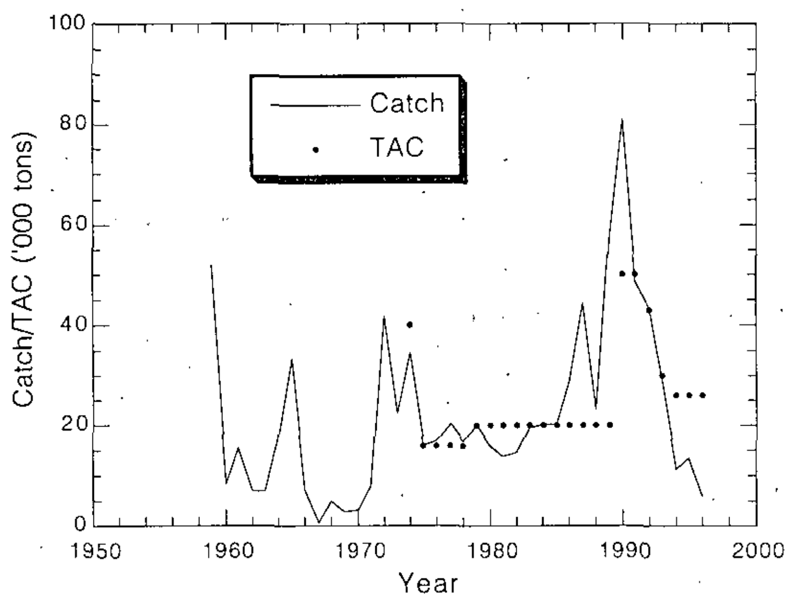

Fig. 9. Redfish in Div. 3M: catches and TACs.

From 1987 to 1992 (excluding 1988) annual catches were greater than 40 000 tons. Catches have since declined to 5 800 tons in 1996.

Historically, the fishery was conducted primarily by bottom trawlers from EU-Portugal, Cuba and South Korea and by midwater trawlers from Russia and the Baltic States (these latter fleets only showing up in 1992 and 1993). A small proportion of the catch was taken annually by Portuguese gillnetters. Catches from the Spanish bottom trawl fleets were taken as by-catch of the cod and Greenland halibut fisheries. Japanese bottom trawling maintained a limited but constant presence in the Div. 3M redfish fishery.

In 1992 Russian catches fell to only 2 937 tons compared to 24 661 tons caught in the previous year. In 1994 and 1995 Russia and EU-Portugal were still the main participants in the fishery, although with an important decline in the Portuguese catches from 1994 (5 630 tons) to 1995 (1 282 tons). Neither the Baltic fleets nor South Korea reported redfish catches in 1994 or 1995.

Estimated Div. 3M redfish catches from non-Contracting Parties (EU crewed) represented 13% and 26% of the overall catch for 1994 and 1995, respectively. Most of these catches, as well as the Portuguese catches, were taken as by-catch of the Div. 3M cod trawl fishery.

In 1996 the Div. 3M redfish catch was the lowest observed in recent times. The limited fishery was carried out mainly by Korean crewed non-Contracting Party vessels (4 150 tons, from Canadian surveillance reports). Japan (678 tons) and EU-Portugal (332 tons) were the major Contracting Parties fishing in 1996. Based on courtesy inspections, the EU crewed non-Contracting Parties vessels in 1996 recorded a Div. 3M redfish catch of 575 tons, most probably as a by-catch of the residual Div. 3M cod fishery.

c) **Input Data**

i) **Commercial fishery data**

Sampling data. Most of the commercial sampling data available for the Div. 3M redfish stocks, since 1989, were from the Portuguese fisheries. All redfish otoliths were read using the same criteria. The criteria have been revised recently and all age information has been revised accordingly.

The available 1995 and 1996 length distributions from Portuguese beaked redfish trawl catches showed that the mean length decreased by about 5 cm (32 cm in 1995 to 27 cm in 1996). The respective age structure of the 1995 beaked redfish trawl catches was mainly built up of ages 7 to 16. In 1996 younger fish dominated the catch (ages 5 to 10). Beaked redfish 19 years and older represented 30% of the Portuguese gillnet catches in 1993, 49% in 1994 and 26% in 1995. No sampling of the gillnet catches was available for 1996.

Information on length and age composition of the 1996 golden redfish trawl catches were from a small sample, but suggest a dominance of fish aged 5 and 6. This 1996 age composition should be interpreted with caution due to the small sample size, but it is consistent with the 1994-96 EU survey results.

Redfish by-catch in the shrimp fishery. Redfish has been the most important component in the by-catch of the Div. 3M shrimp fishery. The rapid decline of the redfish by-catch in weight and in numbers from 1993 to 1995 may be related to the introduction of the Nordmore grate in 1994 and the reduction of the bar spacing of the grate in 1995. However, reductions may also have occurred due to weak year-class strengths.

The Canadian and Norwegian by-catches were dominated by the 1990 year-class in 1994 and 1995. There were no by-catch samples for 1993. Only preliminary data were available for 1996. These data from the Icelandic shrimp fishery in 1996 and early-1997 indicate a reduction of the proportion in weight of redfish in the shrimp catch to 1.6% and 0.5%, respectively.

A loss of potential yield for the Div. 3M redfish stocks due to the 1993-95 by-catches has been previously estimated to be about 25 000 tons (NAFO Sci. Coun. Rep., 1995, p. 75). This figure was updated for Div. 3M deep water redfish (commercially the most important redfish species and the most abundant redfish stock in Flemish Cap) using a yield-per-recruit curve calculated with EU survey data and Portuguese commercial data, and assuming a constant natural mortality of 0.1. This confirmed the loss of potential yield through the 1993-95 by-catch in the shrimp fishery to be in the range of 23 000-25 000 tons.

CPUE data. In previous Div. 3M redfish assessments it has been concluded that a standardized CPUE series based on STATLANT 21B data was not appropriate as an indicator of the state of the Div. 3M redfish stocks (NAFO Sci. Coun. Rep., 1995, page 75).

A standardized CPUE series from the Portuguese trawl fleet was presented, based on data taken only from monitored vessels and only from fishing days directed to Div. 3M redfish, from 1988 onwards. Redfish trawl catch rates in Div. 3M gradually declined from 1989 to 1991, most probably as an immediate consequence of the unusually high catches observed in 1989-90. They then fluctuated with no apparent trend from 1992 to 1996.

Trends in both Portuguese CPUE and EU survey biomass series (for the three species combined) generally agreed over this more recent period.

The schooling behaviour and changes in distribution of redfish species, both vertically and spatially, make interpretation of any CPUE series difficult. For redfish, CPUE series may be more appropriate to detect a general trend of the stocks only over a time period of several years.

ii) **Research survey data**

There are two survey series providing biomass indices as well as length and age structure of the Flemish Cap redfish stocks; one from Russia and the other from EU-Spain and EU-Portugal. The Russian survey has been conducted as a bottom trawl survey down to the 731 m depth contour from 1983 to 1995, with an interruption in 1994. The 1996 Russian bottom trawl survey covered for the first time the strata within 731-914 m range. The biomass estimates were for beaked redfish, whereas in 1995 and 1996 separate estimates are available for golden redfish and for beaked redfish.

The Russian bottom trawl survey series was complemented with an acoustic estimate of the pelagic component of the redfish stocks between 1988 and 1993.

Both bottom and total redfish biomass from the Russian surveys have now been updated with the bottom golden redfish biomass estimates for the 1987-96 period now available.

The EU survey has been conducted annually in June-July since 1988 as a bottom trawl survey, down to the 731 m depth contour. During the 1988 and 1989 surveys, only golden redfish were separated from the rest of the redfish catches. Beginning in 1990, juvenile redfish (less than 15 cm) were also separated as an independent category because it is very difficult to separate these small fish by species. From 1991 onward, the 3 species and juveniles were separated in each haul catch prior to sampling procedures.

Bottom trawl biomass indices from both surveys show large interannual variability. Nevertheless, each survey series presents a different picture of the recent evolution of the trawlable biomass and abundance of the Div. 3M redfish stocks, primarily as regards the beaked redfish stock.

A bottom trawl survey was also conducted by Canada on Flemish Cap during autumn 1996, the first since 1985. The survey used a stratification scheme down to 1 462 m and was carried out by 2 vessels using the same fishing gear, one covering the strata to 731 m and the other covering the deeper strata, but just on the western and northern slopes of the bank.

Survey results. Biomass indices from all surveys are presented in the following table (Fig. 10):

	EU					Canada			Russia			
Year	*S.marinus*	*S.mentella*	*S.fasciatus*	juveniles	total	*S.marinus*	*Sebastes* spp.	total	*S.marinus*	*Sebastes* spp.	bottom(1)	total(2)
1983	-	-	-	-	-	-	-	-	-	-	154.900	-
1984	-	-	-	-	-	-	-	-	-	-	132.300	-
1985	-	-	-	-	-	-	-	-	-	-	51.900	-
1986	-	-	-	-	-	-	-	-	-	-	309.500	-
1987	-	-	-	-	-	-	-	-	4.300	106.400	110.700	461.300
1988	15.289	-	142.933	-	158.222	-	-	-	14.400	47.000	-61.400	393.400
1989	22.958	-	113.675	-	136.633	-	-	-	6.800	83.300	90.100	372.700
1990	14.699	72.893	-	16.601	104.193	-	-	-	3.000	17.700	20.700	249.400
1991	4.093	50.071	5.680	4.001	63.846	-	-	-	0.100	45.400	45.500	107.800
1992	4.130	71.810	5.308	23.229	104.477	-	-	-	0.300	18.200	18.500	99.800
1993	4.173	25.056	4.425	28.935	62.589	-	-	-	2.800	69.800	72.600	149.900
1994	33.240	35.710	7.829	49.233	126.011	-	-	-	-	-	-	-
1995	9.042	59.332	5.032	235	73.641	-	-	-	0.900	20.700	21.600	-
1996	11.293	77.897	11.025	329	100.544	10.800	112.687	123.487	5.900	10.000	15.900	

Russian survey. While the total redfish biomass from the Russian survey series declined from a level of 461 300 tons in 1987 to 107 800 tons in 1991, increasing to 149 900 tons in 1993, the trawlable redfish biomass generally declined from 110 700 tons (1987) to 18 500 tons (1992), increasing in 1993 to 72 600 tons. Bottom biomass represented a proportion of the total biomass between 8% (1990) and 48% (1993).

In 1995 and 1996 the combined redfish trawlable biomass was estimated to be 21 600 tons and 15 900 tons respectively (Vaskov, 1997). These estimates are the among lowest in the Russian trawl survey series.

Survey results indicate poor recruitment for golden redfish since 1992 and for beaked redfish since 1991.

EU survey. The trawlable redfish biomass from the EU survey series for the 3 species combined declined continuously from 158 000 tons (1988) to 64 000 tons (1991). From 1991 to 1996 the redfish trawlable biomass oscillated with no apparent trend between 64 000 tons (1991) and 126 000 tons (1994), being in 1996 at 100 500 tons.

Examination of the abundance at age and biomass by species shows that the most recent history of each of the Div. 3M redfish stocks does not follow the same trends. The majority of the redfish from the 1990 to 1992 cohorts were deep water redfish and their growth and 'recruitment' to the fishable stock each year allowed a continuous increase of the trawlable biomass from 1993 (25 000 tons) till 1996 (78 000 tons). The 1991 cohort was the most abundant in this stock in 1996, followed by ones from 1992 and 1990.

Acadian redfish was the most stable stock for the 1991-95 period (at least near the bottom), with a trawlable biomass around 5 000 tons. However in 1996 the biomass increased drastically to 11 000 tons, possibly due to an unusually high concentration of this species near the bottom.

The golden redfish biomass dropped from a former level between 15 000 tons and 23 000 tons (1988-90), to 4 000 tons (1991-93). In 1994 an anomalous concentration of golden redfish near the bottom pushed up the biomass estimate to an isolated peak of 33 000 tons. In 1995 and 1996 the golden redfish biomass didn't change and was around 10 000 tons, with the 1990 and 1991 cohorts dominating the age structure of this stock.

Juvenile redfish biomass began increasing in 1992, up from 4 000 tons to 23 000 tons just in one year. The juvenile biomass continued to increase up to 49 000 tons in 1994 as a consequence of good consecutive year-classes (1990, 1991 and 1992) and individual growth. By 1995 and 1996, the strong cohorts from the early-1990s have grown to lengths greater than 15 cm and were assigned to species. Meanwhile the year-classes after 1992 are weaker than their predecessors. The result has been very low juvenile biomass estimates during 1995 and 1996.

Canadian survey. At present only trawlable biomass is available for the 1996 Canadian survey. Considering only the strata to 731 m there was reasonably good agreement between the biomass estimates from the Canadian survey (123 500 tons) and the EU survey (100 500 tons). There was also a reasonably good match between the strata where most of the combined redfish biomass was found during each survey.

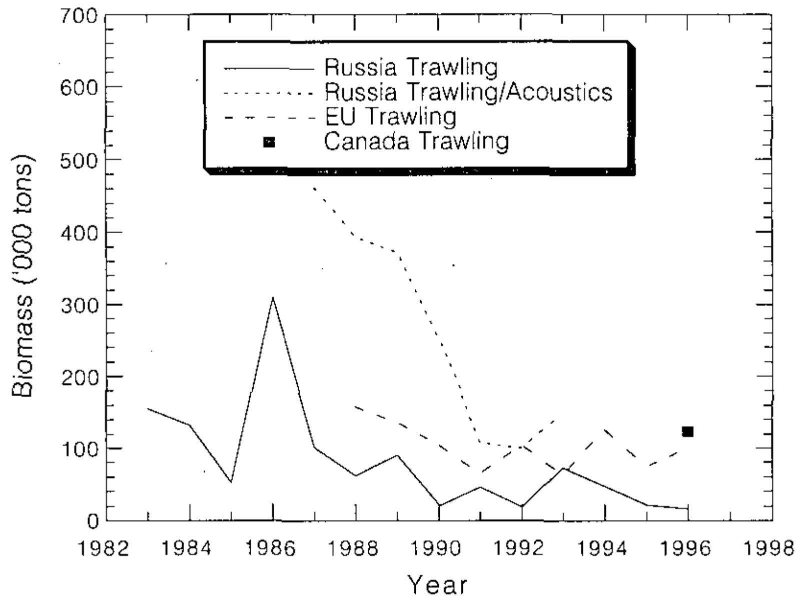

Fig. 10. Redfish in Div. 3M: biomass.

d) **State of the Stock**

During the late-1980s and early-1990s (1989-91) the overall biomass of the Div. 3M redfish stocks declined, most probably as a consequence of the unusual high level of the Div. 3M redfish catches, both on the direct redfish fishery and on the cod fishery in Flemish Cap.

Since 1991 biomass and abundance estimates from the EU bottom trawl survey series suggested no change of the golden and American redfish stocks, together with a continuous increase of the beaked redfish stock observed since 1993. These survey results match with the Portuguese catch rate series available for Div. 3M redfish, which presents an interannual fluctuation synchronized with the fluctuations observed in the combined Div. 3M redfish biomass from the EU survey.

The recruitment to all stocks (but primarily to the beaked redfish stock) of at least 2 consecutive strong year- classes (1991 and 1992), contributed to an increase in number and weight of the younger ages of all 3 redfish stocks and to an overall decline on fishing mortality. Despite the annual fluctuations on the concentration of redfish near the bottom, reflected in the observed fluctuations on the survey biomass indices, if strong year-classes continue to be allowed to pass through the shrimp fishery with minimum damage and if redfish catches do not increase again to the high levels of 1989-91, most probably the Flemish Cap redfish stocks will continue to recover in the near future.

e) **Research Recommendations**

STACFIS noted that the method of presentation of redfish by-catch information from the shrimp fishery continues to be variable. It is **recommended** that *in future the estimated numbers of redfish by-catch in Div. 3M shrimp fishery, as well as their length-frequency distribution be presented to STACFIS*. This will enable STACFIS to better evaluate possible impacts on a regular basis.

STACFIS encourages continuing efforts to resolve the age determination problems for redfish. Because of continuing discrepancies in interpretation it is difficult to easily compare data from different laboratories. Therefore STACFIS **recommended** that *in addition to age determinations, length frequency distribution for redfish in Div. 3M should also be provided.*

5. **American Plaice in Divisions 3L, 3N and 3O** (SCR Doc. 97/25, 60; SCS Doc. 97/9, 10)

a) Introduction

This fishery was under moratorium in 1996. Total catch in 1996 was 913 tons, mainly taken in the Regulatory Area (Fig. 11). Canadian catch in 1996 was about 59 tons, taken as by-catch, mainly by inshore gears.

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	48	40[1]	30.3	24.9	25.8	25.8	10.5	4.8[2]	0	0	0
Catch	55[3,4]	41[3,4]	43[3,4]	32[3,4]	35[4]	13[4]	17[5,6]	7[5]	0.6[5]	0.9[5]	

[1] Although the TAC was set at 40 000 tons, Canada reduced its domestic quota to 33 000 tons, therefore the effective TAC was 33 585 tons.
[2] No directed fisheries allowed.
[3] Includes a percentage of the "flounder non-specified" catch reported to NAFO by South Korea.
[4] Includes estimates of misreported catches.
[5] Provisional.
[6] Catch may be as high as 19 400 tons.

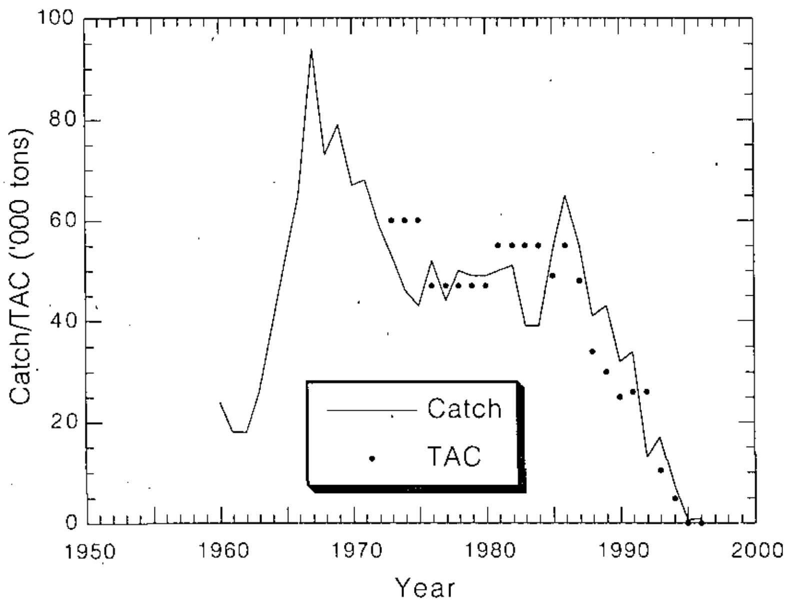

Fig. 11. American plaice in Div. 3LNO: catches and TACs.

b) Input Data

i) Commercial fishery data

Catch and effort. There were no catch and effort data available.

Catch-at-age. There were no catch-at-age data available. There was limited sampling of by-catch in the Portuguese and Spanish fisheries. In the Portuguese catch in Div. 3L there was a mode of about 32-38 cm while in Div. 3N the mode was 36 cm (SCS Doc. 97/9). The catch of the Spanish trawler fleet showed a mode of 30-37 cm in Div. 3L and of 26-33 cm in Div. 3NO (SCS Doc. 97/10).

ii) **Research survey data**

Canadian stratified-random groundfish surveys. Data from **spring surveys** in Div. 3L, 3N and 3O were available, with some exceptions, from 1971 to 1996 (SCR Doc. 97/60). Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 1996, the depth range has been extended to at least 731 m in each survey.

In Div. 3L, the trawlable biomass index was highest from 1978-82, declined to a lower but stable level from 1985 to 1988, then declined by 35% or more in each year from 1989 to 1994, and in 1995 was at a level (4 600 tons) which is only about 3% of the 1985-88 mean value.

In Div. 3N, the trawlable biomass index also showed a decline in recent years, with 1994 and 1995 (4 100 tons) being the lowest points by far in the series, about 55% lower than the 1993 value. In Div. 3O, the biomass index has shown a consistent decline since 1990, with the 1994 and 1995 (9 600 tons) values being the lowest in the series, down 30% from the previous low in 1993.

In all areas, the trawlable abundance was generally highest in the late-1970s and early-1980s (Fig. 12) as the strong year-classes of the early-1970s dominated survey catches. The total abundance index for 1995 was the lowest estimate in the series having declined by 85% from the value of 1990. In the late-1970s, fish aged 9 years and older made up 35 to 45% of the abundance index. By 1995, fish in these age groups made up only 25% of the index, and the estimates of abundance at these ages had declined by more than 95% during this period. Also, the proportion of the stock north of 45°N has decreased substantially in recent years.

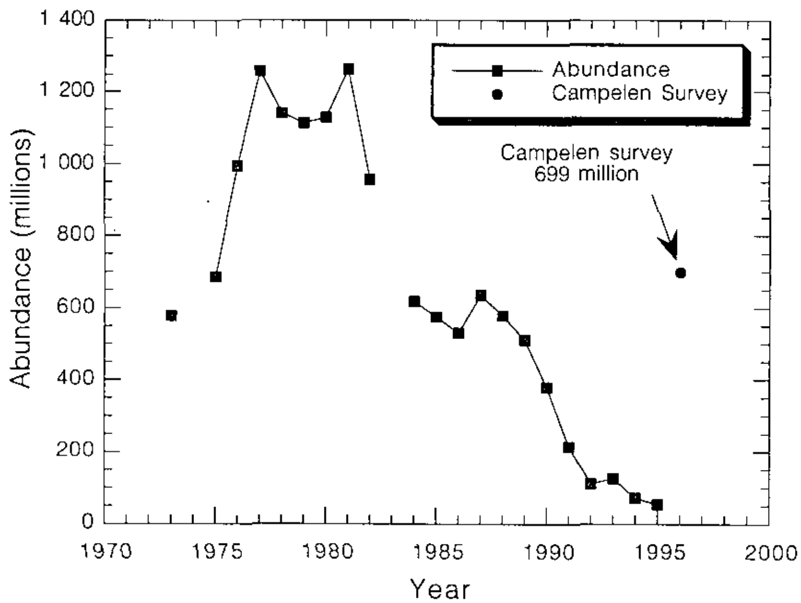

Fig. 12. American plaice in Div. 3LNO: abundance from spring surveys.

The 1996 spring survey was conducted using a Campelen 1800 trawl. Until a conversion factor is applied the biomass estimates from this survey are not comparable to the earlier spring surveys. The biomass index for Div. 3L was 31 000 tons, for Div. 3N it was 26 000 tons and for Div. 3O 49 000 tons. Only 4% of the abundance index is made up of fish aged 9 years and older.

From Canadian autumn surveys in Div. 3L, (maximum depth of 731 m since 1990) population estimates have shown a sharp downward trend since 1984 to a level in 1994 (6 500 tons) which was less than 3% of the estimates in the early-1980s (SCR Doc. 97/60). Similar to the spring surveys, the 1994 abundance estimates at almost every age older than 4 years were the lowest in the series.

From 1990 to 1994, autumn surveys were also carried out in Div. 3NO (maximum depth of 731 m since 1993). The 1994 biomass estimates in both Divisions were the lowest in the time series (Div. 3N 23 200 tons, Div. 3O 16 600 tons). The estimates of total abundance from the autumn surveys in Div. 3L declined by 30% or more in each of the last 4 years, while there was no trend in either Div. 3N and 3O. For Div. 3LNO in total, the autumn surveys indicate a decline in abundance of 75% from 1990 to 1994 (Fig. 13), compared to a decrease of 80% during this period in the spring surveys (Fig. 12).

The autumn 1995 and 1996 surveys were conducted using a Campelen 1800 trawl and are not yet comparable to previous autumn surveys. The Div. 3LNO combined biomass estimate was 153 000 tons in both years. In 1995, less than 5% of the abundance was made up of fish age 9 years and older.

Canadian juvenile groundfish surveys. Stratified-random surveys of Div. 3LNO were conducted inside the 91 m depth contour from 1985 to 1988, were extended to 183 m in the 1989 to 1991 surveys and further to 273 m in the 1992 to 1994 surveys (SCR Doc. 97/60). In both Div. 3L and 3N, the total abundance and biomass increased slightly in 1994 compared to 1993, but were relatively stable over the last few years. In Div. 3O, total abundance declined somewhat in 1994, but both abundance and biomass in Div. 3O were fairly stable since 1989.

This survey was examined including only the commonly surveyed area in each year to determine if increases in survey coverage were responsible for the stability in the estimates of abundance and biomass in this survey series (Fig. 14). Analyses of the commonly surveyed area also produced stable estimates over the time period.

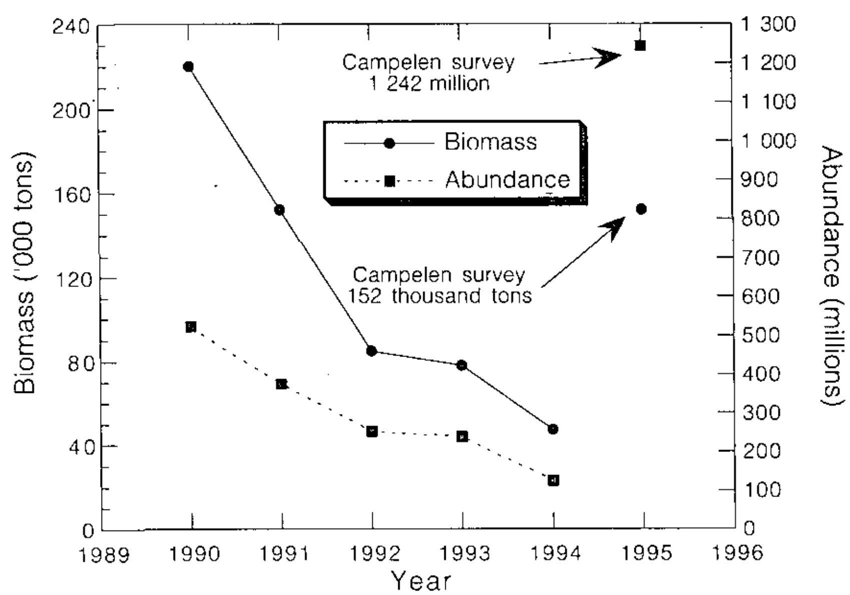

Fig. 13. American plaice in Div. 3LNO: biomass and abundance from autumn surveys.

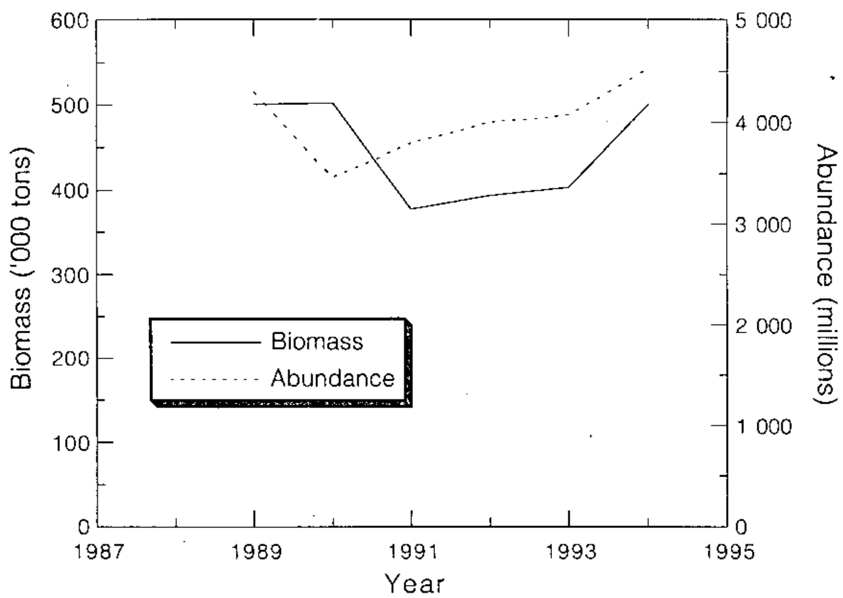

Fig. 14. American plaice in Div. 3LNO: biomass and abundance from juvenile surveys.

USSR/Russian surveys. Results from USSR/Russian surveys in Div. 3LNO were available for 1972-91. The results agree with those of the Canadian spring surveys indicating an increase in stock size in the late-1970s and early-1980s followed by an almost continuous decline from 1984. No comparable survey was done in 1992 or 1995, and the 1993 and 1994 results were not available at this meeting. STACFIS recognized the importance of the Russian spring survey data in providing an index of abundance for the stock, but noted that data for 1993 and 1994 are unlikely to be available in the near future.

Spanish surveys. Surveys have been conducted annually since 1995 by Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 300 m (SCR Doc. 97/25). The biomass index of American plaice in strata surveyed in both the 1996 and 1995 surveys showed a large increase in 1996. The biomass index in strata surveyed in both 1997 and 1996 showed a large decrease in 1997. The fish appeared to be distributed deeper in 1997.

iii) **Biological studies**

Mean weights at age were calculated for males and females in Div. 3L, 3N and 3O from 1990-1995. There were no apparent trends in mean weights for either sex (SCR Doc. 97/60).

Length at 50% maturity (L_{50}) was calculated for Div. 3LNO for males and females from 1975-96. For both sexes, L_{50} has declined starting in about 1984. From 1975-82 the average L_{50} for males was 23 cm while since 1990 it has been 19 cm. Females had an average L_{50} of 39 cm from 1975-82 with the average since 1990 being 36 cm (SCR Doc. 97/60).

An index of female spawning stock biomass was calculated from the Canadian spring groundfish surveys from 1975 to 1995. This index was relatively stable until the late-1980s when it began a precipitous decline (Fig. 15). The 1995 estimate of 6 000 tons is 95% less than the estimates of the mid-1980s (SCR Doc. 97/60).

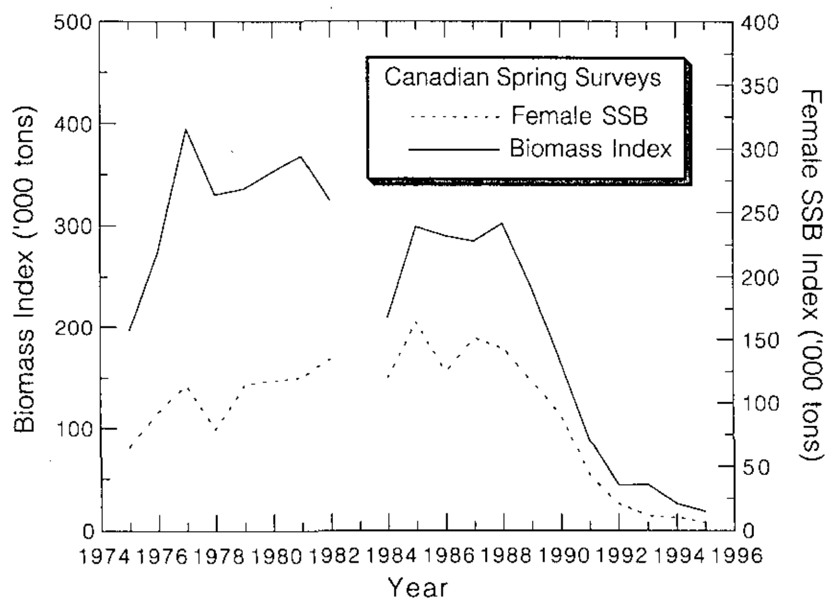

Fig. 15. American plaice in Div. 3LNO: estimates of biomass and SSB from Canadian spring surveys.

Relative cohort strengths (ages 2-5) were estimated from the Canadian spring groundfish surveys from 1975 to 1996 (SCR Doc. 97/60). From 1968-78 cohort strengths appear to have varied with little trend. From 1980 to 1993 cohort strengths have been low except for the cohorts of the mid-1980s. STACFIS noted that changes in discarding patterns in the fishery over time could affect the survey estimates of relative cohort strength.

Total mortalities were calculated from 1975-95 for ages 1 to 16. There was a trend for increased mortality at almost every age over the time period (SCR Doc. 97/60).

c) **Assessment Results**

The Canadian spring and autumn surveys showed a large decline in abundance and biomass since the mid to late-1980s. The 1995 and 1996 autumn and the 1996 spring estimates are not yet comparable to the previous data. The Spanish survey in the Regulatory Area of Div. 3NO showed a large increase in biomass and abundance between 1995 and 1996 and a large decrease between 1996 and 1997. The indices from Canadian juvenile surveys have been relatively stable from 1989 to 1994. The differences in the trends of the Canadian survey series can not be resolved at this time. There have been no good year-classes between 1987 and 1993 and the fate of year-classes since then remains to be determined. Mortality as estimated on an age by age basis remains high. The stock is composed mainly of fish less than 6 years old. Most of the indicators evaluated suggest that the stock is at a low level.

6. **American Plaice in Division 3M** (SCR Doc. 97/28, 42, 45; SCS Doc. 97/9, 10)

a) **Introduction**

The stock mainly occurs on Flemish Cap at depths shallower than 600 m. Catches of Contracting Parties are mainly in trawl fisheries directed for other species in this Division.

Since 1974, when this stock became regulated, catches ranged from 600 tons in 1981 to 5 600 tons in 1987. After that catches presented a declining trend to 275 tons by 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. Catch for 1996 was estimated to be 300 tons. Half of this catch was made by non-Contracting Parties.

From 1979 to 1993 a TAC of 2 000 tons has been in effect for this stock. A reduction to 1 000 tons was decided for 1994 and 1995 and a moratoria was agreed to thereafter (Fig. 16).

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	2	2	2	2	2	2	2	1[1]	1[1]	0	0
Catch	5.6	2.8	3.5	0.8	1.6	0.8	0.3[2]	0.7[2]	1.3[2]	0.3[2]	

[1] No directed fishing.
[2] Provisional.

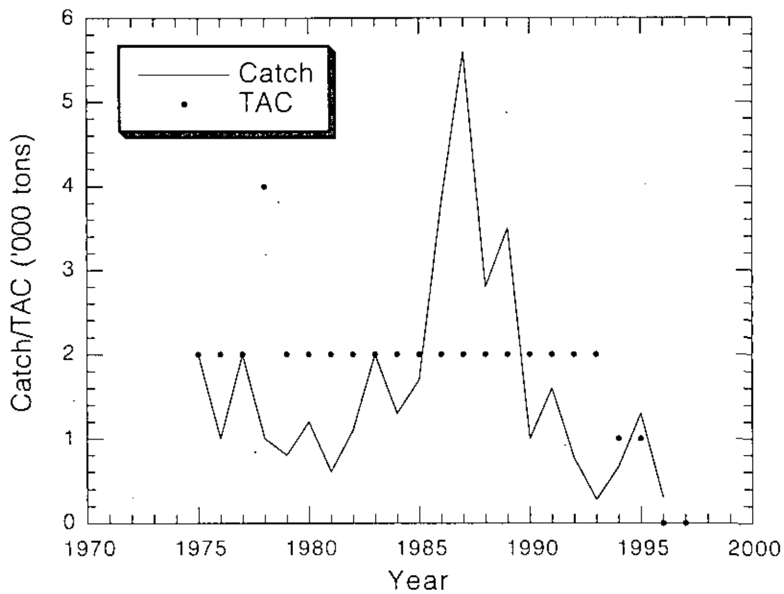

Fig. 16. American plaice in Div. 3M: nominal catches and agreed TACs.

b) **Input Data**

i) **Commercial fishery data**

EU-Portugal and EU-Spain provided length composition of the trawl catches. Biological information for Portuguese catches is only available for the 4th quarter of 1996 (23 samples). This information was used to estimate the length composition of the 150 tons catches by the non-Contracting Parties. The age composition of the Portuguese catches was obtained using the age-length key derived from the 1996 EU Flemish Cap bottom trawl survey. The 1990 and 1991 year-classes appear as the most abundant ones.

ii) **Research survey data**

The series of research surveys conducted by the EU since 1988 was continued in July 1996. The Russian survey series started in 1983 was interrupted in 1994. There was a survey carried out by Canada during 1996, but due to changes in survey gear and timing, results are not comparable with the former Canadian series (1978-85) in this area. A continuous decreasing trend in both the indices of abundance and biomass was observed since the beginning of the EU series. Russian series, although presenting a higher variability, also showed a decreasing trend between the 1986 - 1993 period (Fig. 17).

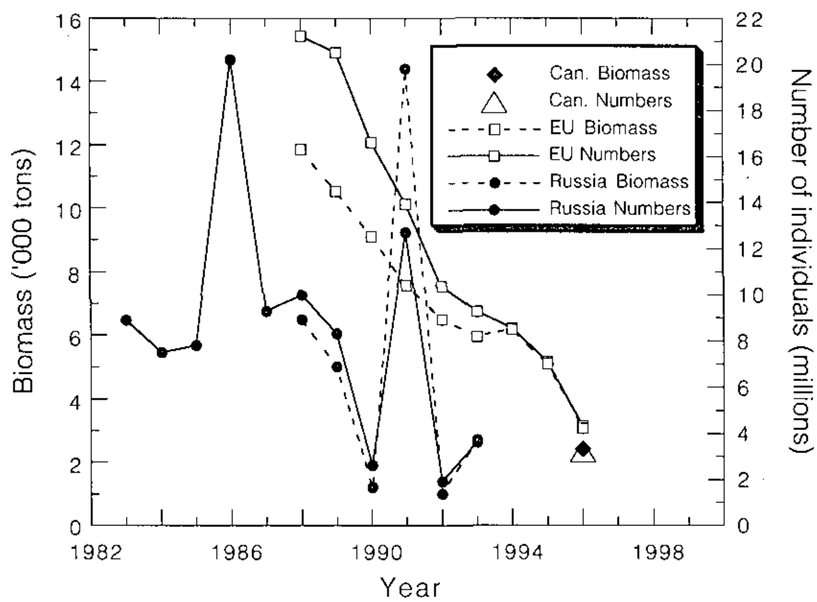

Fig. 17. American plaice in Div. 3M: trends in biomass and abundance in the surveys.

The spawning stock biomass (50% of that in age 5 + age 6+), as estimated from the EU surveys, increased in 1993 to a value close to 1991, but decreased since 1995 (table below). The level in 1996 was only 34% of the 1988 level, the lowest point observed in the survey series (1988-96). This decreasing trend is expected to be continued as long as no strong year-classes recruit to the SSB in the near future.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996
SSB	8.5	5.8	5.3	5.7	3.6[1]	5.0	5.0	4.3	2.9

[1] Estimated using mean weight-at-age in the catch.

c) **Estimation of Parameters**

Taking into account the deficiencies in the data base, only a crude approximation of the trend in fishing mortality could be obtained, by comparing the catch and survey biomass ratio for ages fully recruited to the fishery (8-11).

For 1996 the F index was 0.13, which indicate a decrease to half the level observed in 1995 (table below; Fig. 18).

American plaice in Div. 3M: trend in F index for the period 1988-96.

Year	Catch	Survey	C/B
1988	1 298	6 066	0.21
1989	1 470	2 573	0.57
1990	497	3 262	0.15
1991	768	2 481	0.31
1992	435	2 141	0.20
1993	111	1 075	0.10
1994	309	2 666	0.12
1995	429	1 580	0.27
1996	161	1 199	0.13

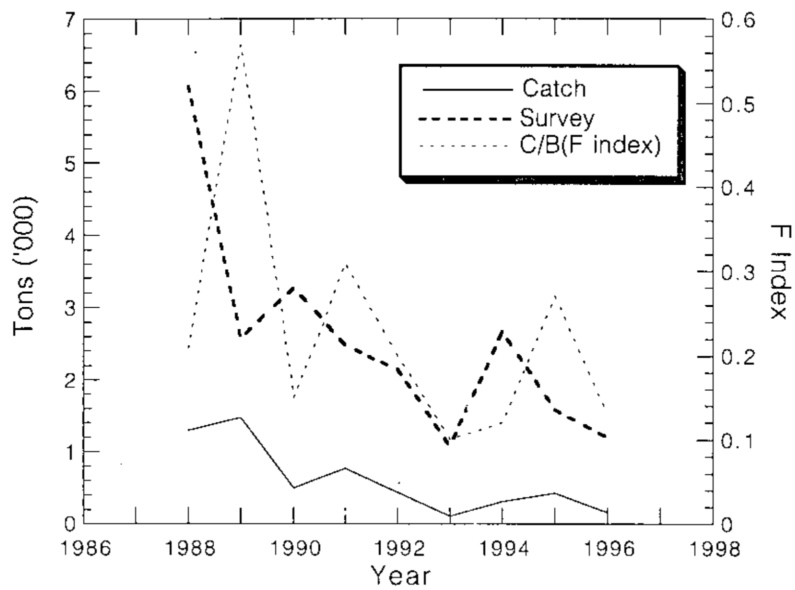

Fig. 18. American plaice in Div. 3M: trend in F index, catch and survey biomass.

d) **Assessment Results**

STACFIS noted that this stock continues to be in a very poor condition, with only poor year-classes expected to be recruited to SSB for at least five years. Although the level of catches since 1992 is relatively low, survey data indicate that this stock is at a very low level and there is no sign of recovery.

7. **Witch Flounder in Divisions 3N and 3O** (SCR Doc. 97/24, 25, 65)

a) **Introduction**

Reported catches in the period 1972-84 ranged from a low of about 2 400 tons in 1980 and 1981 to a high of about 9 200 tons in 1972 (Fig. 19). With increased effort, mainly by EU-Spain and EU-Portugal in 1985 and 1986, catches rose rapidly to 8 800 and 9 100 tons, respectively. This increased effort was concentrated mainly in the Regulatory Area of Div. 3N. Non-Contracting Parties such as South Korea

(Contracting Party as of December 1993), Cayman Islands, Panama and USA (Contracting Party as of November 1995) also contributed to the increased catches.

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	5	5	5	5	5	5	3[1]	0	0	0
Catch	7	4	4	5	5	4[2]	1[2]	0.3[2]	0.3[2]	

[1] No directed catch.
[2] Provisional.

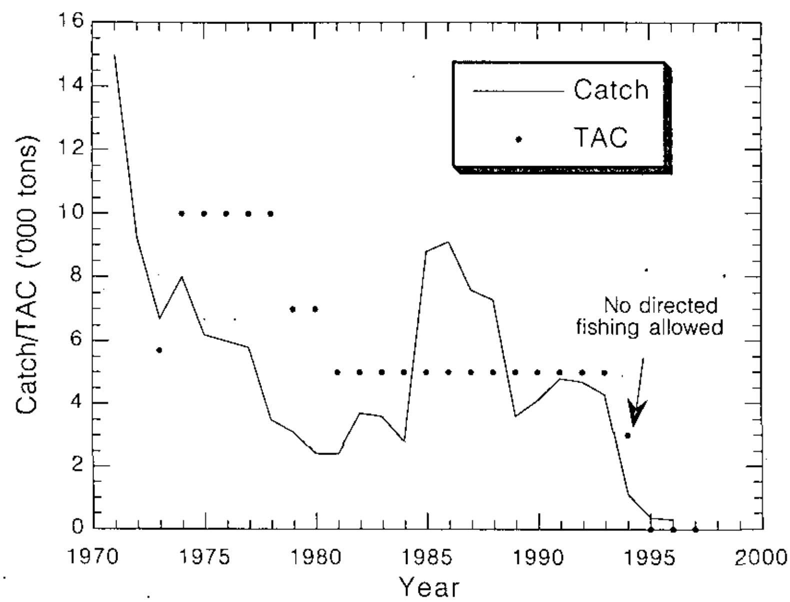

Fig. 19. Witch flounder in Div. 3NO: catches and TACs.

In 1987 and 1988, the total catch was about 7 500 tons, declining to between 3 700 and 4 900 tons in 1989 to 1992 with a catch of 4 400 tons estimated for 1993. The best estimates of catch for 1994-96 were 1 100, 300 and 300 tons, respectively.

Catches by Canada ranged from 1 200 tons to 4 300 tons from 1985 to 1993 (about 2 650 tons in 1991 and 4 300 tons in 1992) and were mainly from Div. 3O. Only 2 tons were reported by Canada in 1994 (by-catch) and zero catch in 1995. About 32 tons of by-catch was reported for 1996. Catches by USSR/Russian vessels declined from between 1 000 and 2 000 tons in 1982-88 to less than 100 tons in 1989-90, and to zero since then.

STACFIS noted catch statistics were not adequate for this stock, given that there were catches by non-Contracting Parties which were not reported to NAFO and have been only estimated from other sources, for example greater than 30% for 1991 and 1992. There were also catches in some instances which must be estimated from breakdowns of large catches of unspecified flounder in the early years of the fishery.

b) **Input Data**

i) **Commercial fishery data**

Very little information was available due to a moratorium on directed fishing. Some length frequency data from by-catch in the Spanish trawler fishery during 1992-96 in Div. 3NO indicated catches in the range of about 30-60 cm with modes at 35-45 cm (SCR Doc. 97/24). Mean lengths in the catch also declined somewhat between 1992-94.

ii) **Research survey data**

Biomass estimates. Biomass estimates from Canadian surveys (SCR Doc. 97/67) in Div. 3N have been at very low levels during 1971-97 and in most years were less than 1 000 tons. For Div. 3O the estimates of biomass fluctuated annually, on average between 6 000 and 12 000 tons in the late-1980s. It was observed that despite the fact that survey coverage in Div. 3NO during 1991-97 has been the most complete in the time series, including much deeper water, there was a declining trend since 1989. The 1993 and 1995 values were among the lowest observed in Div. 3O (Fig. 20). Although surveys were conducted in the autumn of 1995-96 and spring of 1996-97, they were carried out with a modified shrimp trawl (Campelen) compared to a groundfish trawl (Engel) in previous years. The indices were higher from these surveys, however, they were not directly comparable to previous years to allow for a full evaluation of trends in population size to the present. Nevertheless, there was an increase in the estimated biomass between the two most recent surveys both of which used the Campelen trawl.

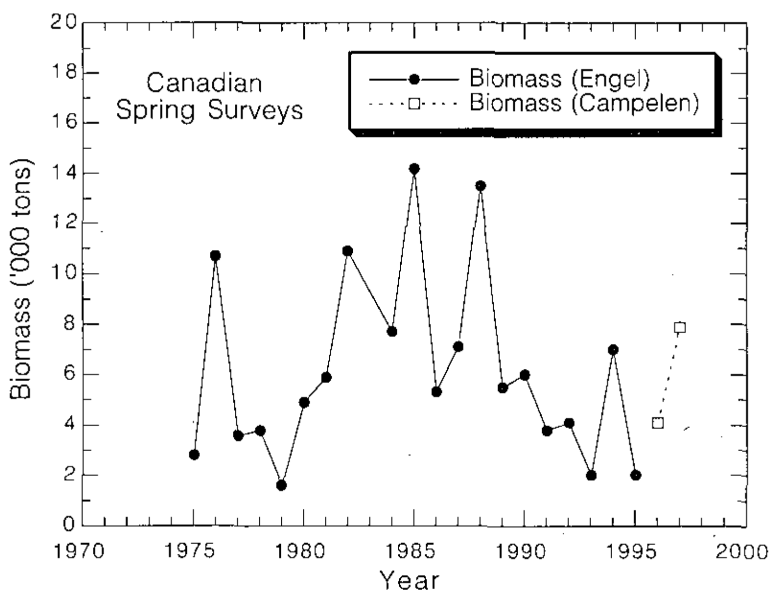

Fig. 20. Witch flounder in Div. 3NO: estimates of biomass.

A survey conducted by Spain in May 1995 estimated biomass in the Regulatory Area of Div. 3NO at about 3 500 tons comprised of fish mainly in a length range of 30-50 cm. A similar survey in 1996 estimated biomass to be 2 300 tons for similar strata mainly in a length range of 26-50 cm. The survey was extended from a maximum depth of 730 m in 1995 to 1 100 m in 1996. About 76% of the estimated biomass from the survey in 1996 was accounted for by strata not surveyed in 1995. The 1997 survey biomass estimate declined by about 50% compared to the 1996 value. However, the abundance declined only slightly indicating a shift to smaller fish in 1997 (SCR Doc. 97/25).

c) **Assessment Results**

Based on the available data, the stock appeared to remain at a low level although data from the 1996-97 surveys indicate there may be a slight improvement in the stock.

d) **Research Recommendations**

STACFIS noted that it was not possible for ageing data for witch flounder in Div. 3NO to be available for this meeting from any of the Canadian surveys since 1993, which made it difficult to evaluate abundance-at-age or estimate the recruitment potential of recent year-classes. It was **recommended** that *wherever possible the most up to date catch-at-age data for witch flounder from the surveys in Div. 3NO be made available for the June 1998 Meeting.*

8. **Yellowtail Flounder in Divisions 3L, 3N and 3O** (SCR Doc. 97/25, 31, 71, 72; SCS Doc. 97/7)

a) **Introduction** (SCR Doc. 97/72)

Catches decreased from around 2 069 tons in 1994 to about 287 tons in 1996 (Fig. 21). Catches exceeded the TACs in each year from 1985 to 1993. In 1995 and 1996 small catches were taken as a by-catch in other fisheries. As noted in previous reports of Scientific Council, catch statistics for this stock prior to the moratorium are not adequate, with as much as 25-50% of the catch in some years coming from surveillance estimates and categorization of unspecified flounder catches.

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

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
TAC	15	15	15	5	5	7	7	7	7[1]	0[1]	0[1]
Catch	30[2]	16	16[2]	10[2]	14[2]	16[2]	11[2]	14[2,3]	2[1,3]	0.1[2,3]	0.3[1,3]

[1] No directed fisheries permitted.
[2] Includes estimates of misreported and non-reported catches.
[3] Provisional.

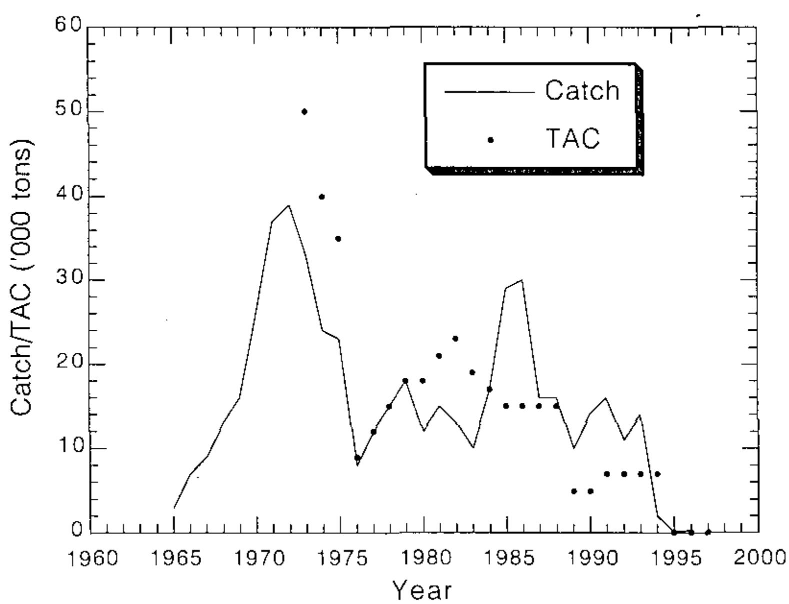

Fig. 21. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

There were no catch-rate or sampling data from the commercial catch in 1996. A multiplicative model used in 1994 to analyze the Canadian catch and effort data showed a slight increase from 1991 to 1993, but the values in these years were the lowest in the 29 year time series. Given the continuing uncertainties with catch and the lack of sampling data from some fleets and years, no catch-at-age or mean weights-at-age have been calculated for the total removals for many of the years since 1984. Catch rate analysis of data from the 1996-97 cooperative DFO/fishing industry surveys in Div. 3NO showed that catch rates were higher in the spring and summer surveys relative to the spring-summer Canadian CPUEs in the fisheries of the mid-1980s while the winter survey catch rates were much lower than the winter catch rates in the fishery.

ii) **Research survey data**

Canadian stratified-random spring surveys (Engel otter trawl series 1971-95, SCR Doc. 97/72). Surveys have been carried out by Canadian research vessels in Div. 3LNO each year, with some exceptions, from 1971 to 1995, with the results based upon Engel 145 Hi-Lift otter trawl equivalents. Yellowtail flounder are confined almost exclusively to depths less than 100 m on the Grand Bank. The surveys in all years have covered the depths where yellowtail flounder are found. In 1995, most of the trawlable biomass of this stock continued to be found in Div. 3N, where the index declined from about 60 000 tons in 1985-86 to between 29 000 and 43 000 tons from 1988-95. In Div. 3L the index of trawlable biomass declined steadily from about 15 000 tons in 1984-85 to zero in 1995 (Fig. 22). In Div. 3O, the biomass index was relatively stable around 15 000 tons from 1988 to 1991, however, the 1992-95 values were around 6 000-8 000 tons, compared to 27 000 tons in 1993. There was a high degree of variability associated with the 1993 biomass estimate in Div. 3O, and the 1994 and 1995 surveys suggest that this 1993 estimate may have been anomalously high. The Canadian groundfish survey catches have been usually dominated by yellowtail flounder aged 5-8 years, however, in 1994 and 1995 the catches were dominated by ages 6-7.

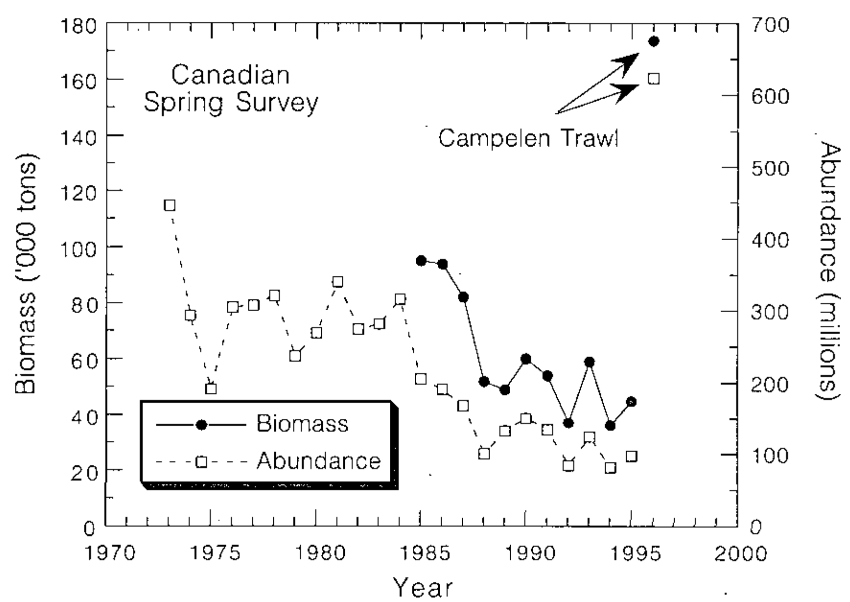

Fig. 22. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian spring surveys.

Canadian stratified-random autumn surveys (Engel otter trawl series: 1990-94; SCR Doc. 97/72). These surveys covered depths to 731 m and were carried out using the Engel 145 Hi-Lift otter trawl during the period 1990-94. The trawlable biomass index from these autumn surveys in Div. 3LNO from 1990 to 1992 ranged from 38 000 to 48 000 tons, although the 1992 estimate was biased downward by the omission of one stratum and part of another which historically had relatively high yellowtail flounder abundance. The 1993 and 1994 estimates of trawlable biomass were 67 000 tons in each year. Both abundance and biomass have shown an increasing trend since 1990 (Fig. 23).

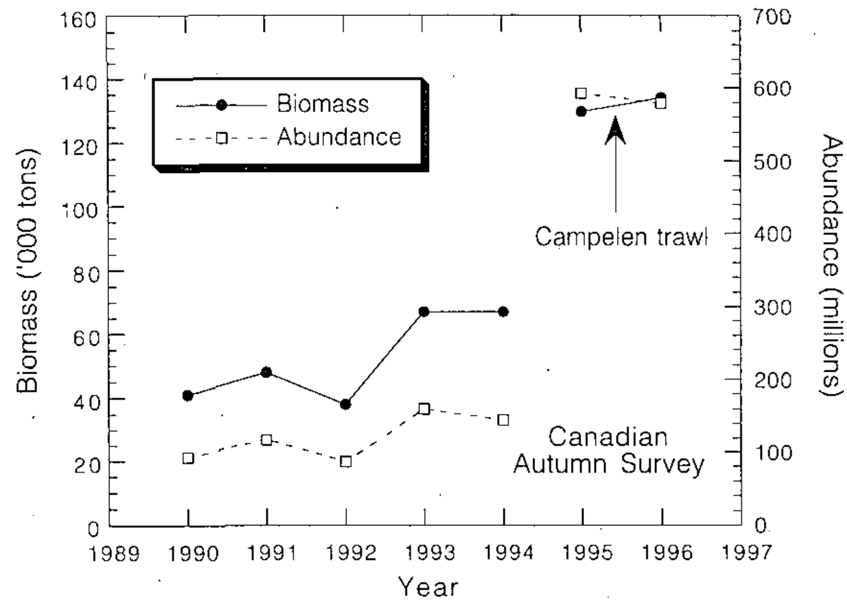

Fig. 23. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian autumn surveys.

Canadian stratified-random Campelen trawl surveys (1995-97, SCR Doc. 97/72). Beginning in the autumn of 1995, Canadian autumn and spring surveys were carried out using a Campelen 1800 shrimp trawl. The "new" standard trawl will replace the "old" standard trawls, the Engel 145 Hi-Lift otter trawl and the Yankee 41 shrimp trawl used in the spring, autumn and juvenile groundfish surveys. Because the conversion factors have not been derived to convert the old standard time series, the autumn 1995, the spring and autumn 1996 and spring 1997 estimates are not directly comparable to any of the other time series. In the 1997 spring surveys the biomass estimates of Div. 3NO (Div. 3L not available) increased from 130 000 tons in the 1996 survey to 181 000 (Fig. 22). In the autumn surveys in both years, the indices of abundance and biomass were stabilized at average value of 586 million fish and 132 000 tons, respectively (Fig. 23). Age 7+ biomass indices in the 1995-96 surveys contributed over 85 000 tons (range of 68 000 to 116 000 tons) to the total biomass index in each year. STACFIS noted that the converted time series will be available in 1998. The length range of yellowtail flounder in the 1996 autumn survey was 8 to 50 cm with two modal peaks: one at 22 to 26 cm and another at 36 cm. Ages 4 and 5 dominated the 1996 autumn survey.

Cooperative DFO/fishing industry surveys 1996-97 (SCR Doc. 97/31). Beginning in July 1996, a fixed grid survey was carried out using a commercial fishing vessel with an Engel 145 (96) Hi-lift otter trawl to study catch rates and distribution of yellowtail flounder in Div. 3NO. In 1997, the surveys were carried out in March and May. Catch rates for the July and May period were higher than commercial catch rates in the same grid area during the 1980's, and these high CPUE were spread throughout the grid. However the March catch rates were extremely low when compared to the other two estimates and STACFIS noted that such a drop in catch rates during the winter occurred occasionally in the Canadian long term commercial CPUEs during March. The length range of yellowtail flounder in the 1996 July survey was 17 to 56 cm with a modal length ranging from 35-39 cm and only 6% of the catch was less than 30 cm. Ages 6-8 dominated the catch.

Spanish stratified-random spring surveys in the NAFO Regulatory Area of Div. 3NO, Pedreira otter trawl 1995-97 (SCR Doc. 97/25, 72). These surveys which were carried out with a Pedreira otter trawl and covered a depth range of 45 to 1 000 m in 1995-96 and 45-1 280 m in 1997, produced a trawlable biomass estimate of 116 000 tons compared to 129 000 tons in 1996 and 28 000 tons in 1995. Similar to the 1995-96 surveys, the majority of the biomass was found in strata 360 and 376, the traditional nursery area in Div. 3N. STACFIS noted that it was difficult to put this survey in the context with the Canadian spring surveys because information on the catchability of the different bottom trawls used in the Canadian and Spanish surveys was not available. The length composition of the yellowtail flounder in the 1997 survey catches ranged in size between 12 cm and 52 cm, with a modal length of 24 cm similar to catches in 1995 and 1996. No age data was available.

Stock distribution (SCR Doc. 97/72). The 1995 autumn and the 1996 spring and autumn surveys with the Campelen trawl showed that the stock is mainly concentrated in Div. 3NO, similar to other time series. The expansion of the range back into Div 3L, as seen in the 1995 and 1996 spring surveys, was difficult to interpret given the change in the standard survey gear. Juveniles were mainly concentrated in and around the nursery area located in the transboundary area of Div. 3N. Adults were also found here, but were also more widespread to the west and northwest.

Biological studies (SCR Doc. 97/71, 72). Length and age at 50% maturity were calculated for males and females using data from the 1975-95 spring survey time series. Males reached 50% maturity-at-age 4.4 and 50% maturity-at-length at 25 cm and females reached 50% maturity-at-age 6.3 and 50% maturity-at-length at 34 cm in recent years. Mean weights-at-age for the spring and autumn time periods from 1990-96 were estimated for ages 3 to 9 for the stock in Div. 3NO. For ages 3 to 7 there was no obvious trend in the data, however, there was a gradual upward trend in older fish in latter years.

c) Assessment Results

The estimated cohort strength (ages 2 to 5) from a multiplicative analysis of the 1975-95 spring survey data showed that recent year-classes have been poor relative to year-classes in the 1970s (Fig. 24). These estimated cohort strengths were used to investigate a potential stock-recruitment relationship using the female SSB determined from the 1975-95 Canadian spring survey data. The results suggested that because the SSB index was low from 1989-95 the probability of obtaining good year-classes from spawning during this period may have been low. Interpretation of the S/R relationship may, however, be confounded by high fishing mortality on juveniles in the late-1980s and early-1990s.

Estimates of total mortality (Z) from the 1975-95 data for similar cohorts between ages 6 and 9 showed that Z-values for ages 6 and 7 were being affected by lack of full recruitment to the survey gear, and for ages 7-8 Z-values were generally higher in the early-1990s compared to previous years, coincident with very high fishing effort during this period. The high estimates ($Z > 1$) between ages 8 and 9 is considered to be related to the high natural mortality as yellowtail flounder approach the end of their life span and this would mask any attempts to measure fishing mortality. A catch/survey biomass ratio was used as a proxy for exploitation rates using the 1975-95 spring research vessel index. The ratio remained high during the late-1980s and early-1990s, as biomass declined, and has declined substantially since 1994 when fishing was reduced.

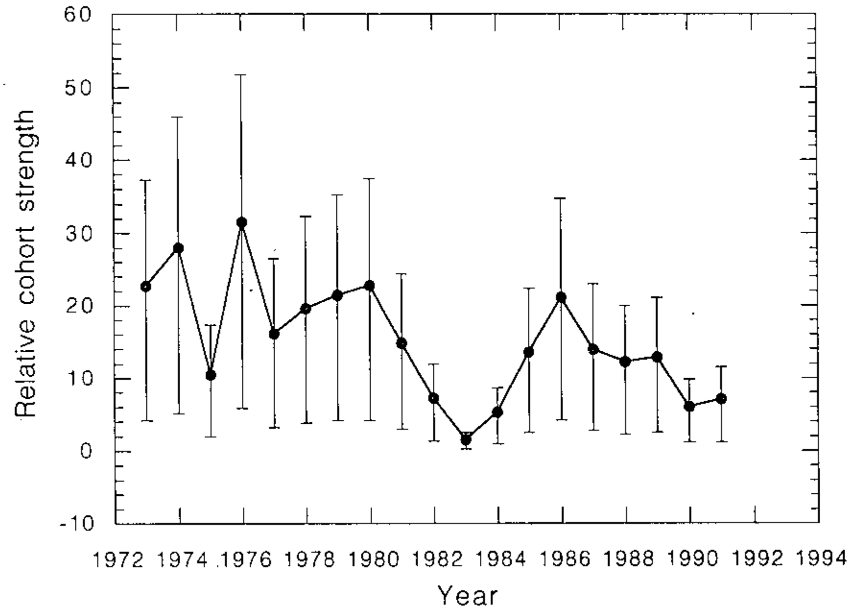

Fig. 24. Yellowtail flounder in Div. 3LNO: relative cohort strength.

In summary, surveys in 1996-97 have shown the stock is more widely distributed than the early-1990s but not as extensive as in earlier years. The age structure has remained stable in all of the surveys for which age data are available and many age-classes are contributing to the biomass index in 1996. The SSB has been at lower levels in recent years relative to the 1980s and the relative cohort strength in recent years is below average as measured in the 1975-95 spring surveys. The mean weights-at-age have also remained stable. Based on 6 additional surveys since the 1996 assessment, the current view is that the stock size has increased since 1994 although the stock is perceived to be lower than the levels of the 1980s.

d) **Research Recommendations**

STACFIS **recommended** that *1) comparative fishing studies should be carried out between the new Canadian research survey gear and the Spanish survey gear in the Regulatory Area to determine similarities in catchability and 2) comparative fishing studies should be carried out between the Canadian research survey gear and the DFO/fishing industry trawl to determine similarities in catchability.* Note: it is expected that these comparisons will occur on an *ad hoc* basis and in an effort to minimize impact on individual surveys the comparative fishing should occur during several surveys.

9. Capelin in Divisions 3N and 3O

a) **Introduction**

Nominal catches of capelin increased from about 750 tons in 1971 to 132 000 tons in 1975, but then declined again to only 5 000 tons in 1978. During this period, most of the catch was taken by USSR trawlers and Norwegian purse seiners. The fishery was closed from 1979 to 1986, but reopened during 1987-92 under quota regulation. During this period, the TAC was never reached; the largest catch of 25 000 tons was taken in 1990. The fishery was again closed in 1992 and the closure has continued through 1997.

Nominal catches and TACs ('000 tons) for the recent period are as follows (Fig. 25):

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Advised TAC	10	10	18	30	30	30	0	0	0	0
TAC	10	15	28	30	30	30	0	0	0	0
Catch	1	7	9	25	+	+	+[1]	0[1]	0[1]	0[1]

[1] Provisional.

b) **Input Data**

The mean estimate of biomass of capelin, based on acoustic surveys carried out by the USSR was 900 000 tons during 1975-77. During 1981-88 the mean estimate was only 300 000 tons. The estimate from the 1994 survey was only 83 000 tons which represented an approximate 50% reduction from the 1993 estimate. No surveys were conducted in 1996 and none are planned for 1997.

During the 1990s, below normal oceanographic temperatures delayed the spawning season of capelin by about 4-6 weeks and resulted in extensions and shifts in distribution to areas such as Flemish Cap that are not normally part of the capelin distribution. It is not known the extent to which these changes have affected the distribution and spawning of Div. 3NO capelin.

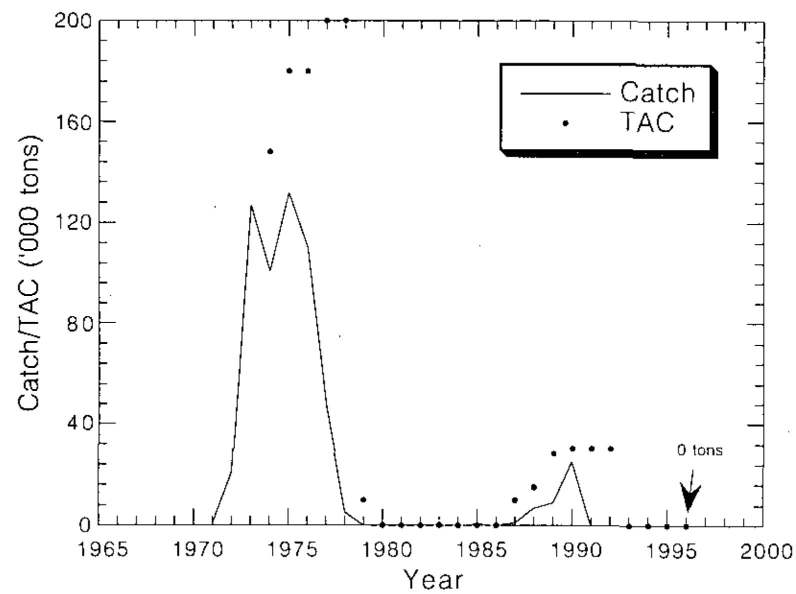

Fig. 25. Capelin in Div. 3N and 3O: catches and TACs.

STACFIS has no data on Div. 3NO capelin on which the current status of that stock can be evaluated.

10. Squid in Subareas 3 and 4

a) Introduction

Recent catches of *Illex* squid began increasing in Subareas 3 and 4 in 1989 and peaked at 11 000 tons in 1990, but declined again to only 2 000 tons in 1992. Catches increased to 6 000 tons in 1994, mainly as a by-catch in the silver hake fishery of Cuba in Subarea 4. The catches further increased to 8 800 tons in 1996 with more than 8 300 tons being reported in Subarea 3 from a directed catch, with an additional 500 tons in Subarea 4 as a by-catch in the silver hake fishery of Cuba. The Cuban silver hake directed fishery ended on 14 August, 1996, and the squid by-catch showed an increasing pattern as the fishery progressed from June to August. This may suggest that the Cuban silver hake fishery ended before squid availability in the area was fully experienced.

Nominal catches and TACs ('000 tons) for the recent period are as follows (Fig. 26):

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
TAC	150	150	150	150	150	150	150	150	150	
Catch (SA 3+4)	+	1	7	11	4	2	3[1]	6[1]	1[1]	9[1]
Catch (SA 5+6)			7	12	12	18	18[1]	20[1]	15[1]	17[1]

[1] Provisional.

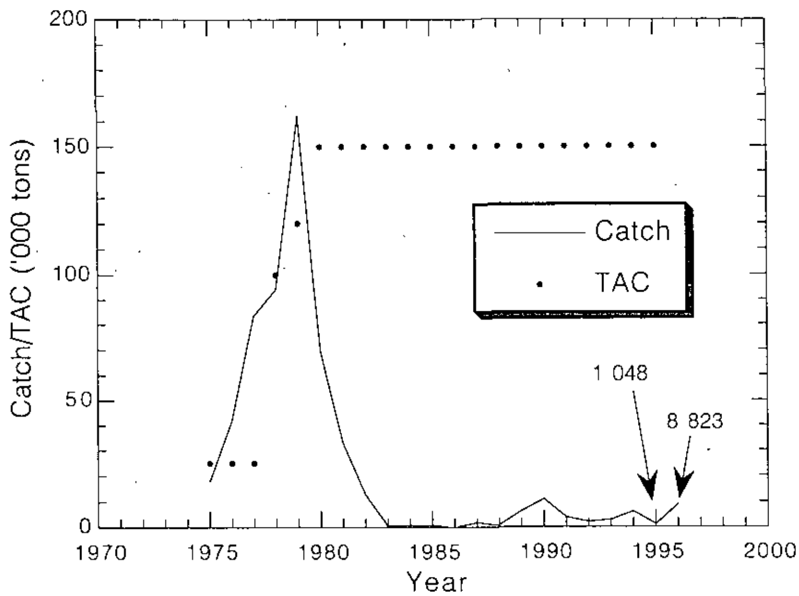

Fig. 26. Squid in Subareas 3 and 4: catches and TACs.

b) **Input Data**

There were no data available for assessment.

11. **Greenland Halibut in Subarea 2 and Divisions 3KLMNO** (SCR Doc. 97/10, 16, 23, 25, 27, 28, 30, 34, 35, 36, 52; SCS Doc. 97/3, 4, 8, 9, 10)

a) **Introduction**

Catches increased from low levels in the early-1960s to over 36 000 tons in 1969, and ranged from 24 000 tons to 39 000 tons over the next 15 years. From 1986 to 1989, catches exceeded 20 000 tons only in 1987 (Fig. 27). In 1990, an extensive fishery developed in the deep water (down to at least 1 500 m) in the Regulatory Area, around the boundary of Div. 3L and 3M and by 1991 extended into Div. 3N. The total catch estimated by STACFIS for 1990-94 was in the range of 47 000 to 63 000 tons annually, although estimates in some years were as high as 75 000 tons. The accepted catch for 1995 was 15 000 tons, a reduction of about 75% compared to the average annual catch of the previous 5 years due to new management measures introduced in 1995. The catch accepted for 1996 was about 19 000 tons, although estimates by Canadian surveillance authorities placed the catch about 6 500 tons higher. The major participants in the fishery in the Regulatory Area were EU-Spain (7 300 tons) and EU-Portugal (3 300 tons), using mainly otter trawls.

Canadian catches peaked in 1980 at just over 31 000 tons, while the largest non-Canadian catches before 1990 occurred in 1969-70. USSR/Russia, Denmark (Faroe Islands), Poland and EU-Germany (GDR before 1989) have taken catches from this stock in most years, but catches by the latter two countries were negligible since 1991. USSR/Russia catches increased from about 1 100 tons in 1988-90 to 8 200 tons in 1991, the largest catch by this fleet since 1975. EU-Portugal and Japan have taken catches from this stock each year since 1984. Canadian catches ranged from 8 200 to 13 500 tons from 1985-91. The Canadian catch declined annually since then to 2 300 tons in 1995, but increased in 1996 to about 6 000 tons.

In most years, the majority of the Canadian catch has come from Div. 3K and 3L, with catches from Div. 2G and 2H usually being relatively low. Canadian gillnet catches declined from a high of 28 000 tons in 1980 to about 3 000 tons annually in 1992-94, and 1 800 tons in 1995 which was the lowest in the time series. Catches prior to 1992 were mainly from inshore areas using 140-152 mm mesh, while catches since then have been taken mainly in offshore areas at the edge of the Continental Shelf, mostly with 190 mm mesh.

Canadian otter-trawl catches peaked at about 8 000 tons in 1982, declined to less than 1 000 tons in 1988 and increased to about 7 400 tons in 1990, which was the highest level since 1982. Since then, the otter trawl catch declined steadily to less than 600 tons in 1995. The value in 1996 was just over 1 000 tons by this fleet component.

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC[1]	100	100	100	50	50	50	50	25	27	27	27
Catch[2]	31	19	19	47	55-75	63	42-62[3]	48[3]	15[3]	19[3]	

[1] Set autonomously by Canada 1985-94 and by NAFO Fisheries Commission in 1995 and 1996.
[2] Includes estimated unreported catches in 1990-96.
[3] Provisional.

b) Input Data

i) Commercial fishery data

Catch and effort. A detailed analysis of Canadian gillnet catch and effort data since the mid-1980s was presented at the Scientific Council Meeting of June 1995 (SCR Doc. 95/78). The general trends observed indicated steep declines over time since 1986/87 for the near shore areas of Div. 3K and 3L (<500 m fishing depth) and by the early-1990s this fishery had essentially collapsed. Some of this effort moved from near shore areas to the deep waters of the Continental Slope (about 1 000 m fishing depth) particularly in Div. 3K and 3L. Mainly as a result of declining catch rates in these areas, effort moved northward along the slope area to as far north as Div. 2G, where catch rates in these areas also declined quickly over a very short time period during the 1990s. No new data were available for this meeting on Canadian gillnet catch rates.

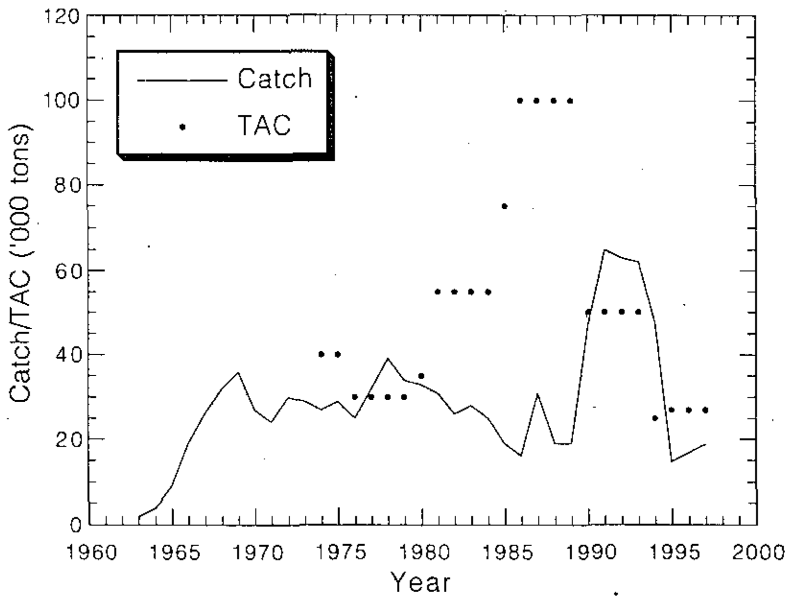

Fig. 27. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

An analysis of otter trawl catch rates, mostly from Canadian vessels, indicated a declining trend since about the mid-1980s to reach its lowest level by 1992 . Catch rates have shown a slight improvement since then, but are still among the lowest observed in the time series, just under one-half of the peak values seen in 1982-83. Data from the most recent years were very limited as a result of low effort, due to the poor catch rates (SCR Doc. 97/52).

A catch-rate analysis of Portuguese otter trawlers fishing in the NAFO Regulatory Area of Div. 3L from 1988-96 was also reviewed. The CPUE declined sharply from 1989 to 1991, recovered somewhat in 1993 then declined again to the lowest level observed during the period by 1995 (SCS Doc. 97/9). CPUE increased in 1996 to the level seen in 1992. Although directed effort on Greenland halibut in Div. 3N accounted for only 30% of the observed effort from the Portuguese trawl fishery, no trend in catch rates for this Division could be detected despite an isolated peak in 1992. Data were available from only 3 years in Div. 3M (1990, 95 and 96), and CPUE was similar in each year. The combined CPUE index for all 3 Divisions increased from 1995 to 1996, to around the level in 1993.

A fishery by EU-Germany occurred late in 1996 in Div. 3M, and caught 25 tons (SCS Doc. 97/4). CPUE was similar to the values observed in the Portuguese fishery.

By-catch data for Greenland halibut in the Icelandic shrimp fishery in Div. 3M in 1996 and early 1997 were available. The by-catches were around 0.3% (by weight) in 1996, or 54 fish per ton of shrimp. No length compositions were available.

Size and age data were available from the 1995 and 1996 Canadian fisheries (SCR Doc. 97/52). Sampling data from the catches of Canada in 1995 and 1996 were used to calculate catch-at-age and mean weights-at-age from this component of the fishery. The gillnet catch in 1995 was comprised mainly of fish aged 9 to 13 years, compared to mainly 7 to 9 in the otter trawl catch. Overall, ages 7 to 11 comprised the bulk of the catch, with a peak at age 8. In 1996, the gillnet catch-at-age was bimodal, with peaks at ages 7 and 11, reflecting catches by the different mesh sizes used. Otter trawl catches in 1996 consisted mainly of ages 6-9 fish, with a peak at age 7. Overall, the catch-at-age had the same bimodal pattern observed in the gillnet catches, with peaks at age 7, and ages 10-11. Mean weights-at-age were similar in both years.

Catch-at-age data could not be derived for all fleets during the entire time period. Sampling data from Canadian catches from 1988-96 indicated that there were relatively more older fish (age 10+) in the catches in recent years due to the increase in the use of large mesh (>190 mm) gillnets in deep water since about 1992, accompanied by a reduction in trawler effort which usually catches smaller (younger) fish (SCR Doc. 97/52). No trends were seen in the mean weights over the period 1988-96.

The commercial catch-at-age data for 1996 from EU-Portugal was similar to 1995 and indicated low numbers of fish older than age 8 in the trawler catches, which comprised most of the Portuguese fishery. The peak of the catches was at ages 5 and 6 in Div. 3L and 3M. (SCS Doc. 97/9). The mean length and weight of fish in the Portuguese catches in 1996 seemed to decline relative to 1995 in Div. 3M and 3L but not in Div. 3N. The mean length of fish in the Spanish catch increased from 1994 to 1996 in Div. 3LN, and remained constant in Div. 3M. The increases were from 41.5 to 45.2 cm in Div. 3L, and 43 to 46 cm in Div. 3N.

Length frequency samples from the fishery by EU-Spain were collected in 1996 from Div. 3LMNO. Fish in the length range 36-51 cm dominated catches in all Divisions, with peaks generally around 42-46 cm (SCS Doc. 97/10). These data agreed with length frequencies from the Russian fishery in Div. 3LM (SCS Doc. 97/3), and with the data from the Portuguese fishery (SCS Doc. 97/9).

ii) **Research survey data**

STACFIS noted once again that all research vessel survey series providing information on the abundance of Greenland halibut were deficient in various ways and to varying degrees. The surveys were often initiated to obtain abundance indices for other species and this remains a major objective for most surveys. The geographical and depth range of the surveys have been progressively adapted in accordance with changes in the fishery for Greenland halibut and possible changes in the geographical distribution of this species and others. This creates problems in the comparability of results from different years. However, in autumn 1996 the Canadian survey covered almost the entire geographical range of the Greenland halibut stock in SA 2 + Div. 3KLMNO, giving a point estimate of stock abundance and biomass. Unfortunately, there is no single survey series prior to 1996 with which the total results of the 1996 survey can be compared.

Japanese stratified-random survey in Div. 2G and 2H (SCR Doc. 97/23, 30). During August 1996, a stratified random survey of Div. 2GH was carried out by Japan on the RV *Shinkai Maru*, in depths from 201 to 1 500 m. Biomass and abundance estimates for Greenland halibut were around 54 000 tons and 138 million fish, respectively. About half the biomass in Div. 2G came from depths greater than 1 000 m, compared to about 25% in Div. 2H. Ages 1 and 7 were the most abundant in Div. 2G, while ages 2-4 were predominant in Div. 2H. Overall, ages 1-5 were about equal in abundance, followed by ages 6 and 7. Few fish older than age 9 were found.

Canadian stratified-random survey in Div. 2G and 2H (SCR Doc. 97/30). During September-October 1996, a stratified random survey of Div. 2GH was carried out by Canada on the RV *Teleost*, in depths from 122 to 1 436 m. Coverage was not complete in Div. 2G, particularly in depths beyond 400 m. Biomass and abundance estimates for G.halibut were around 48 000 tons and 315 million fish respectively. The biomass estimate agreed with the Japanese survey, and a significant correlation between the two surveys existed for biomass estimates in common strata. The estimate of abundance was larger in the Canadian survey, and was due to the higher selectivity of the Campelen trawl used in the Canadian survey for small Greenland halibut. The age composition in both Divisions was dominated by small fish, with ages 1 and 2 being the most abundant in catches. As with the Japanese survey, few fish older than age 9 occurred in the catches. Estimates of biomass and abundance from the surveys in Div. 2GH in 1996 are not directly comparable with estimates from previous surveys in this area, but suggest that biomass is generally lower in 1996 than in the late-1970s and early-1980s.

Canadian stratified-random surveys in Div. 2J and 3K. These surveys are conducted in the autumn (Oct-Dec). During 1995, a new survey trawl was introduced to this survey series. A Campelen 1800 shrimp trawl with rock hopper footgear replaced the previously used Engel 145 groundfish trawl with large steel bobbin footgear. Based upon the results of comparative fishing experiments between the two gears presented to STACFIS in 1996 (SCR Doc. 96/28) length based conversion factors were developed and accepted to convert the historic time series of biomass and abundance of Greenland halibut to equivalent estimates had the Campelen 1800 shrimp trawl been used throughout (Fig. 28). While the actual index values changed from those in past reports, due to variable conversion factors by length, the overall trends from 1977-95 for Div. 2J and 1978-95 for Div. 3K were directly comparable. A correction to account for the different swept areas of the trawls, inadvertently omitted in the 1996 assessment, was applied to the data in the current assessment. No conversions were available for the Div. 3L time series, although conversion factors have been developed in further comparative fishing trials (SCR Doc. 97/68). However, this time series accounted for little of the Greenland halibut distributed in Div. 3L due to limited depth coverage.

The results indicated that the biomass index for Div. 2J and 3K combined generally increased from the late-1970s to peak in 1984. The index then declined steadily to 1990. There was a sharp decrease by about 50% between 1990 and 1991, and the index reached its lowest level observed by 1992. The 1992 value was only about 20% of the peak values observed in the late-1970s and early-1980s. The estimates have generally increased since then, with the 1995 value about the same as that of 1991. The 1996 value was about 80% higher than the 1995 point, and was similar to the levels observed in 1987 to 1990. This value was about 70% of the maximum level, estimated in 1978. Increases were observed in most strata throughout Div. 2J and 3K, particularly in the depths less than 500 m, where smaller fish dominate catches. It should be noted that the 1995 and 1996 surveys were actually conducted with the new survey trawl and are not converted values. About two-thirds of the biomass index in Div. 2J and 3K combined in 1996 was comprised of fish smaller than 36 cm, compared to about one-quarter in 1978.

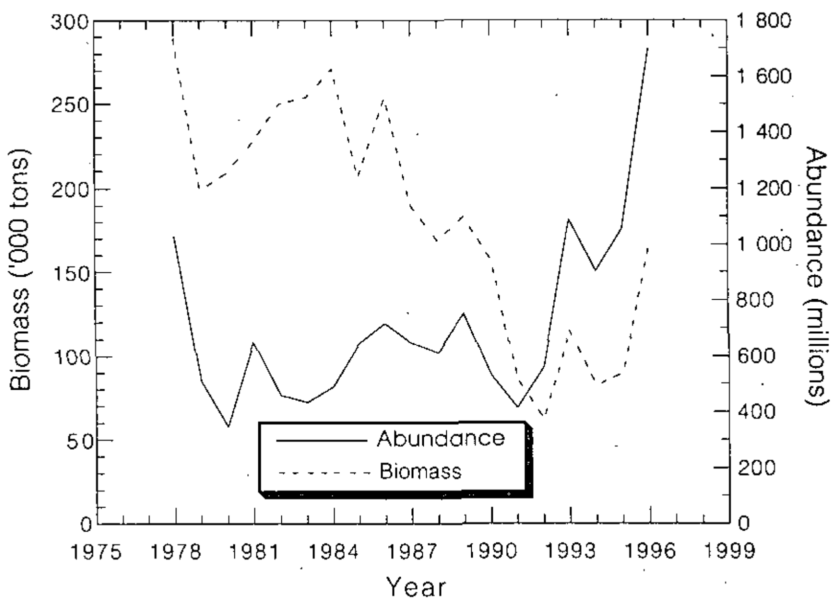

Fig. 28. Greenland halibut in Div. 2J and 3K: estimates of biomass and abundance from Canadian surveys.

An examination of the age structure indicated that the ages 6+ abundance declined by over 80% from the peak values of the mid-1980s to the lows observed in 1993-96. By 1994, the age 6+ abundance was far below anything previously observed, but was followed by a slight increase in 1995 to near the low 1992 value. Ages 10+ have been declining since at least the early-1980s and in 1994 and again in 1995 appeared only incidently in the survey catches. Abundance at ages 10+ increased in 1996, but was still less that 10% of the estimates in the mid-1980s. Biomass of fish larger than 35 cm increased slightly in 1996, but remained at a level less than 20% of peak values in 1982-84. On the other hand, the abundance index of ages 3-5 slowly increased from the early-1980s to about 1989. From 1989 to 1991, however, this index also declined very sharply to a level less than half the 1989 estimate. The ages 3-5 index since then has been above average, and the index peaked in the 1993 survey. This increasing trend in recent years is a result of high indices of abundance of the 1990-94 year-classes.

STACFIS noted that otoliths for Greenland halibut less than 30 cm, caught in the 1994 and 1995 Canadian surveys, were reaged, based on discrepancies in mean length-at-age data and criteria for ageing young fish developed at the joint NAFO/ICES workshop in 1996 (NAFO Sci. Coun. Rep., 1996, p. 115). The reageing was complete for 1994 and included in this assessment, but was not complete for the 1995 samples. Therefore, the data for ages 1-5 in the 1995 survey were excluded from any analyses.

EU stratified-random surveys in Div. 3M (SCR Doc. 97/28). These surveys indicated that the Greenland halibut biomass index on Flemish Cap in July in depths to 730 m , ranged from 4 300 tons to 8 600 tons in the 1988 to 1994 period. The estimated biomass in the 1995 and 1996 surveys was 10 700 and 11 400 tons respectively, which is the highest in the series. While the estimates from these surveys were not indicative of the total biomass in Div. 3M and were outside the commercial fishery area, they were stable during 1991-94 at about 8 000 tons within the survey area with some increase in 1995 and 1996. The results could only be interpreted as an index of the population in depths to 730 m. The age composition data indicated that the abundance in 1996 was dominated by ages 4-7 or the 1989-92 year-classes, but a peak was also observed at age 2 (1994 year-class). Few fish older than age 10 were encountered in any of these surveys, and the abundance at these ages combined declined steadily from 1991 to 1996. The increased population estimates in 1995 and 1996 are mainly the result of recruitment of the 1994 and 1995 year-classes to the survey. The 1994 year-class had the highest values in the time series at age 1 and age 2. At age 1, this year-class accounted for nearly one-third of the 1995 abundance estimate and was 6-8 times higher than the estimates of the 1991 - 1993 cohorts at the same age.

Russian surveys in Flemish Cap and Pass (SCR Doc. 97/10). A stratified-random survey was conducted in part of Flemish Cap in Div. 3M during May 1996 to a depth of 914 m. The abundance index was 2.8 million fish and the biomass index was 1 200 tons, which were very similar to the estimates obtained in a comparable survey in 1995. A stratified random survey in Flemish Pass during February 1996, in a depth range from 732-1 463 m, indicated an abundance estimate of 46 million fish and a biomass estimate of about 32 000 tons. Peaks in the length distributions from both surveys were observed around 40 to 46 cm., corresponding to ages 4 to 6, and few fish were caught beyond about 60 cm. Catches were comprised almost entirely of immature fish.

Spanish stratified-random surveys in Div. 3NO Regulatory Area (SCR Doc. 97/25). During April-May of 1995, 1996, and 1997, stratified-random bottom trawl surveys were conducted by Spain in the Regulatory Area of Div. 3NO to a depth of 730 m in 1995, 1 100 m in 1996, and 1 275 m in 1997. The estimated biomass (comparable strata only) was about 2 800 tons in 1995, 6 100 tons in 1996, and 18 200 tons in 1997. The total biomass estimated in 1997, including the deep strata not surveyed previously, was 71 000 tons. The size composition was trimodal in 1997 at 20-22, 28-30 and 38-42 cm. Few fish above 60 cm were caught.

Canadian stratified-random survey in Div. 3LMNO (SCR Doc. 97/52). As part of the annual Canadian autumn survey (September to December), coverage in 1996 was extended to Div. 3M, and to areas in Div. 3N deeper than 731 m. Div. 3L was also surveyed to a maximum depth of 1 433 m, extending the usual survey coverage in this Division. Coverage of the deep water in the southern areas, particularly Div. 3O, was not as extensive as further north. Biomass estimates from the 4 Divisions were as follows: 3L - 36 600 tons, 3M - 10 200 tons, 3N - 5 100 tons, 3O - 1 000 tons. Fish greater than 36 cm made up the bulk of the biomass in Div. 3LM, unlike the situation in Div. 2J and 3K.

Overall, biomass in Div. 3LMNO comprised about 18% of the total biomass estimated from the Canadian autumn survey in 1996.

iii) **Recruitment indices** (Fig. 29)

During both the 1994 and 1995 assessments STACFIS concluded that the 1990 and 1991 year-classes were above average abundance based on survey trends in year-class strength. These year-classes were predominant in virtually all fisheries and surveys throughout the Regulatory Area in 1996, but not in Subarea 2 and Div. 3K.

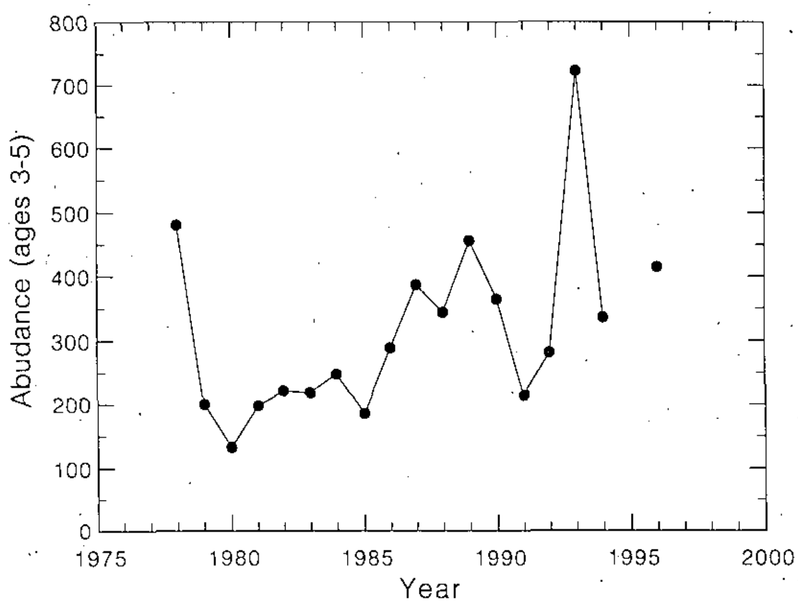

Fig. 29. Greenland halibut in Subarea 2 + Div. 3KLMNO: recruitment estimates (ages 3-5 combined) from surveys in Div. 2J+3K.

Surveys in Div. 2J and 3K suggested that the 1992 and 1993 year-classes may also be above average abundance. However, STACFIS cautions that estimates of abundance of these year-classes at very young ages are very sensitive to the length conversion factors for small sizes between the two survey gears. More confidence in the strength of these year-classes will be developed over the next 1-2 years' surveys.

Both the 1995 and 1996 Canadian survey in Div. 2J and 3K (1995 based on length frequencies) and the EU survey in Div. 3M in 1995 and 1996 estimated the 1994 and 1995 year-classes to be among the largest observed. These two year-classes also dominated catches in the Canadian survey in Div. 2GH, and were prominent in the Japanese survey in Div. 2GH. STACFIS reiterates its concern, however, that these estimates also be treated with caution until the year-class strengths can be confirmed at older ages in subsequent surveys.

iv) **Biological studies**

Several papers were presented with data from the Spanish fishery in the Regulatory Area. SCR Doc. 97/35 indicated patterns of seasonality in both mean length and yield in the fishery in two distinct study areas: one north of 47°30'N and one south of 45°N. Several possibilities exist to explain the observations, including movement of young fish between the areas, and fish changing their depth distribution seasonally. SCR Doc. 97/36 showed that differences in the catches of Greenland halibut made during the day were not significantly different from those made at night. This observation is of importance when considering survey catches, since the results of tows should be comparable regardless of when they were made during the day. SCR Doc. 97/34 examined the influence of geographic latitude on the catchability of Greenland halibut, by comparing the sex ratio in the catches in the NAFO Regulatory Area with those in the Svalbard area of the Barents Sea. A higher proportion of males was found in the Svalbard area, for reasons which were not clear. SCR Doc. 97/27 presented the variations in the sex ratio of Greenland halibut. Proportion of females increased from the northern Subareas to the southern ones. The increase in the proportion of females generally occurred at ages 7-9. SCR Doc. 97/16 used length and weight samples collected from the fishery in 1993-94 and from Flemish Cap surveys in 1995-96 to calculate length weight relationships for Greenland halibut in Div. 3L, 3M, and 3NO. Data were available for both total fish weight and gutted fish weight. Relationships were calculated for each half of the year 1993 and 1994, and for July in both 1995 and 1996.

c) **Assessment Results**

In 1996, STACFIS concluded that the longer term indices of fishable stock had declined substantially in recent years. The decline of age 6+ abundance was particularly evident from Canadian surveys in Div. 2J and 3K with recent estimates among the lowest levels observed. Data from the Portuguese otter trawl fishery in the Regulatory Area of Div. 3L also indicated that the commercial stock had declined to the lowest level observed by 1995, based on CPUE trends since 1988. The catch by commercial fishing vessels exhibited a relatively wide range of age groups, however, most of the catch continued to be comprised of young, immature fish most of which were several years younger than the age of sexual maturity. Although the total catch in 1995 was significantly reduced compared to the previous four years, in 1996 STACFIS stated that it was too soon to expect any recovery of the stock.

In the current assessment, there is some indication of improvement in most indices of abundance, although the biomass of older fish clearly remains at a low level.

In the past three assessments of this stock, STACFIS indicated that the 1990 and 1991 year-classes were above average. Data from the current assessment support this view. There were indications from survey data that the 1992-95 year-classes may also be above average abundance. STACFIS cautions, however, that estimates of these cohorts at older ages need to be obtained in future surveys to confirm the relative strengths more confidently.

Considering the significant reduction in catches after 1994, and the indications of good recruitment, STACFIS concluded that the stock is showing signs of recovery, but that fishable biomass is still at a low level.

12. **Roundnose Grenadier in Subareas 2 and 3** (SCR Doc. 97/23, 74; SCS Doc. 97/10) (with some comments on roughhead grenadier SCR Doc. 97/19, 58; SCS Doc. 97/9, 10)

a) **Introduction**

After the first reported catch of about 17 000 tons of roundnose grenadier in NAFO Subareas 2+3 in 1967, nominal catches were greater than 20 000 tons (Fig. 30) in most years from then until extension of jurisdiction by Canada in 1977. During this period, most of the annual catch was taken in Div. 3K with the exception of 1971 when over 50 000 tons was reported from Div. 2G.

After declining to only about 2 000 tons in 1980, catches increased somewhat during the 1980s to about 7 000 tons in 1986 and 1987 due to increased catches by the former USSR and to some extent, by the former GDR. Catches declined again since then as a result of declines in catches by 'traditional' countries in 'traditional' areas, and beginning in 1993 there have been no allocations to non-Canadian vessels inside the Canadian zone. The majority of the catch since 1993 are primarily because of by-catch associated with the Greenland halibut fishery primarily prosecuted by non-Canadian fleets outside 200 miles in Div. 3LMNO.

It has been recognized for a number of years that reported catches represented a mixture of both roundnose and roughhead grenadier. EU-Portugal reported that all of their catch since 1988 was roughhead grenadier. It is likely that EU-Spain catches are roughhead grenadier. From 1987 to 1996 catches of roughhead grenadier have been reported in the Regulatory Area and since 1990 have exceeded those of roundnose although the nominal statistics do not indicate this and makes it difficult to track. It is believed that the catches have been between 50 to 60 tons for 1995 and 1996 most of which was taken by Japan.

Prior to 1993 most of the roundnose grenadier was taken during the second half of the year. The distribution of actual roundnose grenadier catches by area and season in the Regulatory Area in recent years has not been confirmed, but based on reports to NAFO, catches of roundnose and roughhead grenadier combined have been taken primarily during the first half of the year corresponding with the period of most effort for Greenland halibut.

A TAC was first imposed within the Canadian zone at 32 000 tons in 1974, increased marginally to 35 000 tons in 1977 and reduced successively to 27 000 tons by 1982. A reduction to 11 000 tons occurred for 1983 and the TAC was maintained at that level to 1993. From 1994 to 1996 a 3 000 ton TAC was in effect for the Canadian zone only. Currently there is a moratorium imposed within the Canadian zone but the fishery is unregulated outside the 200-mile limit.

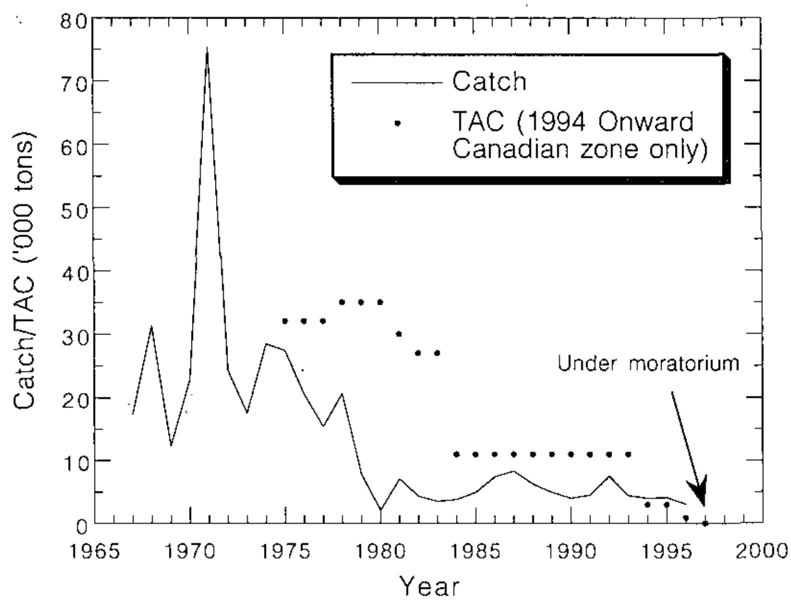

Fig. 30. Roundnose grenadier in Subareas 2+3: catches and TACs.

Nominal catches, as reported to NAFO, and TACs ('000 tons) for roundnose grenadier in the recent period are as follows:

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	11	11	11	11	11	11	11	3	3	3	0
Catch[2]	8	6	5	4	8-14[1]	8	4[3]	4[3]	4[3]	3[3]	

[1] Includes estimates of misreported catches which could not be determined precisely.
[2] Original as reported to NAFO.
[3] Provisional.

Catches of roughhead grenadiers in the Regulatory Area ('000 tons) have been estimated to be:

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Catch	1	1	0.3	3	4	5	6	5	3	4

b) **Input Data**

i) **Commercial fishery data**

Limited sampling information available from the discarded by-catch of the Spanish trawler fleet suggested the bulk of the roundnose by-catch in Div. 3L was composed of sizes between 6.5 cm to 12.0 cm based on pre-anal fin length. In Div. 3M, fish between 8.0 cm-13.5 cm pre-anal fin length dominated the yearly aggregated size distribution.

ii) **Research survey data - roundnose grenadier**

Two stratified-random bottom trawl surveys were conducted in 1996, one by Japan in Div. 2GH (SCR Doc. 97/23) and a more extensive one by Canada covering Div. 2G to Div. 3O (SCR Doc. 97/74).

The survey by Canada was conducted from September to December and generally covered down to 1 500 m in Div. 2GHJ+3K and to 146 meters in Div. 3LMNO. The only exceptions were in Div. 3M where certain deep strata on the east and south were not covered, in Div. 3NO where areas beyond 732 m were not covered and in Div. 2G, where there was minimal coverage beyond 500 m. Overall, highest abundance occurred in strata beyond 900 m and in Div. 2H and Div. 3K. Survey biomass estimates ranged from 2 600 tons in Div. 3L to 26 000 tons in Div. 2H. The total survey biomass amounted to about 68 000 tons.

The Div. 2GH survey by Japan was conducted in August and covered strata from 201 m to 1 500 m and utilized the same stratification scheme as the Canadian survey mentioned above. The survey biomass estimate was 2 250 tons for Div. 2G and 2 736 tons for Div. 2H.

Size distribution from the Canadian survey by Division generally indicated a smaller range of sizes and predominantly smaller fish in Div. 3LM, compared to the northern Div. 2HJ and 3K. There was a much broader size range of fish in Div. 2HJ and 3K where pre-anal fin length sizes occurred between 3.5 cm to 17 cm with modes at 5 cm and 10-12 cm than in Div. 3LM where fish were mostly between 3.0 cm and 12 cm with modes around 5 cm to 7 cm. There were very few fish captured in Div. 3NO.

The pre-anal fin length distributions sampled from the Japanese survey in Div. 2GH suggested a familiar pattern of increasing fish size with depth for both Div. 2G and Div. 2H. The overall size distribution for Div. 2G ranged from about 2.5 cm to about 18 cm with bulk of the catch between 4.5 cm and 8 cm with a clear mode at 6.5 cm. In Div. 2H the sizes ranged between 2 cm and 17 cm and the majority of catch was between 6 cm and 12 cm with a mode around 7 cm.

iii) **Research survey data - roughhead grenadier**

The EU has conducted stratified-random groundfish surveys in Div. 3M since 1988 (SCR Doc. 97/58). The survey is considered not to cover the main depth distribution of roughhead grenadier. Survey biomass estimates have ranged from about 1 000 tons in 1990 to 3 800 tons in 1993. The series of estimates indicated an increase from 1989 to 1993 followed by a decline to 1996. Pre-anal fin length distributions in 1996 indicate modes at 5 cm, 14 cm, 16 cm and 19 cm corresponding to ages 2, 6, 8 and 9 year-olds, respectively. It was reported that length at first maturity for females of this species (L_{50}) was about 67 cm total length (26 cm pre-anal fin length) corresponding to about 15 years old in Div. 3LMN (SCR Doc. 97/19).

c) Assessment Results - Roundnose Grenadier

There has been very limited commercial data since the cessation of fishing within the Canadian zone in 1993. The 1996 Canadian survey is not directly comparable to other Canadian survey data from 1994 to 1995 (for Div. 3LMN) because a different gear was used. The 1996 survey is difficult to judge on its own as a point estimate but suggests that abundance were highest in Div. 2H and 3K. The 1996 survey by Japan is not comparable to the 1996 survey by Canada because different gears were used. STACFIS noted that all considered surveys do not cover the whole distribution of the roundnose grenadier by depth.

d) State of the Stock

Due to the limited amount of information, the status of the stock cannot be determined. The 1996 estimate of survey biomass is the only point available and STACFIS cannot determine the status of the stock compared with the historical period when a directed fishery occurred.

e) Special Comments - Roughhead Grenadier

Roughhead grenadier have been taken in the order of 4 000 tons to 6 000 tons since 1991 as by-catch primarily in the Div. 3LMNO Greenland halibut fishery. The length composition of the by-catch in the EU-Portugal fishery suggested the dominant size range throughout Div. 3LMN area was between 10 cm and 20 cm pre-anal fin length. It has been reported that grenadier are a long lived species and caution is warranted about the impact of the by-catch levels in the Greenland halibut fishery.

13. Silver Hake in Divisions 4V, 4W, and 4X (SCR Doc. 97/1, 3, 47, 51, 54, 69, 75, 79; SCS Doc. 97/3)

a) Introduction

The fishery historically was conducted primarily by large Cuban and Russian Federation otter trawlers using small-meshed bottom trawls. Before 1977 the fishery was not restricted by season or area. However, since 1977 the fishery has been subjected to various seasonal, area, and gear restrictions. Since 1990, allocations have been made to Canadian companies which have entered into developmental arrangements with Cuban and Russian Federation fishing companies to harvest silver hake. A commercial fishery for silver hake with Canadian vessels fishing in Emerald and LaHave Basins has been conducted since 1995. Catches by this fleet increased greatly in 1996 to 3 500 tons compared to 300 tons in 1995. Nominal catches since 1970 ranged from a maximum of 300 000 tons in 1973 to a minimum of 8 000 in 1994. Catches generally increased from 1977 to 1989, with the exception of 1983, from 37 000 tons in 1977 to 89 000 tons in 1989, followed by a substantial decline. Catches increased after 1994. Since 1977 catches for this stock have been below the TAC as a result of allocations being made to parties which did not participate in the fishery, and allocations which were made late in the season when commercially viable catch rates could not be achieved. These trends continued in 1996, with 26 000 tons being harvested from a TAC of 60 000 tons.

Recent catches and TACs ('000 tons) are as follows (Fig. 31):

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	100	120	135	135	100	105	86[1]	30	60	60	50
Catch	62	74	91	69	68	32	29[2]	8[2]	17[2]	26[2]	

[1] Projected catch at $F_{0.1}$ was 75 000 tons; 11 000 additional tons were allocated by Canada in the knowledge that all allocations would not be harvested.

[2] Provisional.

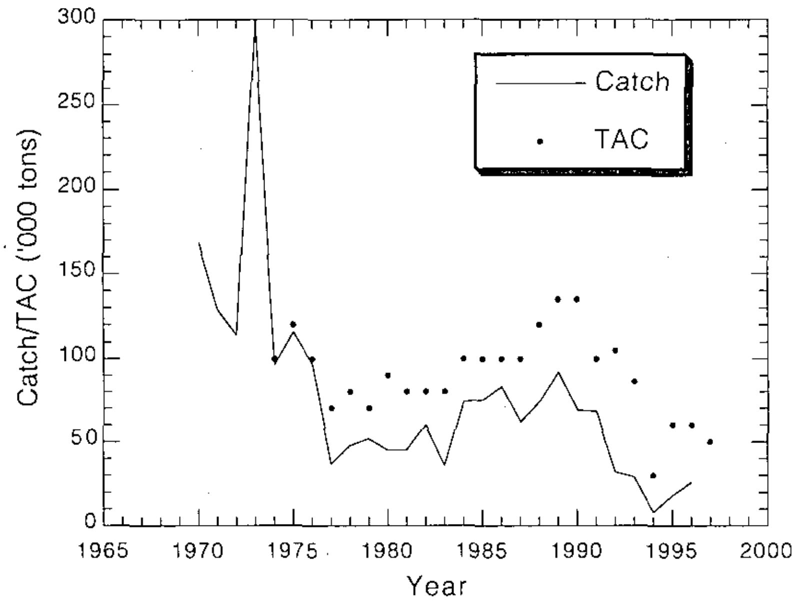

Fig. 31. Silver hake in Div. 4VWX: catches and TAC

The 1996 non-Canadian fishery commenced in March, and finished in August. As was the case in 1994 and 1995, regulatory measures intended to minimize by-catches of cod, haddock, and pollock were implemented. These include repositioning of the Small Mesh Gear Line (SMGL) to restrict fishing to water deeper than 190 m, and use of a separator grate in codends was mandatory. These measures were effective in reducing by-catches.

b) **Input Data**

i) **Commercial fishery data**

Catch rates. In response to a 1996 NAFO Scientific Council recommendation, an analysis of silver hake catch rates by the non-Canadian fleets in relation to the revised SMGL was conducted (SCR Doc. 97/47). As a result of various exemptions to the new SMGL regulations, the temporal and spatial distribution of fishing in 1994-96 was closely similar to the fishery distribution in 1990-93, and thus the regulation was unlikely to have affected catch rates. In any case, the catch rates in the fishing area defined by the 1994 restrictions were consistently as high or higher than those in the broader fishing area permitted under the previous regulations. Thus, even if the regulations had, in fact, been strictly enforced, no effect on catch rates is to be expected. An analysis of the effect of a separator grate on silver hake catches showed a reduction in the catch rate of approximately 5% (SCR Doc. 97/51).

Catch rates in the non-Canadian fleets have dropped in recent years, from a peak of 4 tons per hour in 1989 to approximately 1.3 in 1996 (Fig. 32; 1994-96 adjusted for separator grate). Catch rates by the Canadian fleet increased in 1996 over those seen in 1995, to 1.0 tons per hour (SCR Doc. 97/54), but this was attributed to the different fishing season in the two years, and to learning process on the part of vessel captains, and was not considered to be a reflection of stock abundance.

Catch-at-age and weight-at-age data. An analysis of condition and size-at-age based on Canadian July research vessel surveys in 1970-95 indicated that time of sampling did not affect the annual condition index but did have a significant effect on the estimates of length-at-age (SCR Doc. 97/75). Both condition and length-at-age (corrected for sampling date) declined over the time series and hence so too did weight-at-age. Weight-at-age was lowest in most recent years, 1994-95.

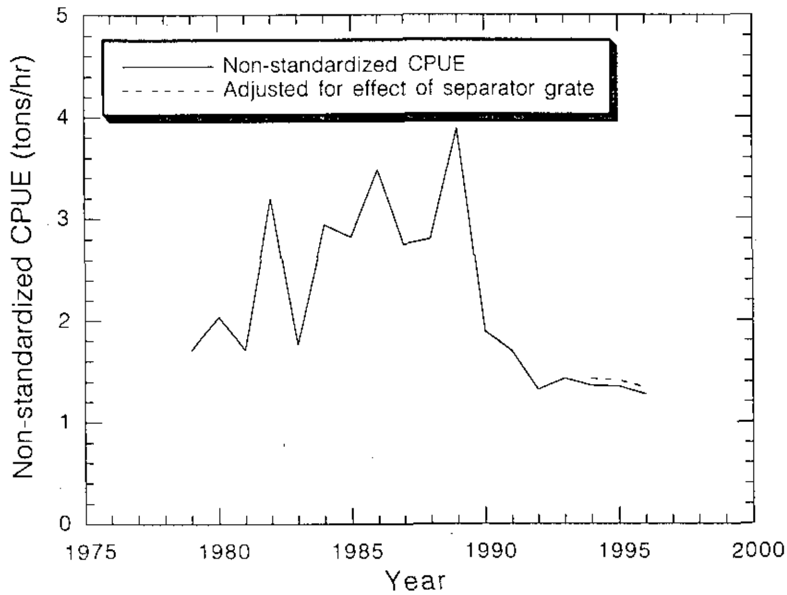

Fig. 32. Silver hake in Div. 4VWX: non-standardized catch rates.

The commercial removals-at-age for the 1996 non-Canadian fishery were calculated from Canadian observer length samples from the commercial fishery and monthly age-length keys. Length/weight data from Canadian July research vessel surveys were used in the calculation of weight-at-age. Removals for the Canadian silver hake fishery were calculated from Canadian observer length samples, and monthly age-length keys from the non-Canadian fishery, and combined with those from the non-Canadian fishery to provide estimates of total removals. The Canadian fishery catches smaller silver hake than the non-Canadian fishery (SCR Doc 97/54), and commercial mean weight-at-age was calculated using data from both fisheries, weighted by catch. The removals-at-age and weight-at-age for 1979-95 were taken from the previous assessment, to provide estimates for the period 1979-96 inclusive. Commercial mean weight-at-age declined from 1992-94. In 1996 the mean weights-at-age remained the same, or close to, those seen in 1994-95.

ii) **Research survey data**

Canadian July survey estimates of total numbers and biomass indicated relatively high abundance in the early- to mid-1980s (Fig. 33), followed by a decline in the late-1980s and early-1990s. However, since 1992 survey abundance and biomass have increased. The survey estimate of the size of the 1995 year-class based on a regression between sequential population analysis (SPA) numbers and survey numbers at age 1, indicated that this year-class was about the long term average, at 790 million fish.

The October 1996 0-group survey index was high and, based on a regression between SPA numbers at age 1 and the 0-group index, the 1996 year-class was estimated at 1 800 million fish. However, this estimate is particularly uncertain, as the 1996 survey index lies outside of the observations on which the regression is based, requiring extrapolation, and the regression itself explains only 36% of the variation in the data. In addition, the 1996 survey estimates had almost double the coefficient of variation of any other estimates in the time series, further reducing its reliability.

The 0-group survey also gave a second estimate for the size of the 1995 year-class of 1 200 million, substantially above the estimate of 790 million from the July survey at age 1. The latter estimate is likely the more reliable one, as the regression on which it is based explains about 78% of the variation in the data.

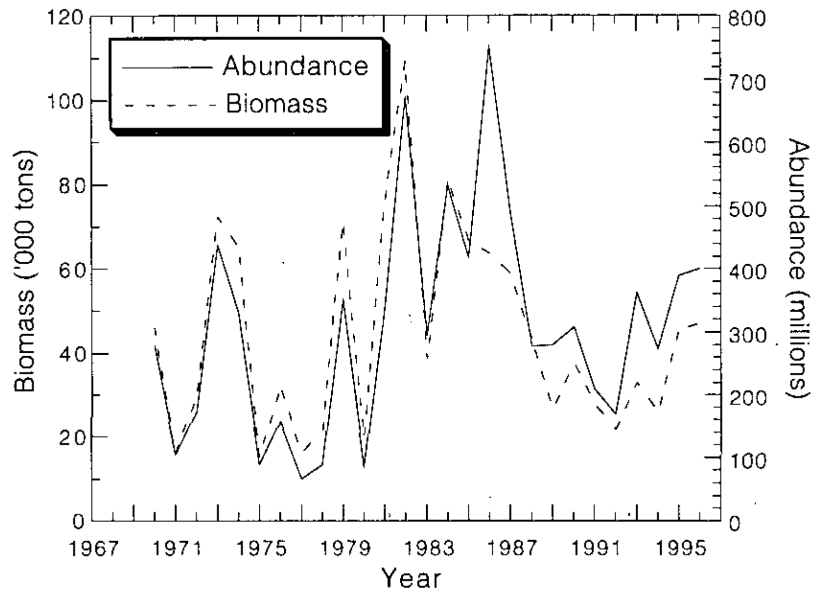

Fig. 33. Silver hake in Div. 4VWX: survey biomass.

iii) **Biological studies**

Relationships between the abundance of silver hake and juvenile cod, haddock, and pollock were examined from 1969 to 1992 (SCR Doc.97/3). Negative relationships between silver hake abundance (1+) and cod and haddock (age 1), and pollock (age 2), was seen for most periods, some of which were statistically significant.

A comparison of biomass estimates for the period 1979-83 from the 1985 assessment to those reported in the 1996 assessment showed that the estimates based on the 1996 assessment were lower, and it was suggested that the more recent analysis does not reflect true stock abundance (SCR Doc. 97/1). STACFIS noted that 1979-83 biomass estimates had converged in the 1996 analysis, while those of the earlier analysis had not. Under these circumstances the earlier estimates might be inflated, especially in light of the retrospective pattern now apparent.

c) **Estimation of Parameters**

Sequential population analysis. Commercial catch-at-age (ages 1-9, 1979-96), age desegregated non-standardized CPUE (ages 1-9, 1979-96), Canadian July survey catch-at-age (ages 1-9, 1979-96) and a juvenile index (0-group, 1983-95, except 1992) were used for tuning an SPA using a bias-adjusting adaptive framework (ADAPT). A dome-shaped partial recruitment pattern was used (pr at age 9 = 0.10), with M set at 0.4. This analysis gave an estimate of F in 1996 of 0.2, on average, for ages 3-5 (Fig. 34). An analysis incorporating both a less severe dome and a flat-topped partial recruitment pattern produced similar trends in ages 2-4 biomass and average F for ages 3-5.

A retrospective analysis using the results of the ADAPT formulation showed a tendency for F to be underestimated, and population numbers over estimated, as a longer time series of data were introduced. This pattern had been noted in previous assessments of this and other North Atlantic stocks, but the underlying cause remains obscure. An analysis of the retrospective pattern on an age-by-age basis showed the degree of overestimation of the population numbers to range between 15 and 50%, with a tendency to increase with age. Thus, numbers from the population analysis were adjusted, on an age-by-age basis, for catch projection purposes.

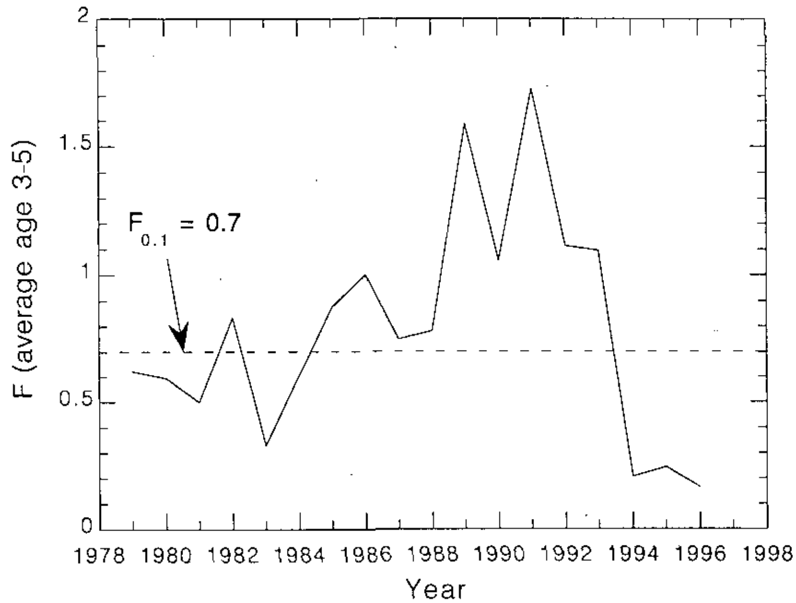

Fig. 34. Silver hake in Div. 4VWX: average fishing mortality for ages 3-5.

d) **Prognosis**

The 1996 year-class will make a significant contribution to the catch in 1998 at age 2. The size of this year-class was taken as that estimated by the 0-group survey, 1 800 million. The size of the 1995 year-class at age 1 is poorly estimated in the SPA, as the estimate is based on only a single occurrence in the catch matrix. The predicted size of the 1995 year-class was 790 million fish based on the July survey, while the estimate from the 0-group survey was 1 200 million. As was the case in the 1996 assessment, the size of the 1995 year-class was taken as an average of the two estimates, at 996 million fish. A geometric mean of age 1 numbers from the VPA (1985-94 year-classes) was used for the 1997 year-class (800 million). For projection, an $F_{0.1}$ value of 0.70 was used, based on the yield-per-recruit analysis conducted during the 1994 assessment. Mean weights-at-age for projection were taken as the average of the three most recent years (1994-96), while the partial recruitment pattern was an average of the five most recent years (1992-96). Weight-at-age, partial recruitment and numbers were:

Age	Avg weight (kg)	PR	numbers[1]
1	0.050	0.04	1 800 000
2	0.100	0.34	660 335
3	0.136	0.85	371 498
4	0.170	1.00	79 440
5	0.202	0.92	70 361
6	0.291	0.73	18 214
7	0.432	0.64	5 130
8	0.431	0.84	842
9	0.685	0.09	239

[1] Jan 1, 1997 numbers, age 3+ adjusted for retrospective pattern.

The 1997 silver hake fishery is still in progress, and the exact total catch cannot be determined at this time. Based on preliminary catch rates, level of participation, and historical trends in resource availability, the final catch for the foreign fleet was predicted to be 17 000 tons, and that of the Canadian fleet 3 500 tons, for a total of 20 500 tons. Based on the input parameters above, the estimated catch at $F_{0.1}$ in 1998 is 65 000 tons. Of this estimate, 21 000 tons (32%) are accounted for by the 1996 year-class, the estimated size of which is of very low reliability.

e) **Future Studies**

STACFIS continues to support cooperative studies on silver hake. These include continuation of the joint Canada-Russia juvenile survey, which is noted as a critical element in the prediction of the size of incoming year-classes for this stock.

There remains concern among members of the Committee that variation in the timing of the spawning period may be affecting estimates of weight at length (condition) measured by the July survey, and it was again **recommended** that *for Div. 4VWX silver hake the proportion of post-spawning fish in the Canadian July survey data be examined.*

It was noted that a dome shaped partial recruitment pattern has been imposed in the SPA for several years but that recent developments, including the introduction of separator grates and the development of a domestic Canadian fishery in new areas, indicate the need for a re-examination of the basis for the partial recruitment pattern in this fishery. As well, STACFIS notes that the effect of the dome-shaped partial recruitment pattern has been to increase the numbers of fish in the population, particularly at older ages, while the retrospective analysis has indicated a tendency towards severe overestimates of fish at these same ages. Therefore, STACFIS **recommended** that *the basis of a domed-shaped partial recruitment pattern in Div. 4VWX silver hake be further investigated and, in particular, that the distribution of silver hake in the Canadian July surveys be examined for differential patterns in availability among ages in areas where the fishery has traditionally operated.*

f) **Special Comment**

In contrast to the view of STACFIS, the Russian members expressed their doubt about the accuracy of the conclusion that a new SMGL does not affect silver hake catch rates and proposed to continue research on this item.

14. **Greenland Halibut in Subarea 0 and Divisions 1B-1F** (SCR Doc. 97/21, 38, 39, 48, 53; SCS Doc. 97/3, 4, 7, 8, 11)

a) **Introduction**

The annual catches in Subarea 0 + Div. 1B-1F, were in the period 1984-88 below 2 600 tons. From 1989 to 1990 catches increased from 2 200 tons to 15 500 tons. In 1991 catches dropped to 10 000 tons and then increased to 18 100 tons in 1992. In 1993 catches decreased to 10 957 tons and have remained at that level since. The catch in 1996 was 10 430. In Subarea 0 catches peaked in 1990 with 14 513 tons, declined from 12 358 tons in 1992 to 4 274 tons in 1994 and increased gradually to 5 874 tons in 1996. Catches in Div. 1B-1F have fluctuated between 900 and 1 600 tons during the period 1987-91. After then catches increased to about 5 550 tons where they have remained until 1995. In 1996 catches decreased to 4 556 tons (Fig. 35).

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

	1987	1988	1989	1990	1991	1992	1993[1]	1994[1]	1995[1]	1996[1]	1997
Recommended TAC[2]	25	25	25	25	25	25	25	25	11	11	11
SA 0	+	1	1	15	8	12	7	4	5	6	
Div. 1BCDEF	1	2	1	1	2	5	4	6	6	5	
Total	1	3	2	16	10	18	11[3]	10[4]	11[5]	10[6]	

[1] Provisional.
[2] In the period 1986-1994 the TAC included Div. 1A.
[3] Including 739 tons non-reported.
[4] Including 780 tons non-reported.
[5] Including 3 308 tons non-reported.
[6] Including 3 153 tons non-reported.

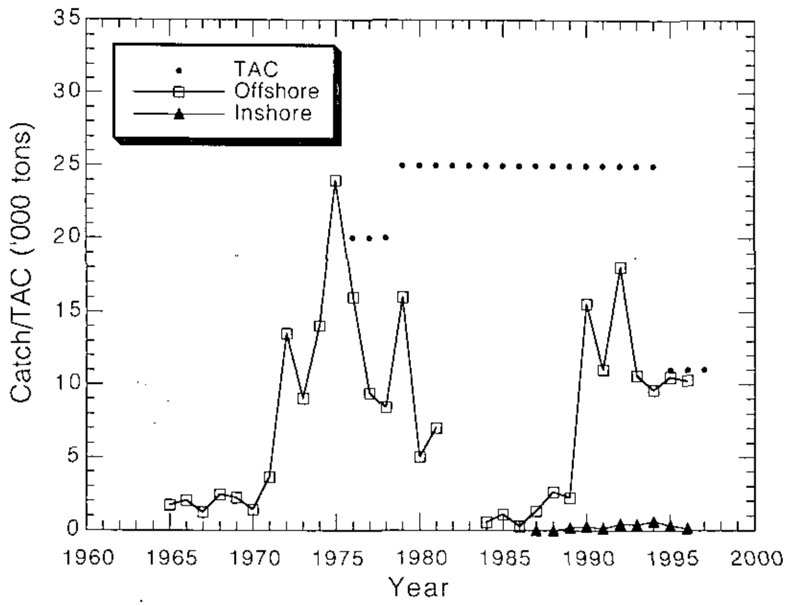

Fig. 35. Greenland halibut in Subarea 0 + Div. 1B-1F: catches and TACs.

The fishery in Subarea 0. Prior to 1984, USSR and GDR conducted trawl fisheries in the offshore part of Div. 0B. In the late-1980s catches were low and mainly taken by the Faroe Islands and Norway. In the beginning of the 1990s catches taken by these two countries increased and Canada, Russia and Japan were introduced to the fishery. The three latter countries have been fishing regularly in the area since then. Catches were about 12 400 tons in 1992 but have decreased to 5 874 tons in 1996 of which 4 372 tons were taken by trawlers. In 1995 an offshore Canadian gillnet fishery was introduced in Div. 0B and this fishery yielded catches of 1 147 tons in 1996. Most of the fishery takes place in the second half of the year.

In 1987 a longline fishery started inshore in Cumberland Sound. The catches gradually increased to 400 tons in 1992 where they remained until 1994. Since then catches have gradually decreased through 285 tons in 1995 to 60 tons in 1996 due to lack of ice cover.

An exploratory fishery in Div. 0A in 1996 resulted 295 tons, which were the only catches reported from this area (SCR Doc. 97/38).

The fishery in Div. 1B-1F. The offshore fishery in Div. 1B-1F increased from about 900 tons in 1987 to about 1 500 tons in 1988 and catches remained at that level until 1992 when they increased to 5 550 tons. Catches then remained at that level until 1995, but decreased to 4556 tons in 1996. Offshore, 3 621 tons were taken by mainly Norwegian and Greenlandic trawlers while 830 tons were taken by Norwegian and Greenlandic longliners. Inshore catches amounted to 105 tons taken mainly by longlines. Almost all the fishery takes place in Div. 1D in the second half of the year.

b) **Input Data**

i) **Commercial fishery data**

For 1996 catch-at-age and weight-at-age data were available from the offshore gillnet and trawl fishery in Div. 0B and from the trawl fishery in Div. 1D. Length frequency data were available from the offshore longline fishery in Div. 1D. As in the previous three years fish at age 7, taken in the trawl fishery, was the dominant age group in the overall catches. The introduction of a gillnet fishery in Div. 0B and an increase in the longline fishery, together with a tendency towards more large fish in the trawl fishery in Div. 1D have, however, given a shift towards larger fish in the overall catches in the last two years compared to previous years (SCR 97/53).

A standardized CPUE index was calculated for the offshore trawl fishery in Div. 1CD during 1988-96 from available logbook data and German data from 1996 (SCS Doc. 97/4). The standardized CPUE index fluctuated, but has shown a decreasing trend in the period. The data from 1996 covered only a small fraction of the fishery. The CPUE was about 45% lower in 1996 compared to 1992, where catch rate peaked. Average catch rates from the Norwegian trawl fishery in Div. 1CD showed a decrease from 1991 to 1993, stabilized between 1993 and 1994, but decreased further in 1995. The catch rates increased slightly in 1996 but is still only about half of the level in 1991 (Fig. 36). Catches rates for a longliner in Subarea 1 were available for the period 1994-1996 and showed an increase of 36% between 1994 and 1995, but was back at the 1994 level in 1996.

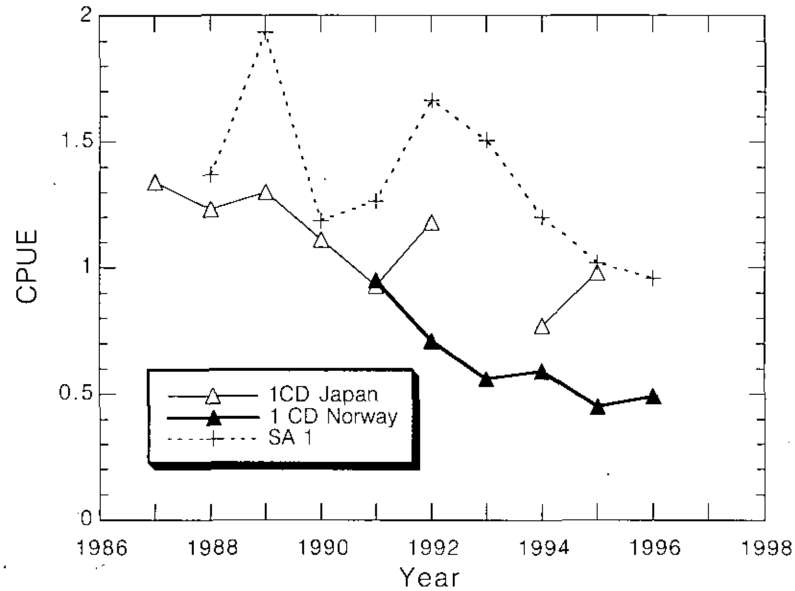

Fig. 36. Greenland halibut in Subarea 0 + Div. 1B-1F: CPUE.

ii) **Research survey data**

During 1987-95 bottom-trawl surveys have been conducted in Subarea 1 jointly by Japan and Greenland. In 1995 trawlable biomass was estimated to be 43 000 tons compared to 34 000 tons in 1994. The estimated biomass in 1995 was, however, still below the level in the late-1980s and early-1990s (The survey area was restratified and the biomasses were recalculated in 1997 (SCR Doc. 97/21)) (Fig. 37).

Biomass estimates ('000 tons) from USSR(Russia)/GDR(FRG) surveys and Japan/Greenland surveys for the years 1987-95 in Subareas 0+1 are as follows:

Year	USSR(Russia)/GDR(FRG) 0B	USSR(Russia)/GDR(FRG) 1BCD	Japan/Greenland 1BCD	Japan/Greenland 1ABCD[1]	Total 0B+1ABCD[2]
1987	37	56	115[3]	116[3]	153
1988	55	47	58	63	118
1989	79	-	69[4]	-	-
1990	72	88	52	55	127
1991	46	-	82	86	132
1992	38	-	73	77	115
1993	-	-	41	-	-
1994	-	-	34	-	-
1995	-	-	43	44	-

[1] Div. 1A south of 70°N.
[2] USSR(Russia)/GDR(FRG) Survey Div. 0B + Japan/Greenland Survey Div. 1ABCD.
[3] In 1987 the biomass at depths >1 000 m (42%) was estimated by an ANOVA.
[4] Estimate only for Div. 1CD.
- no survey.

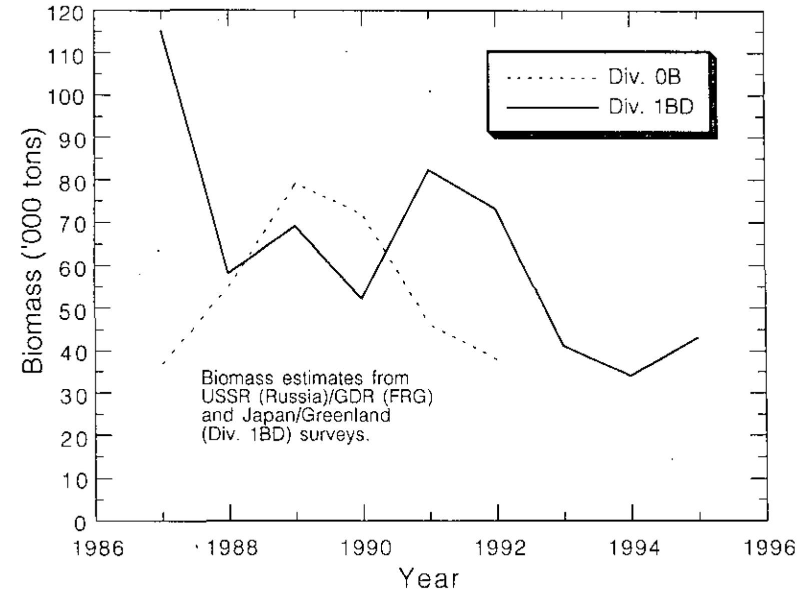

Fig. 37. Greenland halibut in Subarea 0 + Div. 1B-1F: biomass estimates from surveys.

Since 1988 annual surveys have been conducted with a shrimp trawl off West Greenland between 59°N and 72°30'N from the 3-mile boundary to the 600 m depth contour line. The catches in 1996 consisted mainly of one year old fish and the abundance was estimated to 491 million which is the highest in the time series and an increase from 185 million estimated in 1995. In the nursery area (Div. 1AB), which is a subset of the survey area, the abundance was estimated to 342 million which is the highest in the time series and an increase from 145 million in 1995 (SCR Doc. 97/39) (Fig. 38).

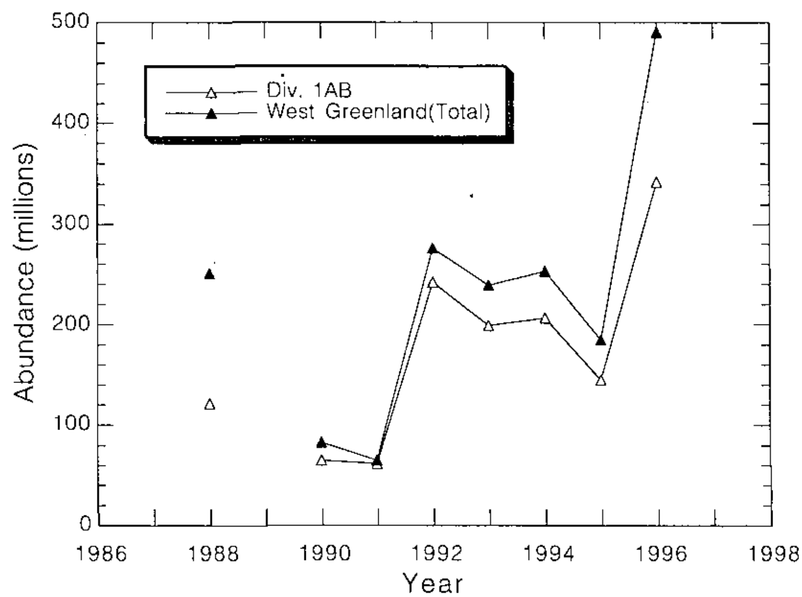

Fig. 38. Greenland halibut in Subarea 0+Div. 1B-1F: offshore abundance from shrimp trawl surveys.

c) **Estimation of Parameters**

Yield-per-recruit analysis could not be used due to uncertainties in the input parameters.

d) **Assessment**

Catches peaked at 18 000 tons in 1992 but have been stable around 11 000 tons since then. Survey trawlable biomass in Div. 1B-1D from the Japan/Greenland survey showed an increase from 34 000 tons in 1994 to 43 000 tons in 1995 and seems to have stabilized, however, at a lower level compared to the late-1980s and early-1990s. There was no survey in 1996. Population estimates at age 1 of the 1992-94 year-classes have declined in recent years compared to the presumably good 1991 year-class, but are still considered to be at or above average for the last decade, and the 1995 year-class is estimated to be the best in the time series. A standardized CPUE index from Div. 1CD has been declining since 1992, where it peaked. The index declined further in 1996. Data from 1996 covered, however, only a small fraction of the fishery. A unstandardized Norwegian CPUE index from Div. 1CD. has been declining since 1991, but the index rate increased slightly in 1996 to a level a little below the average of the period 1993-1996.

Although data for 1996 are very limited they do not indicate changes in the stock compared to 1995, i.e. the decline in the stock observed until 1994 seems to have stopped and the stock has apparently stabilized at a lower level compared to the late-1980s and early-1990s.

e) **Research Recommendations**

Although Greenland will initiate a new trawl survey series during 1997 including Div. 1C and 1D, the lack of conversion factors between the new vessel and the previous vessel which conducted the surveys during 1987-95 will preclude any linkage between the two. As a result, it will take a few years before any trends in stock size can be established with some confidence using the new time series. In addition, with no survey data for Div. 0B anticipated in the foreseeable future, a more complete evaluation of the status of this stock will remain difficult. Therefore STACFIS **recommended** that *a survey covering both SA0 and SA1 should be conducted in order to allow for a more complete evaluation of the stock status.*

The question of whether the Cumberland Sound Greenland halibut stock contributes to the Subareas 0+1 stock needs to be resolved. STACFIS **recommended** that *the tagging program in Cumberland Sound should be continued in 1998 to ascertain whether adult Greenland halibut fish move into Davis Strait.* The degree of spawning activity should be examined at the same time.

The joint Greenland/Japan survey was conducted for the last time in 1995. The survey will be continued with another vessel by Greenland. STACFIS **recommended** that *comparative trawling between the Japanese and Greenlandic vessels should be carried out in order to make it possible to extend the already established time series for Greenland halibut in Subareas 0 and 1.*

STACFIS **recommended** that *the investigations of the by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued.*

15. Roundnose Grenadier in Subareas 0 and 1 (SCR Doc. 97/11, 22; SCS Doc. 97/3, 4, 11)

a) **Introduction**

A total catch of 127 tons, was reported for 1996 compared to 306 tons for 1995 (Fig. 39).

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Recommended TAC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	0	0
Catch	0.52	0.08	0.29	0.19	0.12	0.14[1]	0.12[1]	0.31[1,2]	0.13[1,3]	

[1] Provisional.
[2] Includes 24 tons roughhead grenadier from Div. 1A misreported as roundnose grenadier.
[3] Includes 30 tons roughhead grenadier from Div. 1A misreported as roundnose grenadier.

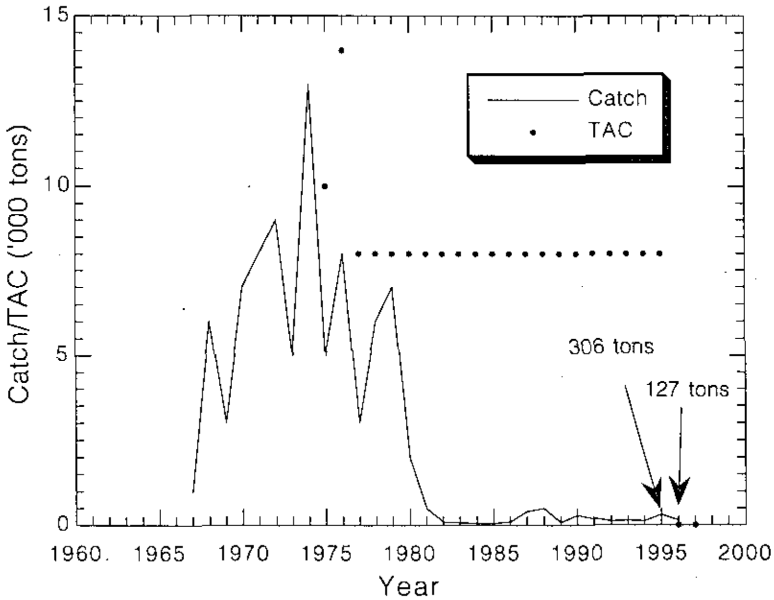

Fig. 39. Roundnose grenadier in Subareas 0+1: catches and TACs

b) **Input Data**

i) **Commercial fishery data**

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier was taken as minor by-catch in the Greenland halibut fishery in 1996. No update of the catch/ effort analysis which was presented previously (NAFO Sci. Coun. Rep., 1985, p. 72) was possible.

ii) **Research survey data**

In the period 1987-95 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. (The survey area was restratified and the biomasses recalculated in 1997). Russia has in the period 1986-92 conducted surveys covering Div. 0B and Div. 1CD at depths down to 1 250 m until 1988 and down to 1 500 from then on. The surveys took place in October-November. The trawlable biomass ('000 tons) was estimated as follows (Fig. 40):

	Year									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Russia										
0B	2.0	5.0	26.5	9.7	6.5	0.6	1.4			
1CD		80.6	36.8		48.1					
Japan/Greenland 1CD	83.8[1]	44.2[2]	8.1[3]	19.2[4]	41.9[4]	43.1[4]	8.0[4]	3.1[4]	7.2[4]	

[1] June/July. Biomass at depth >1 000 m estimated by an ANOVA (47%).
[2] September/October.
[3] April/May.
[4] August/September.

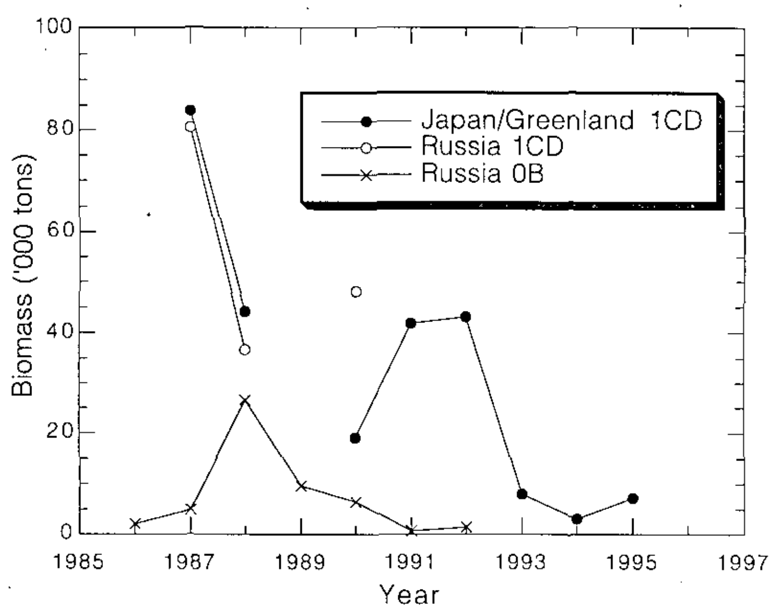

Fig. 40. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian and Japan/Greenland surveys in Div. 0B and Div. 1CD.

c) **Assessment Results**

No surveys were conducted in 1996, but the biomass has been at a very low level in recent years in Div. 1CD, where most of the biomass is usually found.

16. **Cod in Divisions 2J, 3K, and 3L** (SCR Doc. 97/40, 41, 43, 46, 49, 57, 59, 62, 63)

a) ***Introduction***

In the 1996 assessment of the stock, STACFIS determined that the stock continued to remain at an extremely low level. The 1996 status of the Div. 2J and 3KL cod stock is updated based on an additional year of data from the research vessel bottom trawl survey, Sentinel Survey, inshore acoustic surveys and prerecruit surveys.

b) **Description of the Fishery**

Prior to the 1960s the Div. 2J+3KL cod stock supported fisheries catching from 200 000 to 300 000 tons annually. During the 1960s good recruitment along with high exploitation rates resulted in catches averaging about 580 000 tons (Fig. 41). However, the stock was in a period of decline from the 1960s until the mid-1970s. Reduced exploitation and some improved recruitment after that time allowed the stock to increase until the mid-1980s, when catches were about 230 000 tons. With the subsequent stock decline, catches decreased and in 1992 only 41 000 tons were landed as a result of closure of the fishery in mid-1992. A Canadian food and subsistence fishery was permitted in 1993 and part of 1994 but not in 1995. A food fishery was also allowed in 1996 and it was estimated that about 1 200 tons were landed. A limited fishery for scientific purposes (Sentinel Survey) caught 163 tons in 1995 and 397 tons in 1996. The Sentinel catches together with the food fishery catches and the by-catch gave a total catch of 1 694 tons in 1996 (Fig. 42).

No catch was reported in the Regulatory Area in Div. 3L in 1996.

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

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Fixed Gear Catch	74	80	102	103	117	61	12	9[1]	1.3[1]	0.3[1,2]	1.7[1]
Offshore Catch	193	160	167	151	103	111[2]	29[2,3]	2[1,2]	0.5[1,2]	0[1]	0[1]
Total Catch	267	240	269	254	220	172	41	11[1]	1.4[1]	0.3[1]	1.7[1]
TAC	266	256	266	235	199	190	120[4]	0[4]	0[4]	0[4]	0[4]

[1] Provisional.
[2] Includes reported landings and Canadian surveillance estimates.
[3] Fishery closed by EU in June 1992.
[4] Moratorium on Canadian fishing became effective in July 1992.

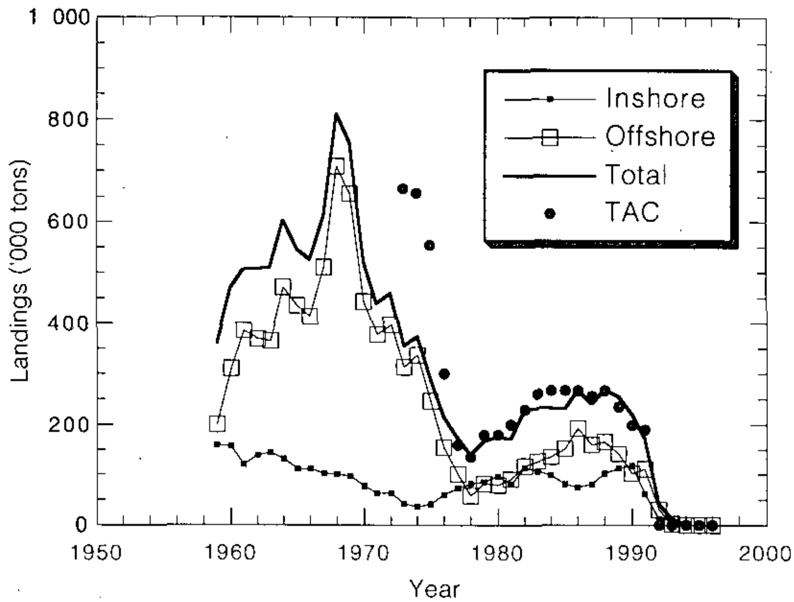

Fig. 41. Cod in Div. 2J+3KL: inshore and offshore landings and TACs.

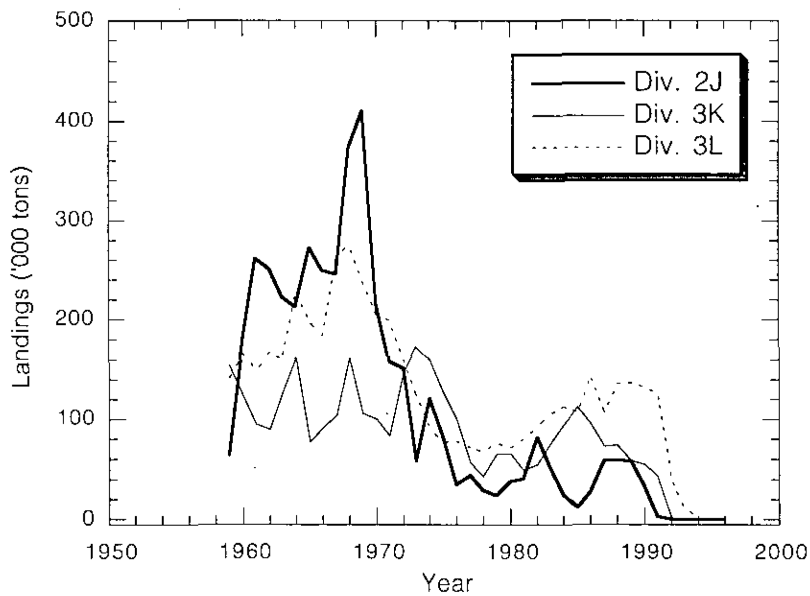

Fig. 42. Cod in Div. 2J+3KL: landings by Division.

c) **Oceanographic Environment**

Warmer than normal sea temperatures were observed over most of the southern Labrador and Newfoundland regions in 1996, reversing the cooling pattern established in the early to mid-1980s. This included warming throughout the water column at Station 27, less than average amount of cold intermediate layer waters, and an increase of near bottom temperatures over the Grand Banks in autumn.

d) **Biomass Trends** (Fig. 43)

The Canadian research trawl surveys switched from the Engel trawl to the Campelen trawl from the autumn of 1995.

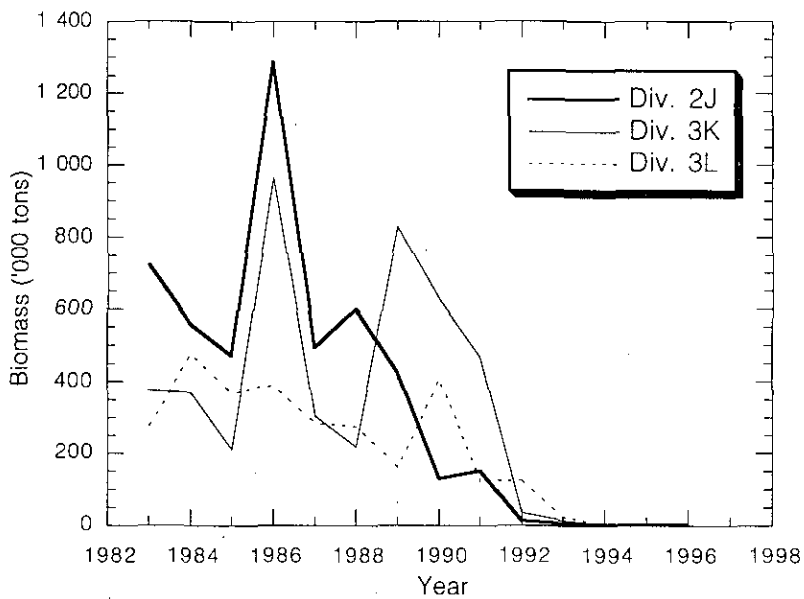

Fig. 43. Cod in Div. 2J+3KL: biomass estimates from surveys.

The survey data for the period sampled with the Engel gear have been converted to Campelen equivalent units using conversion factors derived from extensive comparative fishing between the two gears (SCR Doc. 97/68, 73). The strata surveyed in 1996 were similar to those in 1995 except that 25 new strata have been added inshore in Div. 3K and 3L to obtain a more complete estimate of population size.

Autumn research vessel survey estimates of biomass in Div. 2J+3KL declined abruptly in the early-1990s. The 1996 estimate (excluding new inshore strata) is slightly higher than the previous year but remains extremely low.

The SPA estimates show that the 3+ biomass remains extremely low. The pattern in the residuals from the SPA suggest that caution be used in interpreting the results of the SPA for the more recent years. It is clear, however, that the biomass is currently at an extremely low level.

e) **Spatial Patterns of Abundance and Distribution**

Bottom-trawl surveys in Div. 3L in spring 1996 and in Div. 2J+3KL in autumn 1996 found very low abundance levels of cod. The only sets with significant quantities of fish occurred in the new strata set up inshore of the regular survey.

In April 1995, a dense aggregation of spawning cod was located in Smith Sound, Trinity Bay (Div. 3L). An acoustic study in early May 1995 provided an estimate of about 17 000 tons. Acoustic studies in mid-

May and late-June revealed that the cod had moved out of Smith Sound. Aggregations of cod mainly aged 3 to 8 were again found in the more northerly two arms of Trinity Bay in December 1995. An acoustic survey in April 1996 revealed cod in all three arms. The densest aggregation of spawning fish was found in deep water in the outer reaches of Smith Sound. The acoustic estimate for all three arms in 1996 was 171 tons, considerably lower than the estimate in the previous year.

The remaining cod appear to be concentrated in a few inshore areas, particularly the fjord like environments of some of the major bays. Very few cod were observed inshore in Div. 2J based on the Sentinel Survey.

f) Changes in Lengths, Weights and Maturity

Mean weights-at-age for cod caught in the commercial fishery declined during the 1980s and early-1990s after peaking in the late-1970s and early-1980s. Research survey sampling shows a strong decline in lengths and weights at age in Div. 2J, a lesser decline in Div. 3K, and little or no decline in Div. 3L. Superimposed on the declining trends are periods of relatively quicker or slower growth associated with changes in the area of the cold intermediate layer. The trend of decreasing mean lengths and weights-at-age during the 1980s appears to have been reversed in recent years.

Sampling from the limited catches taken with commercial gear in recent years suggests an increasing trend in weights-at-age since 1992. Estimated proportions mature for age 5 and 6 female cod increased dramatically from 1986 onwards, but have dropped considerably in the most recent year.

g) Recruitment Trends

Comparisons of year-class strength or biomass in the surveys are, however, restricted to that portion of the area that has been routinely surveyed.

Sequential population analysis was applied to the catch-at-age and Canadian autumn trawl survey index-at-age data for the period 1983 to 1996 in an attempt to reconstruct the time series of fishing mortalities and numbers-at-age for this stock. The number of 3 year olds estimated in the SPA indicates that recruitment has been very low since 1987. There is some evidence from inshore surveys and catches that the 1990 year-class may have been less weak than indicated in the offshore surveys, however, very few survivors from this year-class appeared in the research vessel survey at age 3 and older. Pelagic juvenile fish surveys carried out in August-September 1994-96 provide an index of year-class strength. The abundance of pelagic juvenile cod decreased by a factor of eight from 1994 to 1996. Year-class strength from these surveys predict that recruitment at age 3 for the 1996 year-class will be extremely low.

h) Sentinel Survey

A Sentinel Survey was conducted by fishers at 66 inshore sites in Div. 2J and 3KL in summer-autumn 1996. Catch rates were higher in all Divisions in 1996 over 1995. This increase in catch rate was made up primarily of fish greater than 50 cm rather than an increase in the catch rate of small fish, suggesting that in 1996 the remaining fish in the population were more densely aggregated in the inshore area, rather than any significant increase in recruitment.

i) Seal Consumption

Consumption of fish by seals in the stock area has been increasing in recent years. The total estimate for Div. 2J+3KL in 1996 is 2.5 million tons. This is estimated to comprise 108 343 tons of cod <40 cm in length and 1 427 tons of cod >40 cm, excluding consumption by hooded seals (SCR Doc. 97/40).

j) Summary

The research vessel survey continues to show an extremely low abundance of cod throughout the survey area. Sentinel catch rates were higher in 1996 than 1995 but showed spatial differences in both years, being very low in Div. 2J, variable in Div. 3K and generally higher in 3L. The 1990 year-class has been noticeable in several data sets in the inshore over the last 5 years. However, this year-class has been rare offshore. An acoustic survey in Trinity Bay (Div. 3L) in 1996 suggested that the aggregation of fish is much smaller than it was in 1995. The prerecruit indices indicate that all year-classes after 1994 are very low. Initial indications are that the 1996 year-class may be exceptionally weak. There is no indication to suggest that the Div. 2J+3KL cod stock has begun to recover. Instead it is possible, based on estimates of recent recruitment, that the biomass may continue to decline. Based on the seal consumption study, it is possible that seal consumption may impede the recovery.

17. **Redfish in Subarea 1** (SCR Doc. 97/5, 39, 56; SCS Doc. 97/4, 11)

a) Introduction

Historically, redfish were taken mainly as by-catch in the trawl fisheries for cod and shrimp. However, occasionally during 1984-86, a directed fishery on redfish was observed for German and Japanese trawlers. With the collapse of the Greenland cod stock during the early-1990s resulting in a termination of that fishery, catches of commercial sized redfish were taken inshore by longlining or jigging and offshore by shrimp fisheries only, the latter being suggested to discard juvenile redfish in substantial numbers.

Both redfish species, golden redfish (*Sebastes marinus* L.) and deep sea redfish (*Sebastes mentella* Travin), were mixed in the catch statistics since no species specific data or information to precisely split the catches by species were available. Until 1986, landings were indicated to be composed almost exclusively of golden redfish. Subsequently, the proportion of deep sea redfish represented in the catches increased, and since 1991, the majority of catches were believed to be deep sea redfish. In 1977, total reported catches peaked at 31 000 tons (Fig. 44). During the period 1978-83, reported catches of redfish varied between 6 000 and 9 000 tons. From 1984 to 1986, catches declined to an average level of 5 000 tons due to a reduction of effort directed to cod by trawlers of the EU-Germany fleet. With the closure of the offshore fishery in 1987, catches decreased further to 1 200 tons, and remained at that low level. The official catch figure for 1996 was estimated to amount to 862 tons.

Recent and historical catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp.

Recent catches ('000 tons) are as follows:

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Catch	1	1	1	0.4	0.3	0.3	0.8[1]	1[1]	0.9[1]	0.9[1]	0.9[1]

[1] Provisional

b) Input Data

i) Commercial fishery data

No data on CPUE were available. Information on historical length composition was derived from sampling of German commercial catches of golden redfish during 1962-90 covering fresh fish landings as well as catches taken by freezer trawlers. 118 samples were quarterly aggregated and mean length was calculated. These data revealed significant size reductions of fish caught from 45 to 35 cm, with the biggest reductions occurring during the 1970s. Length frequencies derived from the Greenland bottom trawl survey using a shrimp trawl revealed that the shrimp gear selected all fish sizes <20 cm.

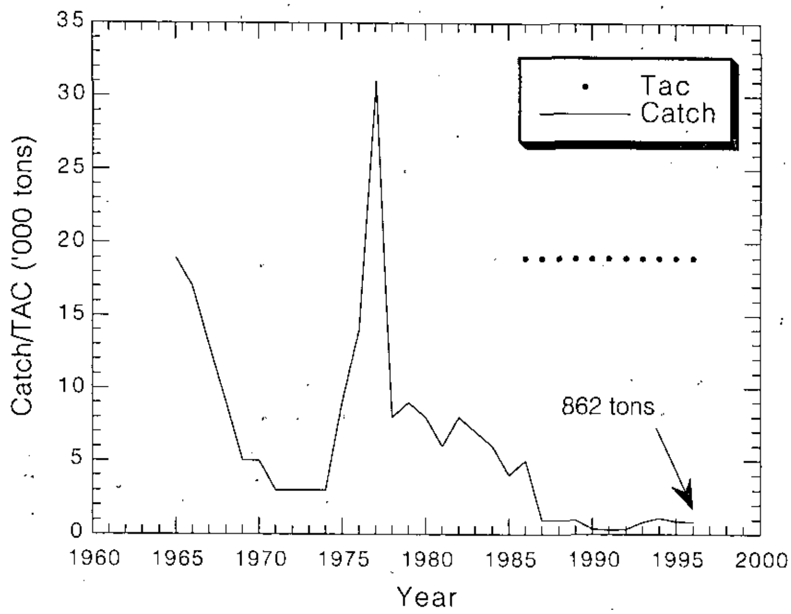

Fig. 44. Redfish in Subarea 1: catches

ii) **Research survey data**

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400 m isobath of Div. 1B to 1F and were primarily designed for cod as target species. Therefore, the high variation of the estimates for redfish could be caused as a result of the incomplete survey coverage in terms of depth range and pelagic occurrence of redfish. The survey results indicated that both abundance and biomass estimates of golden redfish (≥17 cm) decreased by 99% over the period of the survey (Fig. 45). Estimates for deep sea redfish (≥17 cm) varied without a clear trend but have frequently been extremely low since 1989 (Fig. 46). Golden and deep sea redfish showed decreasing trends in their size composition, juveniles dominating the recent stock structures. Juvenile redfish (<17 cm) were found to be very abundant in the survey series, especially in 1986, 1991, and 1996 (Fig. 47).

Recurring peaks at 6, 10-12 and 15-16 cm might indicate annual growth increments and represent the age groups 0, 1 and 2 years. Comparisons between with the survey results off West and East Greenland revealed that all three redfish components were almost exclusively distributed off East Greenland. Significant recovery signals for deep sea redfish based on both fish abundance and size were limited to the area off East Greenland.

Greenland-Japan groundfish survey. During 1987-95, cooperative trawl surveys directed to Greenland halibut and roundnose grenadier have been conducted on the continental slope in Div. 1A-1D at depths between 400 m and 1 500 m. This survey was discontinued in 1996. Deep sea redfish were mainly caught at depths less than 600 m. During 1994-95, an increase of the biomass index from 400 to 600 tons was observed (Fig. 46). However, both estimates represented the lowest values for the time series and a reduction by more than 90% compared to the maximum of 8 100 tons observed in 1987. Length measurements revealed that the size structure of the stock is presently dominated by individuals <20 cm.

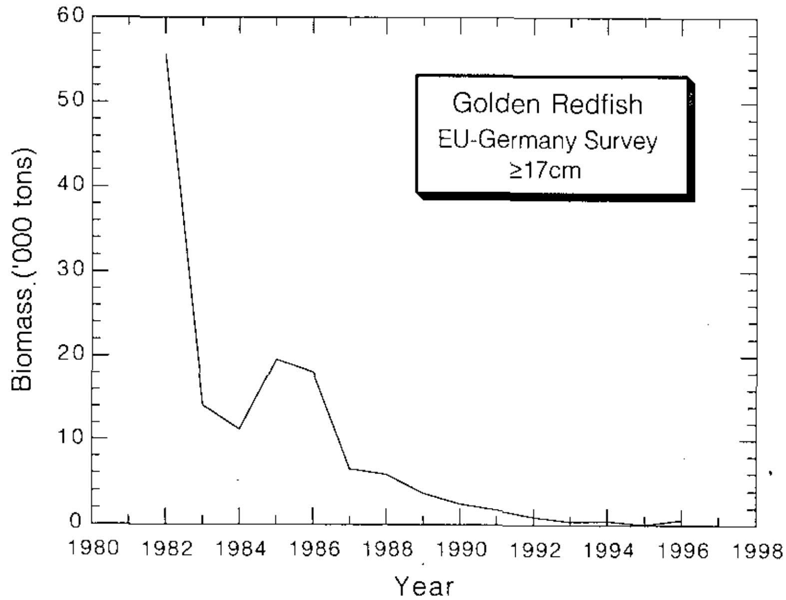

Fig. 45. Redfish in Subarea 1: golden redfish survey biomass index, EU-Germany.

Greenland bottom trawl survey using a shrimp gear. Since 1988, a bottom trawl survey using a shrimp gear was conducted by Greenland covering the Div. 1A to 1F down to 600 m depth. Due to changes in survey strategy and sampling of fish, determinations of abundance and biomass indices and length composition were considered comparable since 1992. Redfish was found to be most abundant in northern Div. 1A to 1C. Abundance and biomass indices varied without a clear trend but indicated juvenile redfish to be very abundant (Fig. 47). During the entire survey series, catches were composed almost exclusively of juveniles smaller than 15 cm.

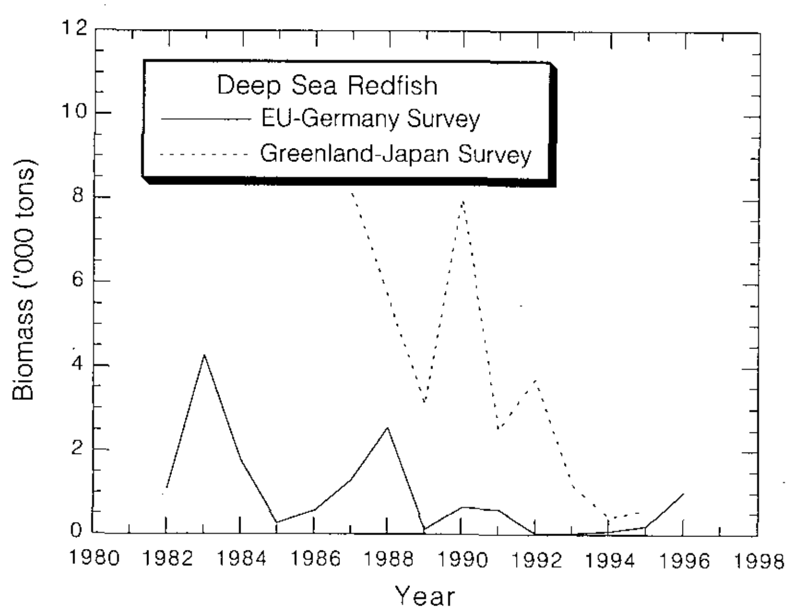

Fig. 46. Redfish in Subarea 1: deep sea survey biomass indices.

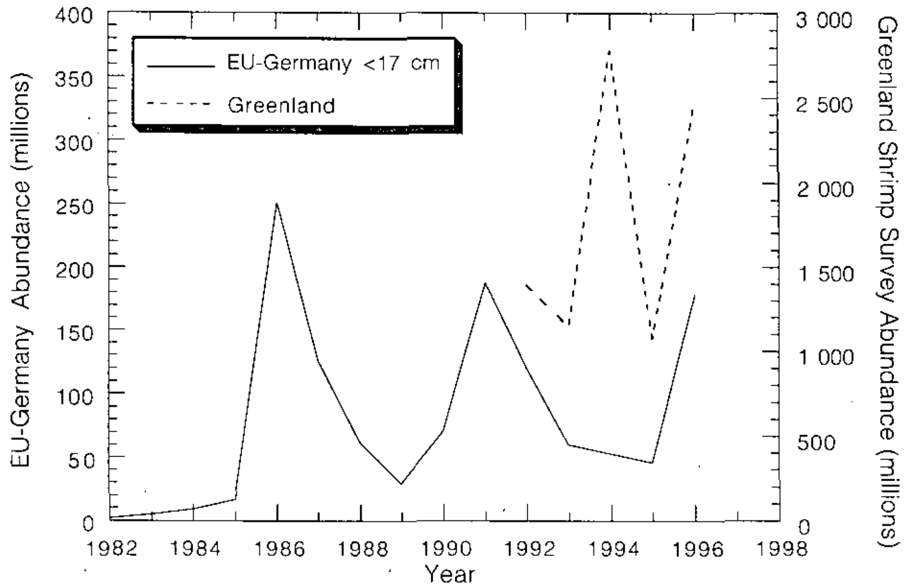

Fig. 47. Juvenile redfish in Subarea 1: survey abundance indices.

c) **Assessment Results**

In view of dramatic declines in survey abundance and biomass indices of golden and deep sea redfish (≥17 cm) to an extremely low level along with significant reduction in fish sizes, it is concluded that the stocks of golden and deep sea redfish in Subarea 1 remain severely depleted and there are no signs of any recovery although pre-recruits (<17 cm) were found to be very abundant as indicated in the surveys. Considering the substantial numbers of redfish caught as by-catch in the shrimp fishery, concern must be expressed about the continuous recruitment failure.

d) **Research Recommendations**

STACFIS **recommended** that *the redfish by-catch taken by the shrimp fishery in Subarea 1 should be assessed based on the Greenland bottom trawl survey results reflecting the catch composition of a commercial shrimp trawl on the shrimp fishing grounds and that the results should be presented at the June Meeting in 1998 on a length disaggregated basis.*

18. **Other Finfish in Subarea 1** (SCR Doc. 97/5, 39, 55; SCS Doc. 97/4, 11)

a) **Introduction**

Catches of Greenland cod, American plaice, Atlantic and spotted wolffishes, starry skate, lumpsucker, Atlantic halibut and sharks are taken by offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut, by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. In 1996, reported catches of other finfishes amounted to 3 367 tons representing a decrease of 9%, compared to the 1995 catch (3 711 tons). Most recent catches of other finfishes were dominated by Greenland cod (63%) and the category of non-specified finfish (18%).

The catch figures do not include the weight of substantial numbers of small fish discarded by the trawl fisheries directed to shrimp.

Nominal reported catches (tons) are as follows:

Species	1993	1994	1995	1996
Greenland cod	1 896	1 854	2 526	2 117
Wolffishes	157	100	51	47
Atlantic halibut	43	38	23	34
Lumpsucker	246	607	447	425
Sharks	10	34	46	135
Non-specified finfish	411	643	618	609

b) **Input Data**

i) **Commercial fishery data**

No data on CPUE, length and age composition of the catches were available. Length frequencies derived from the Greenland bottom trawl survey using a shrimp gear revealed that the shrimp trawl was capable of catching all predominant fish sizes.

ii) **Research survey data**

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400 m isobath of Div. 1B to 1F, and were primarily designed for cod as target species. During 1982-96, survey results indicated fundamental shifts in species composition of the demersal fish assemblage inhabiting the shelf and continental slope off West Greenland in Div. 1B-1F down to 400 m depth. These shifts were coincidental with dramatic changes in survey estimates of stock abundance, biomass and size structure for ecologically and economically important species. Recent decreases of biomass estimates for demersal stocks of American plaice, Atlantic and spotted wolffish and starry skates varied between 70% and almost 100%, losses in abundance being less pronounced (Fig. 51). Length distributions revealed that recently these stocks were mainly composed of small and juvenile fish. A comparison between the survey results off West and East Greenland indicated that 95% of the aggregated demersal fish abundance was distributed off East Greenland in 1996. Positive effects in fish abundance, biomass and size for various stocks observed recently were restricted to East Greenland while negative effects were more pronounced off West Greenland.

Greenland-Japan groundfish survey. During 1987-95, cooperative trawl surveys directed to Greenland halibut and roundnose grenadier have been conducted on the continental slope in Div. 1A-1D at depths between 400 m and 1 500 m. This survey was discontinued in 1996. The estimated biomass of most species classified to other finfishes contributed 16% to the total finfish catch and remained unchanged at lowest level of the time series after a continuous decline up to 1992.

Greenland bottom trawl survey using a shrimp gear. Since 1988, a bottom trawl survey using a shrimp gear was conducted annually by Greenland covering Div. 1A to 1F down to 600 m depth. Due to changes in survey strategy and sampling of fish, determinations of abundance and biomass indices and length composition were considered comparable since 1992. Abundance and biomass indices of American plaice, spotted and Atlantic wolffish were very low (Fig. 48). Starry skates were mainly distributed in northern strata with big areas causing higher abundance and biomass estimates. However, mean individual weight varied only between 0.1 and 0.2 kg which is in agreement with the findings of the small fish caught in the German groundfish survey.

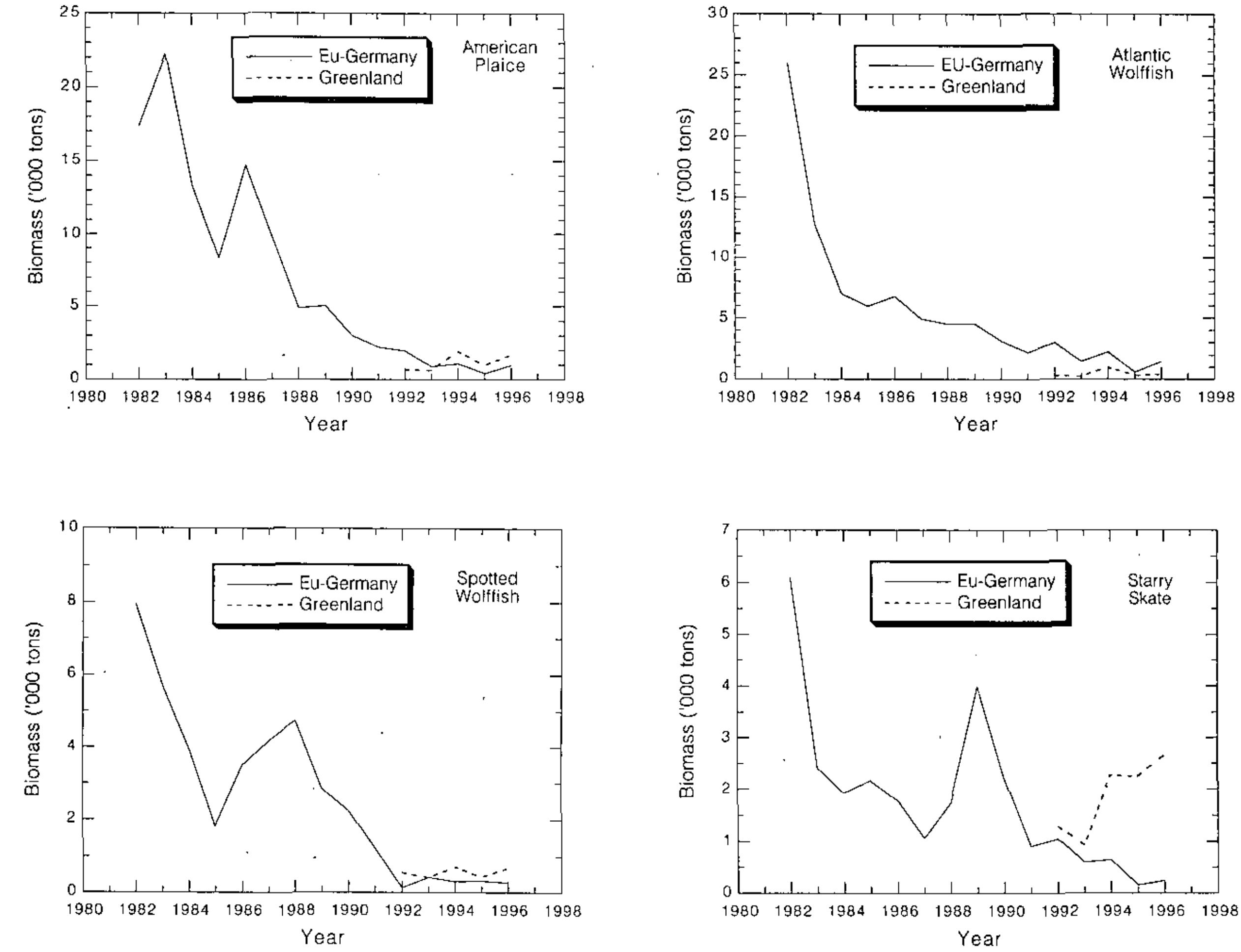

Fig. 48. Finfish in Subarea 1: survey biomass indices of various finfish species.

c) **Assessment results**

In view of dramatic declines in survey abundance and biomass indices to extremely low levels, together with significant reduction in fish sizes, STACFIS concluded that the demersal stocks of American plaice, Atlantic and spotted wolffish and starry skates in Subarea 1 are severely depleted. The status of the demersal fish assemblage has remained at that low level since 1990 and there are no signs of any recovery. In view of by-catches of juvenile finfish in substantial numbers taken by the shrimp fishery concern must be expressed about the continuing recruitment failure.

d) **Research Recommendations**

STACFIS **recommended** that *the finfish by-catch taken by the shrimp fishery in Subarea 1 should be assessed based on the Greenland bottom trawl survey results reflecting the catch composition of a commercial shrimp trawl on the shrimp fishing grounds and that the results should be presented at the June Meeting in 1998 on a species by species, as well as a length disaggregated basis.*

19. Greenland Halibut in Division 1A (SCR. Doc. 97/39, 53, 78; SCS Doc. 97/11)

a) Introduction

The main fishing grounds for Greenland halibut in Div. 1A are located inshore. The inshore catches in Div. 1A were around 7 000 tons in the late-1980s, but have increased steadily since then and have reached a level around 17 000 tons in recent years. The total nominal catch in 1996 was 17 267 tons (Fig. 49). Catches were rather evenly distributed over the year but with a tendency toward higher catches around August.

Catches ('000 tons) in Div. 1A are as follows:

	1988	1989	1990	1991	1992	1993[1]	1994[1]	1995[1]	1996[1]
Disko Bay[2]	2.7	2.8	3.8	5.4	6.6	5.4	5.2	7.4	7.8
Uummannaq	2.9	2.9	2.8	3.0	3.1	3.9	4.0	7.2	4.6
Upernavik	0.8	1.3	1.2	1.5	2.2	3.8	4.8	3.3	4.8
Offshore	-	-	-	-	-	+	+	+	-
Unknown[3]	0.6	0.6	0.5	+	0.1	-	-	-	-
Total	7.0	7.5	8.3	9.9	11.9	13.1	14.0	17.9	17.3
Officially reported	7.0	7.5	7.5	9.2	11.9	-	-	-	-

[1] Provisional.
[2] Formerly named Ilulissat.
[3] Catches from unknown areas within Div. 1A.

The offshore fisheries in Div. 1A. There has been practically no offshore fishing for Greenland halibut in Div. 1A. In 1993, 34 tons were taken by a Japanese trawler, in 1994, 18 tons by a Greenlandic longliner, in 1995, 13 tons by a Japanese trawler. No fishing was carried out in the area in 1996.

The inshore fisheries in Div. 1A. The fishery is mainly performed as a traditional fishery with longlines from small boats below 20 GRT, or by means of dog sledges, typically in the inner parts of the ice fjords at depths between 500 to 800 m. In the middle of the 1980's gillnets were introduced to the inshore fishery, and were used more commonly in the following years. In 1989 gillnets and longlines accounted equally for the Greenland halibut catches, but since then the annual proportion of catches from each gear has varied considerably. Authorities have in recent years tried to discourage the use of gillnets, which has lead to an increased proportion of longline catches. A total ban for gillnets is in force from 1998. Gillnet fishery is regulated by a minimum mesh-size of 110 mm (half meshes). There are no regulations on longline fisheries. Longline catches comprised 76% of the total catches in 1995 and 74% in 1996. There are no quota regulation on the fishery.

The inshore fishery in Div. 1A is mainly located in three areas: Disko Bay (69°N), Uummannaq (71°N) and Upernavik (73°N). Landings in Greenland northernmost settlement, Qaanaq (77°) accounted for 3.6 tons in 1996.

Disko Bay. The Greenland halibut fishery is conducted in, and in front of an ice fjord in the immediate vicinity of Ilulissat town, and in an ice fjord, Torssukattâk, north of Ilulissat. Use of gillnets is prohibited in the inner parts of the ice fjords.

The catches in Disko Bay increased from about 2 300 tons in 1987 to about 6 600 tons in 1992. In 1993 and 1994 the catches decreased to 5 300 tons, however, in 1995 and 1996 catches reached historic high levels, 7 400 tons in 1995 and 7 837 tons in 1996. Longline catches comprised 66% in both 1995 and 1996.

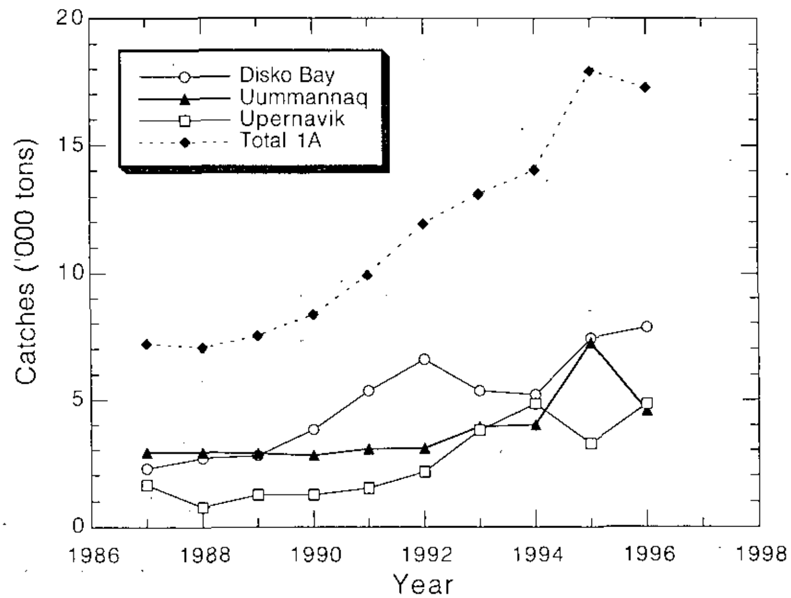

Fig. 49. Greenland halibut in Div. 1A: catches by area.

Uummannaq. Uummannaq comprises a large system of ice fjords, where the fishery for Greenland halibut is conducted. The main fishing ground is the southernmost fjord Qarajaq Ice fjord. Use of gillnets is prohibited in the inner parts of the fjords.

The catches at Uummannaq were stable at about 3 000 tons in the period 1987 to 1992. In 1993 and 1994 the catches increased to 4 000 tons and peaked in 1995 at 7 200 tons. In 1996 the catches declined to 4 579 tons. Longline catches comprised 76% in 1995 and 70% in 1996.

Upernavik. The northernmost area consists of a large number of ice fjords covering a considerable distance of the coastline (from 72°N to 74°45'N). The main fishing grounds is Upernavik Ice fjord, Naajaat and Giesecke Ice fjord, all north of Upernavik town. Use of gillnets is prohibited in the entire area.

The catches in Upernavik have increased steadily from about 1 000 tons in the late-1980s to about 3 000-4 000 tons since 1993. In 1996 the total catch was 4 846 tons.

b) **Input Data**

i) **Commercial fishery data**

Catch-at-age data for the three inshore areas separately were available, based on sampling from the commercial fishery covering area, gear and, in most cases, season. For some years and areas otolith samplings were missing or inadequate. In those cases age-length keys have been applied from adjacent years or areas. In 1996 the fishery was conducted on the age groups 5 to 18 years with age 9 as the most common.

Analysis of weight categories in landings concluded that the proportion of fish above 3.3 kg ('large fish') had decreased in the main fishing areas in the period 1990 to 1996. However, a significant decline is only evident for the Uummannaq area. It should be noted that a change in landings categories was made in 1996 as fish above 3.5 kg were formerly classified as large and this was not taken into account in the analysis.

Length measurements from the commercial longline landings in the period 1993 to 1996 in Ilulissat, Uummannaq and Upernavik indicated that the fishery are taking place on smaller sub-components of the stock as size differences were observed between summer and winter and changes in size seems to be related to season. Overall a minor decline in mean length was observed.

Catch-curve analysis was used in an attempt to determine the F-level. However, the basis for a catch-curve analysis may be violated as the fishery is expected to exploit different age-components in the different seasons and different localities. Therefore the results were considered unreliable.

ii) **Research survey data**

Before 1993 various longline exploratory fisheries with research vessels were conducted. Due to different design and gear these surveys were not quite comparable. In 1993 a longline survey program for Greenland halibut was initiated for the inshore areas, Disko Bay, Uummannaq and Upernavik. The surveys are conducted annually covering two of three areas alternately, with approximately 30 fixed tations in each area. In July-August 1996 the research longline vessel *Adolf Jensen* covered the fjord areas of Disko Bay and Uummannaq. A total of 56 longline settings with 71 614 hooks were performed.

CPUE values (kg/100 hooks) from longline surveys conducted in Div. 1A inshore areas.

Area	1962	1985	1986	1987	1993	1994	1995	1996
Disko Bay	-	-	8.3	16.5	3.1	3.1	-	3.9
Uummannaq	4.6	13.7	-	8.6	2.8	-	6.6	4.5
Upernavik	-	-	-	-	-	5.2	3.9	-

Mean length (cm) from catches taken in Div. 1A inshore longline surveys.

Area	1962	1985	1986	1987	1993	1994	1995	1996
Disko Bay	-	62.4	53.5	62.2	55.9	56.5	-	53.6
Uummannaq	67.8	70.5	-	61.8	57.5	-	57.8	59.5
Upernavik	-	-	-	-	-	64.6	60.8	-

Comparing the mean length for Greenland halibut recorded in the surveys since the 1960s a decline in length with time is evident, however, looking at the surveys from 1993 to 1996 no clear trend was observed, except for Upernavik where mean length declined. A comparison between CPUE values in the period 1993-96 showed that the Upernavik area has had a significant fall in CPUE.

Since 1988 annual trawl surveys were conducted with a shrimp trawler off West Greenland between 59°N and 72°30'N from the 3-mile offshore line to the 600 m depth contour line. Since 1991 the area inshore of the 3-mile line in Disko Bay was also included in the surveyed area. Biomass (8 047 tons) as well as abundance (112 million individuals) estimates in the Disko Bay in 1996 were well above the level since 1991 (Fig. 50). Standardized recruitment indices were presented as catch-in-numbers per age per hour, for both the offshore and inshore nursery areas (Fig. 51). The recruitment in offshore areas declined after 1991 but was high relative to previous years. The most recent year-class of 1995, however, seems to be the largest on record. The mean catch of one year old fish was about 650 specimens per hour compared to about 350 for the 1991 year-class. A large number of the 1995 year-class were also observed outside the traditional nursery area, especially north of Disko Island.

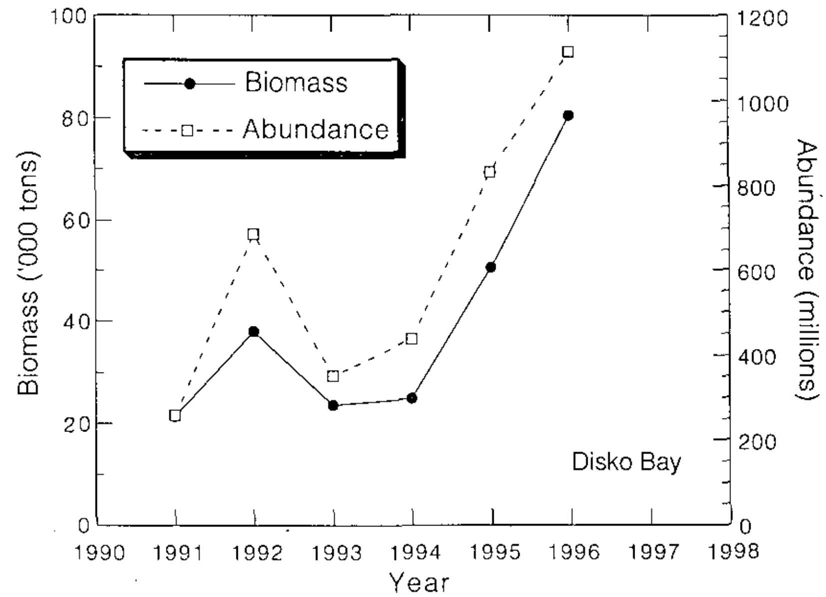

Fig. 50. Greenland halibut in Div. 1A: biomass and abundance indices of Greenland halibut in Disko Bay.

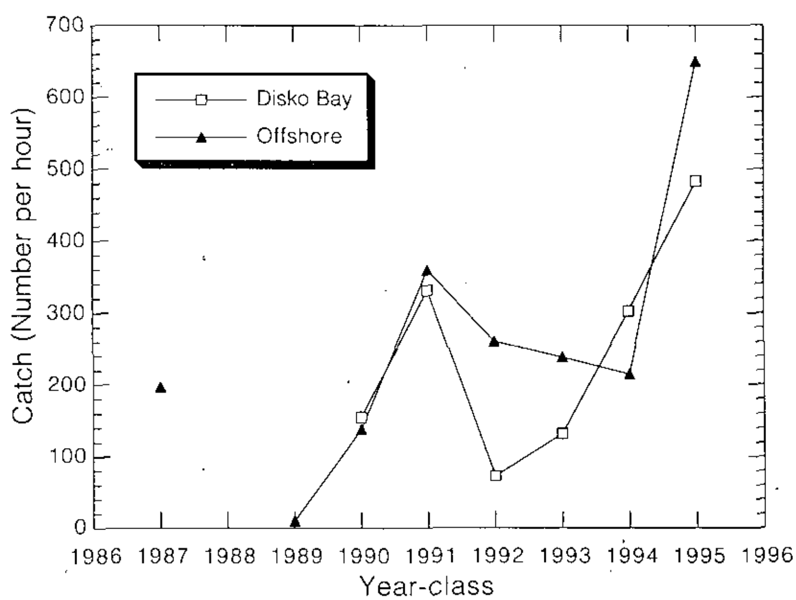

Fig. 51. Greenland halibut in Div. 1A: recruitment of age one on nursery grounds.

iii) Biological studies

Inshore tagging of Greenland halibut in Div. 1A was continued in 1996. No recaptures have so far been recorded outside the tagging area for tagging in the fjords (unpublished data). Therefore the assumption that the stocks in the three main areas are considered separate units can be maintained (SCR Doc. 97/78).

c) Assessment Results

The recent level of fishing mortality could not be estimated.

The stock in all three areas consist of a large number of age groups, and the age structure of the stock does not show sign of collapse.

Disko Bay. Catches have been increasing continuously in the past 10 years from about 2 000 tons to 8 000 tons. However, catch composition in 1996 has not undergone dramatic changes compared to recent years. Survey results since 1993 do not indicate any major changes in total abundance or catch composition and the stock still seems to be growth overfished. The stock component in Disko Bay is composed of younger and smaller individuals compared to the two other areas.

Uummannaq. Catches have been increasing from a level of 2 000 tons before 1987 to about 3 000 tons in the period 1987-92 and further to a record high in 1995 of 7 000 tons. In 1996 catches decreased to 4 500 tons. Catch composition has changed significantly since the 1980s towards a higher exploitation of younger age-groups, thus indicating growth overfishing. Survey results since 1993 suggest a minor increase in total abundance and catch composition also showed a minor increase in mean length.

Upernavik. The fishery for Greenland halibut in Upernavik began in 1986. Catches have been increasing annually from a level of 1 000 tons before 1992 to about 4 500 tons in recent years. Catch composition has changed continuously in the period to include exploitation of younger age-groups. Survey results in 1994 and 1995 suggest a decrease in total abundance and a decreased mean length in stock composition.

d) Comments on the Assessment

The inshore stock is exclusively dependent on recruitment from the offshore nursery grounds and the spawning stock in Davis Strait. Only sporadic spawning occurs in the fjords, hence the stock is not self-sustainable. The fish remain in the fjords, and do not contribute back to the offshore spawning stock. It is unclear yet what impact the commercial shrimp fishery have on the survival of the small Greenland halibut.

The connection between the offshore and inshore stocks implies that recruitment failure in the offshore spawning stock due to high fishing mortality, will have severe implications for the recruitment to the inshore stocks.

e) Research Recommendations

STACFIS **recommended** that *measures of effort from the commercial fishery be analyzed to obtain estimates of total mortality for Greenland halibut in Div. 1A.*

STACFIS **recommended** that *the impact of the commercial shrimp fishery on small Greenland halibut in Div. 1A be investigated.*

IV. AGEING TECHNIQUES AND VALIDATION STUDIES

1. Report of the ICES/NAFO Workshop on Greenland Halibut Age Determination

At the 83rd Statutory Meeting of ICES in 1995 it was decided to conduct a joint ICES/NAFO Workshop on Greenland halibut age reading. Co-Chairman K. Nedreaas (Norway) presented to STACFIS the report of this Workshop which was held in Reykjavik, Iceland during 26-29 November 1996, with participants from Canada, Greenland, Iceland, Norway, Portugal, Russia and Spain.

The goals of the Workshop included:

a) evaluate research from comparative age determinations;

b) intercalibrate the age reading and age determination methodology of Greenland halibut;

c) establish a protocol for the handling of otoliths and the age determination of Greenland halibut using otoliths;

d) establish a Greenland halibut otolith exchange program on a regular basis between laboratories involved;

e) in the light of the Workshop results, identify new research and action needed to improve the consistency of age reading.

All of the goals were achieved during the Workshop. It was noted an international exchange of 100 baked otoliths has already been initiated by Iceland.

The most important recommendations were:

i) Age validation

The edge growth of the otolith should be described <u>for each fishing area</u> in a fashion similar to that reported in Lear and Pitt (1975).

Validation of the first 1-3 years of growth should be conducted <u>for each fishing area</u> by analyzing modes in length frequency data (Petersen technique).

Validation is needed for ages older than approximately 3 years and fish larger than about 30 cm in length. This may be achieved by oxytetracycline marking in conjunction with regular, traditional tagging programs. Radionucleotide dating should also be further investigated for this purpose.

ii) Investigation into determining an optimal storage medium for Greenland halibut otoliths that could enhance the acuity between annuli without long-term detrimental effects to the otolith structure.

iii) Investigation into determining an optimal temperature and treatment time when baking otoliths for age determination purposes.

iv) Any intermediate results from the otolith exchanges should be presented both to ICES and NAFO for review and further recommendations for improvements.

STACFIS was informed that the final report (ICES C.M. Doc. 1997/G:1) also contains an extensive bibliography on Greenland halibut age and growth.

Reference:

Lear, W. H., and T. K. Pitt. 1975. Otolith age validation of Greenland halibut (*Reinhardtius hippoglossoides*). *J. Fish. Res. Board Can.*, **32**: 289-292.

Interim results (SCR Doc. 97/67)

With regards to the recommended investigation of optimal temperature and storage medium when baking the otoliths, results from already conducted research were presented to STACFIS. Based on these investigations the best results were achieved when baking the otoliths at a temperature of 250°C for 30-60 minutes depending on the size and thickness of the otoliths. It was also observed that the contrast between the annuli may be enhanced if the baked otoliths are kept in emersion oil for 3 hours prior to reading.

V. OTHER MATTERS

1. Report on Comparative Trawl Surveys

STACFIS noted that a paper on the analysis of the 1996 comparative fishing trial between the *Alfred Needler* with the Engel 145 trawl and its sister ship the *Wilfred Templeman* with the Campelen 1800 trawl (SCR Doc. 97/68). It was assumed that there was no difference between vessels - only differences between the fishing gear. Six species were targeted for study: Atlantic cod, American plaice, Greenland halibut, witch flounder, yellowtail flounder, and beaked redfish. The trial was conducted in the same manner as the *Gadus Atlantica - Teleost* study in 1995 (reported to STACFIS in 1996, SCR Doc. 96/27). During February and March, 1996, a total of 180 successful paired tows was completed, spread over three trips by each vessel, in a number of areas and depths around Newfoundland, mainly in Div. 3NOP. This produced somewhat less than desired sample sizes for most species, given that all species did not occur in all sets. By comparison, the *Gadus Atlantica - Teleost* trial consisted of approximately 285 tows.

Conversion factors were developed for some species in exactly the same manner as in the 1995 study. For other species, a modified approach was required, based on similar methodology. In all cases, the estimated conversion factors were length-based, and showed high values at small fish sizes (i.e. the ratio of Campelen catch to Engel catch was largest at small sizes), declining to values less than 1 (except for American plaice) at larger sizes. For example, the conversion factor for a 16 cm cod is 24.39, and for a 93 cm fish the value is 0.63. These values were applied to all cod <20 cm and all cod >87 cm respectively, in the Templeman/Engel time-series (SCR Doc. 97/73). Work presented for cod in Div. 3NO, and Div. 2J3KL, with the conversion factors applied, showed that perception of year-class strength was not changed in the assessments of these stocks.

STACFIS noted that conversion factors in the mid-length range for all species appeared to be reasonable, but that problems remain with the smaller and larger lengths. Since, however, the Engel was not effective at catching the very small lengths, one practical solution is to determine a lower bound on length with no attempt at conversion for lengths below this. Improvement for the longer lengths requires adequate numbers of fish of such lengths to be caught, which would be difficult and costly. An alternative, as was done with cod, is to specify a constant value of the conversion factor for fish above a certain length (this approach can also be used for fish below a certain size at the small end of the length scale). As has been done for cod, and for Greenland halibut in the *Gadus - Teleost* trials, careful consideration on how to apply the accepted conversion factors must precede the conversion exercise for each of the remaining species in the study. For American plaice, the difference in the conversion factors derived from the two comparative fishing trials will also require study.

Converted estimates of biomass and abundance will be presented to STACFIS during the assessments of relevant stocks in June 1998. Where previous Engel surveys were dominated by small fish, converted estimates (in Campelen catch equivalents) will show higher values for total abundance. Any estimates of abundance and biomass calculated with the converted data should use the swept-area value for the Campelen trawl, and not the Engel trawl, as the conversion factors were not adjusted for swept area.

2. Report on Seal Consumption

STACFIS received a report of prey consumption by seals in the Northwest Atlantic (see also Section 3a below). STACFIS noted that the estimates derived in this study assumed that the diet composition remained stable from 1990-97. Over this period there have been large changes in the population sizes of fish that occur in the diet of seals. It might be expected that prey selection by seals would change given these large changes in prey population size over time. This could mean that proportion of some fish species in the diet is over estimated for recent years. It was also noted that given that the diet reconstruction is based on hard parts in the stomach, the percentage of invertebrates might be underestimated. However, given differing energy values associated with different prey species, and the possible influences of these differences on daily gross intake, it is not possible to speculate on how these potential differences in diet composition might affect the annual consumption estimates of the various species. Finally, STACFIS noted that it is unclear how to incorporate these estimates of seal consumption into its estimates of natural mortality.

3. Review of SCR Documents

a) Prey Consumption by Seals

STACFIS reviewed a paper titled 'Prey Consumption by harp seals (*Phoca groenlandica*), grey seals (*Halichoerus grypus*), harbour seals (*Phoca vitulina*) and hooded seals (*Cystophora cristata*) in the Northwest Atlantic' (SCR Doc. 97/40): Noting seal predation may be one of several factors inhibiting the recovery of fish stocks, this paper estimated fish consumption by seals in Atlantic Canada. It is noted that four species of seals are common throughout Atlantic Canada; grey seals (*Halichoerus grypus*), harbour seals (*Phoca vitulina*), harp seals (*Phoca groenlandica*) and hooded seals (*Cystophora cristata*). Previous estimates of fish consumption by seals have been limited to only a few species, e.g. cod, and no information was available on fish consumption by harbour seals or by hooded seals off the Newfoundland coast.

The Northwest Atlantic harp seal is the most abundant species with an estimated 4.9 million animals in 1996, followed by hooded seals (598 000), grey seals (184 000) and harbour seals (29 100).

From 1990-96 total estimated prey consumption increased from 3.0 million tons to 3.8 million tons. However, 53% of this consumption consisted of three species; capelin, sandlance and Arctic cod. Most prey were consumed in Div. 2J+3KL (74%), followed by the northern Gulf of St. Lawrence (19%) and Div. 4VsW (3%). Less than 2% of this consumption occurred in the southern Gulf of St. Lawrence, the Flemish Cap and in other regions.

Harp seals were the most important predator accounting for 82% of the total fish consumption. Hooded seals and grey seals also consumed significant quantities of fish accounting for 10% and 8% of the fish consumed, respectively. Harbour seals consumed insignificant quantities of fish accounting for less than 1% of the total consumption.

Regional differences were observed in the importance of each predator. In Div. 2J+3KL, the harp seal was the most important consumer, followed by the hooded seal. In the northern Gulf, the harp seal consumed the most fish followed by the grey seal. In Div. 4VsW and in the southern Gulf, the grey seal was the most important predator.

Looking at the consumption of four commercial fish species, during the period 1990-96, the estimated cod consumption increased from 185 072 tons to 251 596 tons; estimated herring consumption increased from 101 385 tons to 136 468 tons, the estimated Greenland halibut consumption increased from 202 140 tons to 262 518 tons, and the estimated redfish consumption increased from 100 888 tons to 129 366 tons (SCR Doc. 97/40, Appendix 2).

The majority of fish consumed were too small to be taken by the commercial fishery, if the commercial sizes of cod, herring, redfish and Greenland halibut were 40 cm, 30 cm, 25 cm and 50 cm, respectively. For grey seals 85% of cod, 84% of herring, and 60% of redfish consumed were pre-recruits to the commercial fishery. For harbour seals 98% of cod, and 63% of herring consumed were too small to be taken by the commercial fishery. For harp seals 98.7% of cod, 95% of herring and 90% of redfish consumed were pre-recruits to the fishery. In hooded seals 72% of herring, 60% of redfish and 90% of halibut consumed were too small to be taken by the fishery.

It was evident that seals consume large quantities of fish in eastern Canadian waters. The majority of this consumption consisted of species such as capelin, Arctic cod, sandlance and Atlantic cod. Little is known about factors affecting prey selection by seals. Recent diet information indicates that different species of seals may prey on different components of a prey population. For example in the case of Northern Gulf cod, harp seals appeared to consume primarily fish ranging from 10 to 20 cm in length, grey seals appeared to prefer fish around 15-30 cm, while hooded seals preferred fish 25-35 cm in length. Thus it appears that in the northern Gulf, harp seals would be feeding largely on 1-2 year old cod, grey seals would consume 2-3 year old cod, whereas hooded seals would be consuming 2-4 year old cod.

The paper suggests, given that seals consume primarily pre-recruits to the commercial fishery, it is unlikely that they have played a major role in the failure of several commercial fisheries in Atlantic Canada. However, seal predation may have a more significant effect on the recovery of fish stocks. Improvements in the estimates of consumption and potential impact can be achieved by improving our information on the temporal and spatial distribution of seals, particularly in offshore areas, and continued monitoring of diet . However, significant advances will not be achieved until more is known about the abundance of small fish and other sources of natural mortality in fish populations.

b) **Gear Studies**

STACFIS reviewed a paper on varying fishing power of Canadian survey trawl (SCR Doc. 97/66). Data on trawl geometry and performance were collected by an acoustic trawl instrumentation package. This permitted a comparison of fishing power differences between 4 research vessels using various survey bottom trawls. It was shown that when two vessels of different size and horsepower used the same survey trawl there was generally a strong vessel induced change in trawl geometry, gear performance, swept area and fishing power. Variation in swept area for each individual trawl could bias estimates of abundance due to changes in catchability and STACFIS noted that the use of a restrictor rope to physically restrain door spread and standardize trawl geometry and performance would minimize these differences.

c) **Other Papers**

Two other research documents (SCR Doc. 97/2 and 97/32) were deferred for consideration during the 7-19 September 1997 Meeting of the Scientific Council.

4. **Other Business**

There being no other business, the Chairman prior to adjournment, thanked the participants for their cooperation and in particular, the Designated Experts and the Secretariat for the work during the meeting.

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

Chairman: D. Power Rapporteur: J. Casey

The Committee met at Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada on 9, 11, and 17 June 1997, to discuss various matters pertaining to statistics and research referred to it by the Scientific Council. Representatives from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), European Union, Japan, Norway, the Russian Federation and United States of America were present.

1. Opening

The Chairman opened the meeting. J. Casey (EU-United Kingdom) was appointed rapporteur. Recommendations from the 1996 Meetings of STACREC were reviewed and it was agreed that they would be addressed under various agenda items.

2. Fishery Statistics

a) Progress report on Secretariat activities in 1996/97

i) Acquisition of STATLANT 21A and 21B reports for recent years

The Assistant Executive Secretary drew attention to the status of submissions of STATLANT 21A and 21B data, and reminded that under Rule 4.4 of the Rules of Procedure of the Scientific Council, the deadline dates for submission of STATLANT data for the preceding year are 15 May for 21A data and 30 June for 21B data. STACREC stressed that timely submission of STATLANT data is of paramount importance to the Scientific Council, since they are used extensively during its June Meetings for stock assessments and other scientific evaluations.

The following table shows the dates of receipt of STATLANT 21A and 21B reports for 1994-96 received by the Secretariat up to 10 June 1997.

	STATLANT 21A (deadline, 15 May)			STATLANT 21B (deadline, 30 June)		
Country	1994	1995	1996	1994	1995	1996
BGR	X	X	X	X	X	
CAN-M	05 May 95	04 Jul 96	20 May 97	21 Aug 96	26 Feb 96	
CAN-N	16 May 95	31 May 96	16 May 97	04 Jul 95	21 Apr 97	
CAN-Q	17 May 95	14 May 96	X	30 Jun 95	02 Jul 97	
CUB	30 May 97	30 May 97	30 May 97	30 May 97	30 May 97	30 May 97
EST	15 May 95	X	X	04 Jul 95	X	
E/DNK	12 Jun 95	15 Aug 96	X	15 Aug 96	15 Aug 96	
E/FRA-M	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
E/DEU	01 Jun 95	No fishing	04 Jun 97	16 Aug 95	No fishing	
E/NLD	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
E/PRT	01 Jun 95	22 May 96	14 May 97	25 Sep 95	04 Sep 96	
E/ESP	08 Jun 95	05 Sep 96	04 Jun 97	06 Jun 95	11 Sep 96	
E/GBR	01 Jun 95	No fishing	X	09 Apr 97	No fishing	
FRO	15 Jun 95	X	X	X	X	
GRL	04 Apr 95	20 Aug 96	06 Jun 97	09 Oct 96	09 Oct 96	
ISL	19 Jun 95	27 May 96	16 May 97	19 Jun 95	X	
JPN	06 Apr 95	02 Apr 96	14 Apr 97	06 Apr 95	02 Apr 96	24 Apr 97
KOR	X	No fishing	X	X	No fishing	
LVA	30 May 95	21 May 96	17 Apr 97	14 Jul 95	21 May 96	17 Apr 97
LTU	X	X	X	X	X	
NOR	11 May 95	31 May 96	22 May 97	20 Jun 95	27 Jun 96	
POL	No fishing	No fishing	X	No fishing	No fishing	
ROM	X	X	X	X	X	
RUS	07 Jun 95	23 May 96	X	07 Jun 95	14 Jul 96	
USA	Partial	X	X	X	X	
FRA-SP	02 Jun 95	18 Jul 96	06 Mar 97	12 Sep 96	12 Sep 96	06 Mar 97
HND*	X	X	X	X	X	
VEN*	X	X	X	X	X	

* Non-Contracting Party.

STACREC noted that the submission of STATLANT data is an agenda item for the 24-26 June 1997 Meeting of STACTIC. In view of the importance of the STATLANT data, STACREC **recommended** that *Scientific Council, draw the attention of the Fisheries Commission to the deficiencies in data submissions, along with a presentation to STACTIC during 24-26 June 1997.*

ii) **Publication of statistical information**

STACREC noted that publication of *NAFO Statistical Bulletin* No. 43 containing 1993 data has not been completed since statistical information from Denmark (with respect to the Faroe Islands) and the United States were still outstanding. Volumes 44 and 45 were also incomplete.

STACREC also noted serious delays in the submission of provisional data for some recent years. Provisional STATLANT 21A data for most countries are still outstanding for 1996, and there are serious shortfalls in data submissions for the period 1993 through 1996. The following table lists the countries (components) that have not submitted data:

STATLANT 21A			STATLANT 21B		
1994	1995	1996	1993	1994	1995
Korea Lithuania USA (Partial)	Estonia Faroe Islands Lithuania USA	Canada (Q) Estonia Denmark United Kingdom Faroe Islands Korea Lithuania Poland Russia USA	Faroe Islands USA	Faroe Islands Korea Lithuania USA	Estonia Faroe Islands Iceland Lithuania USA

STACREC discussed the value of publishing data that were at least four years out of date (e.g. 1993 data in 1997), but agreed that the data should continue to be published although the method of future publication should be reviewed (see next item).

iii) **Considerations on internet site for statistical data**

In response to the STACREC recommendation of 7-13 September 1996, the Secretariat presented a proposal for the establishment and operation of a website for dissemination of statistical information. STACREC supported the proposal which involved first setting up a small website which would evolve and expand over time. However STACREC noted that the cost of setting up and maintaining a website may not be trivial and that expertise would be required to set-up and maintain such a site.

STACREC **recommended** that *a NAFO website be established to facilitate the dissemination of STATLANT and other statistical data and that the following points be considered with regard to its set up and maintenance:*

i) Appropriate expertise be initially sought from outside sources to develop the basic construction of the site.

ii) Consideration should be given to training a member of the NAFO Secretariat in the maintenance of the website.

iii) The website should be written in English.

iv) Relevant disclaimers would have to be clearly stated in the website to denote those data that were considered preliminary in nature.

STACREC noted that the establishment of a NAFO website was also on the agenda for the June 1997 Meeting of STACPUB (see STACPUB report Item 5d). While this will provide valuable guidance, it is suggested that other NAFO Standing Committees give due consideration to utilizing such a facility for dissemination of information.

STACREC also noted that CWP had discussed the possibility of providing statistical information via a website and that many international agencies were taking steps to do so.

b) **Report of the CWP 17th Session, March 1997**

As recommended by the Scientific Council in 1996, the Assistant Executive Secretary, T. Amaratunga, Chairman STACREC, D. Power (Canada), and the Japanese representative, H. Matsunaga, National Research Institute of Far Seas Fisheries [K. Yokawa was unable to attend due to another commitment], represented the NAFO Scientific Council at the 17th Session of the Coordinating Working Party of Fisheries Statistics (CWP), in Hobart, Tasmania, Australia, during 3-7 March 1997. Twenty-four experts representing 11 international organizations attended the meeting, including representatives form the South Pacific Commission (SPC) and International Whaling Commission (IWC), who were voted in as new participating organizations of CWP (NAFO consideration in 1996 had no objections).

An extensive agenda (see CWP Report available at NAFO Secretariat) was covered and the CWP Meeting report was reviewed and adopted during that meeting. NAFO contributed in many areas of discussions in addition to the reports prepared by the Assistant Executive Secretary on i) STATLANT issues, ii) discrepancies among agency databases (NAFO and FAO), iii) NAFO fishing boundary modification, iv) by-catch and discard issues, v) NAFO statistical data and publication, vi) Observer Program and Hail system, and vii) data dissemination and internet.

In general NAFO initiatives were of significant interest to other agencies. Two important issues are as follows:

i) CWP recognized the exchange and dissemination of data (e.g. NAFO STATLANT 21 Data) in electronic form (e.g. World Wide Web is increasing rapidly) and offers more cost-effective data transfer with reduced delays.

ii) With respect to inter-agency discrepancies in published data, NAFO noted that the Yearbook of Fishery Statistics is published and circulated worldwide by FAO well before (some times more than 2 years) regional agencies such as NAFO finalize (or receive) their data. Consequently, discrepancies arise. CWP recommended that reconciliation exercises for the Northeast and Northwest Atlantic be undertaken (item 118) and that an intersessional activity on elimination of discrepancies in agency databases take place in order to report to the next CWP session (item 168).

In its review of the CWP report, STACREC noted that the CWP is in favour of a NAFO website. As noted above STACREC proposes a NAFO Website be established.

In addition STACREC noted that the CWP had highlighted discrepancies in data held by different agencies, e.g. NAFO data do not match with data held by FAO, and an intersessional meeting of Atlantic agencies (NAFO and EUROSTAT) together with FAO to discuss how to proceed was recommended by the CWP. STACREC concurred with the recommendations of the CWP that the Atlantic agencies meet to reconcile the differences between statistics held by the different agencies, and STACREC **recommended** that *activity on the elimination of discrepancies in agency databases be conducted at an intersessional meeting in mid-1998.* STACREC noted that the relevant Secretariats will finalise the meeting plans.

3. **Biological Sampling**

a) **Report on Activities in 1996/97**

The provisional list of biological sampling for 1995 was tabled (SCS Doc. 97/6), with a request to national representatives to provide updates and/or corrections.

STACREC noted that the provision of these data lag one year behind i.e. 1995 data are prepared in 1997. STACREC recognised that with the improvements in data acquisition and transfer there should be no need for this to be the case and **recommended** that *for the June 1998 Meeting of the Scientific Council, an SCS document containing biological sampling data for 1997 be prepared in addition to that containing the 1996 data*. This will ensure that in principle, data for the year proceeding the June meeting of the Scientific Council will be available in future.

b) **Report by National Representatives on Commercial Sampling Conducted**

Cuba: No report available

Canada: Sampling had been carried out via the Pilot Observer Program on the commercial fishery for shrimp and Greenland halibut in Subareas 0+1. Additional sampling was carried out at ports of landing. In Subarea 2, landings of salmon, shrimp crab and Greenland halibut were sampled. From Subarea 3, samples were obtained from the international fishery for shrimp, Canadian fisheries for crab, redfish and samples were also obtained from by-catches.

Denmark-Greenland - Subarea 1: Samples from the trawl fisheries for shrimp and Greenland halibut were taken at sea. Length composition of shrimp samples were carried out by observers on-board the vessels. Samples of Greenland halibut, cod, snow crab salmon and scallops were taken at ports of landing.

Division 3M: The fishery for shrimp in Div. 3M was not sampled in 1996.

EU-Denmark: No report available.

EU-France: Limited commercial fishing activity took place in 1996 in Subdiv. 3Ps. Sampling was conducted covering the inshore cod fishery (length and age composition of catches) and the Iceland scallop fishery (length composition of catches).

EU-Germany: Fishing was limited to Div. 1D and 3M. Only 1 sample of Greenland halibut in the 4th quarter of 1996 was taken. Samples from 55 hauls on the German research survey in Subarea 1 were taken.

EU-Portugal: Samples were obtained for trawl catches only. Data on catch rates and length compositions of cod, *S. mentella, S. marinus*, American plaice, roughhead grenadier and Greenland halibut were taken from February to December from Subarea 3. A research vessel survey in cooperation with EU-Spain was conducted on Flemish Cap (Div. 3M) in July 1996.

EU-Spain: Length distributions of Greenland halibut, American plaice, witch flounder and roughhead grenadier catches were collected from Subarea 3 in a reduced scientific sampling program. Limited age composition data were taken for American plaice, witch flounder and Greenland halibut. EU-Spain carried out 3 research surveys, two of them in co-operation with EU-Portugal as follows:

- Trawl surveys in Div. 3NO in April-May 1996 and in Div. 3M in July 1996.
- Longline survey in 3M and 3NO in April-May 1996.

Japan: A Japanese bottom trawl survey was carried out in co-operation with Canada (SCR Doc. 97/23).

Norway: Fishing in 1996 was limited to a Greenland halibut directed fishery in Div. 1D and a shrimp fishery in Div. 3M. Altogether 7 length samples from trawl and 10 length samples from longline catches in Div. 1D were taken. Catch rates for the trawl catches in Div. 1D were also available.

Russian Federation: A limited fishery in the vicinity of Greenland (Subarea 1) was conducted in 1996. No samples were taken. Length distribution data on Greenland halibut was obtained by observers on commercial trawlers fishing in Div. 3M. Samples from the shrimp fishery in Div. 3M in 1996 were taken and will be made available to Scientific Council in time for the shrimp assessment later this year.

USA: No report available.

c) **Report on Data Availability for Stock Assessments (by Designated Experts)**

Available data from commercial fisheries relevant to stock assessments on a stock by stock basis are given in Table 1.

Table 1. Available Data From the Commercial Fisheries Related to Stock Assessment (1996).

			Biological Sampling					
Stock	Country[1]	Catch	CPUE	Sex	Length	Age	Individual Wt.	Maturity
2J3KL Cod	CAN-N	+	X	X	X	X	X	X
3M Cod	E/PRT	*	X		X	X	X	
	E/ESP	+						
	FAR	+						
	OTHERS	+						
3NO Cod	JPN	+						
	CAN	+						
	E/PRT	+						
	NCP	+	(estimates from Canadian surveillance)					
SA 1 Redfish	GRL	+						
3M Redfish	E/PRT	+	X	X	X	X	X	
	RUS	+						
	JPN	+						
	NCP	+						
3LN Redfish	JPN	+						
	E/PRT	+	X	X	X	X		
	E/ESP	+						
	RUS	+						
4VWX Silver hake	CAN-M	+	X	X	X			
	RUS	+	X	X	X	X	X	X
	CUB	+	X	X	X	X	X	X
3M American plaice	E/PRT	+		X	X	X	X	
	E/ESP	+			X			
3LNO American plaice	CAN-M	+						
	CAN-N	+						
	E/PRT	+			X			
	E/ESP	+			X			
3NO Witch flounder	E/ESP	+	X	X	X		X	
	CAN	+						
	FRO	+						
3LNO Yellow-tail	CAN	+	X	X	X			X
	E/ESP	+						
SA 0 + 1B-F Greenland halibut	CAN	+		X	X	X		
	RUS	+	X					
	JPN	+						
	GRL	+	X	X	X	X		
	NOR	+	X		X			
	E/DEU	+	X	X				
	E/ESP	+						

Table 1. Continued.

Stock	Country[1]	Biological Sampling						
		Catch	CPUE	Sex	Length	Age	Individual Wt.	Maturity
SA 1A Greenland halibut	GRL	+		X	X		X	X
SA 2+3 Greenland halibut	CAN	+	X	X	X	X	X	X
	E/PRT	+	X	X	X	X		
	E/ESP	+	X	X	X	X	X	X
	RUS	+	X	X	X	X		X
	JPN	+	X					
	FRG	+	X					
SA 0+1 Roundnose grenadier	CAN	+						
	JPN	+						
	RUS	+						
	E/DEU	+						
	E/ESP	+						
	GRL	+						
SA 2+3 Roundnose grenadier	CAN	+						
	JPN	+						
	E/ESP	+			X			
3NO Capelin		No Data Available in 1997						
SA 3+4 Squid	CAN	+		X	X			
SA 1 Other finfish	GRL	+						
3M Shrimp	CAN	+	X	X	X	X		
	EST	+	X					
	FRO	+	X	X	X	X	X	
	GRL	+	X	X	X			
	ISL	+	X	X	X	X	X	
	NOR	+	X	X	X			
	RUS	+	X	X	X			
SA 0+1 Shrimp	GRL	+	X	X	X	X	X	X
Denmark Strait Shrimp	ISL	+	X	X	X	X	X	X

[1] Country abbreviations as found in Statistical Bulletin; 'OTHER' and 'NCP' refer to estimates of non-Contracting Parties who did not report catches to NAFO.

4. Biological Surveys

a) Review of Survey Activities in 1996

An inventory of biological surveys conducted in 1996 as submitted by National Representatives and Designated Experts was prepared by the Secretariat (Table 2). Designated Experts also provided more detailed accounts of survey data for 1996 in relation to the stocks for which they have responsibility.

Table 2. Inventory of biological surveys conducted in the NAFO Area during 1996.

Subarea	Division	Country	Month	Type of survey	No. of sets
				Stratified-random Surveys	
1	A-F	GRL	7-8	Trawl survey for shrimp & groundfish	168
	B		6	Snow crab survey	708
	B-F	E/DEU	10	Groundfish, oceanography	55
	D	GRL	9-10	Snow crab survey	708
2	GH	CAN-N	9	groundfish - 1st leg	64
			9-10	groundfish - 2nd leg	60
		JPN/CAN-N	8	groundfish	141
2+3	JK	CAN-N	10-11	groundfish & trawl acoustic	1 125
3	K	CAN-N	11	groundfish & trawl acoustic	2 105
	KL		9	crab	-
	KLMN		11+12	groundfish & trawl acoustic	352
	L		5	groundfish - 1st	84
	LNO		5	groundfish - 2nd	89
	L		6	groundfish - 3rd	94
			6	groundfish - 4th	89
	LM	RUS	2	Greenland halibut	33
	M	RUS	5	groundfish	76
		CAN-N	9+10	groundfish - 1st	47
	LM		10	groundfish - 2nd	64
	L		10+11	groundfish - 3rd	75
	KL		11	groundfish - 4th	123
	NO		11+12	groundfish - 5th (strat. & other)	28
	O		12	groundfish - 6th	20
				Cabot Strait groundfish	-
	NO		11+12	groundfish & trawl acoustic	430
	Ps		4	groundfish - 1st	73
			4+5	groundfish - 2nd	88
	NO	E/ESP	4+5	groundfish	112
		E/ESP+E/PRT	7	groundfish	117
3+4	OPV	CAN-N	7+8	redfish trawl survey	133
4	T	CAN-M	9	groundfish	208
	VWX		7	groundfish	217
				Other Surveys	
1	A	GRL	7-8	longline, inshore G. halibut	53
	B-C		6-7	gillnet, inshore juvenile cod	153
2+3	HJKL	CAN-N	7	oceanography	-
	JK		4+5	biological seal sampling	-
	JKL		8+9	0-group survey	-
	JKLPs		6	acoustic cod	-
3	KLMN	CAN-N	5	capelin acoustic	-
	KLMNO		8+9	0-group survey	-
	L		4	inshore cod distribution	-
			4+5	acoustics research - cod	-
			5	acoustics calibration / test	-
			5+6	snow crab	-
			6+7	juvenile cod habitat	-
			7	Expt. trawling	12
			7+8	fish behaviour re trawls	-

Table 2. (continued)

Subarea	Division	Country	Month	Type of survey	No. of sets
3	L	CAN-N	8	snow crab	-
			9+10	snow crab	-
			10	acoustic testing & calibration	-
			10	juvenile cod habitat - 2	-
	LM	RUS	1-3	Greenland halibut	130
			5	Greenland halibut	72
	LNO	CAN-N	4+5	assessment of Iceland scale	-
	N		5	Clam	-
	NO		3	comparative fishing	84
			?	yellowtail	68
	Ps	FRA-SP+ CAN-N	3	scallops	97
	Ps		5	oceanography	-
	Ps		11+12	herring acoustic survey - 2	-
			9	groundfish catchability	77
3	LMN	EU/ESP+ E/PRT	4+5	longline	64
3+4	PRSTV	CAN-M	1	cod stock mixing	139
4	T	CAN-M	9	herring spawning bed	-
			10	herring acoustic	-
			10	herring acoustic	25
	V	CAN-N	7	redfish acoustic research	-
	Vn	CAN-M	4	plankton	54
			6	juvenile cod.	9
			9	juvenile cod	12
	WX		10	silver hake	141
4+5	XY	CAN-M	11	larval herring	156

b) **Surveys Planned for 1997 and Early-1998**

An inventory of biological surveys planned for 1997 and early-1998 as submitted by National Representatives and Designated Experts was prepared by the Secretariat (Table 3).

Table 3. Biological surveys planned for the NAFO Area in 1997 and early-1998.

Area	Country	Type of Survey	Dates
		Stratified-random Surveys - 1997	
1A-B	GRL	snow crab	May-Jun
1A-F		trawl survey for shrimp and groundfish	Jun-Aug
1B-F		deepsea trawl survey for Greenland halibut	Sep
1B-F	E/DEU	groundfish, oceanography	Oct-Nov
1C	GRL	snow crab	Sep
2GH	CAN-N	groundfish / shrimp trawl survey	15 Sep-10 Oct
2J+3KLMNO	CAN-N	autumn groundfish / shellfish trawl	14 Oct-19 Dec
3KLMNO	CAN-N	groundfish / shellfish trawl	24 Sep-10 Dec
3LNO		groundfish trawl	28 Apr-20 Jun
3P		groundfish / shellfish trawl	01-25 Apr
3NO	EU/ESP	groundfish	Apr-May

Table 3. Continued.

Area	Country	Type of Survey	Dates
3M	EU/ESP+EU/PRT	groundfish	Jul-Aug
3P+4V	CAN-N	Unit 2 redfish trawl	21 Jul-08 Aug
4T	CAN-M	groundfish (200 sets)	Sep
4VsW		groundfish (132 sets)	Mar
4VW		groundfish (100 sets)	Jul
4WX		groundfish (100 sets)	Jul
5Z	CAN-M	groundfish (96 sets)	Feb
		Other Surveys - 1997	
1A	GRL	longline, inshore juvenile Greenland halibut	Jul-Aug
1E-F		gillnets, inshore juvenile cod	Jun-Jul
2J+3KL	CAN-N	0-group survey	11-29 Aug
2J+3KLM		annual physical / biol. oceanography	08-28 Jul
		zonal physical/biol. oceanography	24-Oct-08 Nov
2+3KLMNO		0-group survey	11-29 Aug
3K	CAN-N	White Bay snow crab trap	02-19 Sep
		White/Notre Dame Bay herring acoustic	12 Nov-19 Dec
3L		herring acoustic - 2	Jan-Feb
		fish behaviour re trawls	Feb+Mar
		trawl catchability	Feb+Mar
		inshore cod acoustics - Trinity / Bonavista	21 Apr-16 May
		acoustics testing & calibration - Smith Sound	01-08 May
		ADCP survey Clode Sound	6-22 Jun
		juvenile cod habitat acoustics Newman Sound	09 Jun-01 Jul
		catchability of survey trawls, Smith Sound	07 Jul-01 Aug
		larval fish feeding v. turbulence	21 Jul-06 Aug
		Bonavista Bay snow crab trap/trawl	04-15 Aug
		acoustics testing & calibration - Smith Sound	03-10 Sep
		Conception bay snow crab trap/trawl	22 Sep-03 Oct
		juvenile cod acoustics/habitat - Bonavista/No	06-27 Oct
3LN		Iceland scallops	08-18 Jul
3LNO		climate change / oceanography	06-21 May
3NO		redfish acoustics	Jan
		biological seal sampling	Jan-Feb
3P		Placentia / Fortune Bays - spawning cod	01-18 Apr
3Ps		cod / redfish acoustics	04-20 Jun
		catchability of groundfish	23 Jun-04 Jul
		Bay d'Espoir ADCP survey	25 Jun-02 Jul
			11-18 Sep
		cod tagging PB	20 Oct-07 Nov
3P+4RSTV	CAN-M	cod stock mixing (104 sets)	Jan
3P+4TVn		samples for HP cod stock mixing (8 sets)	Apr
4R	CAN-N	Iceland scallops	03-12 Sep
4RS		zonal redfish / cod mortality	19-30 Apr
4T	CAN-M	herring spawning bed	Aug-Sep
		herring acoustic	Sep-Oct
		herring acoustic (35 sets)	Sep-Oct
4Vn		larval herring (50+ sets)	May
		juvenile cod (12 sets)	Jun
		juvenile cod (12 sets)	Sep
		juvenile cod (12 sets)	Oct

Table 3. Continued.

Area	Country	Type of Survey	Dates
4WX	CAN-N	acoustics / sonar - Scotian Shelf herring	23 May-02 Jun
	CAN-M	silver hake (200 sets)	Oct
4X		redfish high priority (13 sets)	Nov
		herring survey in support of developing fisheries (150+ sets)	Nov
4X+5Y	CAN-M	larval herring (150+ sets)	Nov
		Surveys Planned for Early-1998	
2J	CAN-N	biological seal sampling / acoustics	21-30 Jan
3LPs		catchability survey trawls TB/PB	22 Jan-24 Feb
		St. Mary's-Placentia bay herring acoustic	02-31 Mar
3P		redfish acoustics	5-16 Jan

5. Non-traditional Fishery Resources in the NAFO Area

a) Distribution Data from Surveys

There was no documentation tabled to address the distribution and abundance of non-traditional species in the NAFO Area, accordingly, STACREC **recommended** that *distribution and abundance of non-traditional species data analyses be carried out and the results presented to STACREC as soon as possible.*

6. Review of SCR and SCS Documents

a) Length/weight relationships were considered for some species of fish encountered in the Northwest Atlantic particularly in Div. 3L, 3M and 3NO (SCR Doc. 97/15). Data obtained from samples collected on research surveys (1995 and 1996) and commercial fishing vessels (1993 and 1994) were analyzed to derive length/weight relationships for more than 20 commercial and non-commercial fish species. The results are presented by NAFO Div. and in some cases by semester.

b) Length/weight relationships for Greenland halibut, *Reinhardtius hippoglossoides* in Div. 3L, 3M and 3NO were considered (SCR Doc. 97/16). Data obtained from samples of Greenland halibut collected on research surveys (1995 and 1996) and commercial fishing vessels (1993 and 1994) were analyzed to derive length/weight relationships. The results are presented by sex, NAFO Division and semester.

c) Length at first maturity of roughhead grenadier, *Macrourus berglax*, in Div. 3MNL were presented (SCR Doc. 97/19). An estimation of the length at first maturity for female roughhead grenadier in waters off Newfoundland was obtained using histological analysis of ovaries collected during experimental fishing surveys and commercial fishery operations carried out during 1995 and 1996.

The estimated length at first maturity (L_{50}) for females was 66.7 cm (TL) corresponding to about 14.8 years old (A_{50}). This results were similar to previous findings for this species in the Northeast Atlantic.

d) Reproductive biology of roughhead grenadier, *Macrourus berglax*, in Div. 3MNL was presented (SCR Doc. 97/20). A histological study described oocyte development and maturation process in roughhead grenadier. New data on the reproductive pattern together with a tentative evaluation of the fecundity of the species are also presented. Roughhead grenadier exhibits 'group synchronous' ovaries with at least two populations of oocytes at any one time. The total standing stock of vitellogenic oocytes per individual varied from 63 700 to 297 700 eggs.

e) The differences in the sex ratio of Greenland halibut (expressed as relative number of females) during the period 1984-92 in Div. 0B, 2GH, 3K and from 1993 to 1996 in Div. 3LM were examined (SCR Doc. 97/27). The observed proportion of females was greater in southern Divisions than in northern Divisions.

A reduction in the proportion of females in Div. OB, 2GH was observed over the period 1985 to 1988. During subsequent years the proportion of females remained at or above the long-term mean level. A successive reduction in the proportion of females was observed in Div. 3K from 1984 to 1992.

The paper concluded that the long-term impact of specific fishing gears upon the Greenland halibut stock can essentially influence the sex ratio and its status. Since a trawl fishery in the northern areas, based on prespawning aggregations consisting mainly of males, together with longline and gillnet fisheries directed to females, the long-term impact of these fishing gears may result in a disturbance of the natural population sex ratio. Furthermore, since fecundity of individual Greenland halibut females is size/age-dependent, fishing of large females will reduce potential populational fecundity and have an adverse effect on the stock's reproductive capacity and may result in its reduction.

f) Feeding of Greenland halibut (*Reinhardtius hippoglossoides*) caught in Regulatory Area of NAFO Div. 3LMNO was studied on board commercial vessels over the period June 1991 to December 1994 (SCR Doc. 97/37). A total of 625 165 specimens were examined for stomach contents, 18 527 of which contained prey items.

The data indicate increased feeding intensity with increasing size of fish. The proportion of empty stomachs varied directly with depth in specimens up to 60 cm total length, whereas the relationship was reversed in specimens greater than 70 cm in length. The proportion of empty stomachs in females was less than in males and feeding rate decreased in females as they became reproductively active.

Examination of the main prey groups revealed that there was a change in feeding habit when fish reached about 60 cm in length. This was observed in fish from all Divisions and the change was marked by a reduced proportion of crustacea and molluscs in the diet with a concomitant increase in the proportion of fish and offal together with an increase in the mean size of prey items.

The differences in the diet according to fish size, sex, Division and depth were presented.

7. Other Matters

a) Tagging Activities

The Secretariat compiled the list of tagging activities in 1996 (SCS Doc. 97/15). STACREC **recommended** that *scientists undertaking any tagging activities inform the Secretariat in order that the information may be widely circulated and hence better returns may be obtained.*

b) Development of Protocol for Scientific Data Collection by Pilot Observer Program

Status of Data Availability from NAFO Pilot Observer Program

STACREC noted with concern that all data collected under the NAFO Pilot Observer Project had not yet been submitted to NAFO, and that such information would be extremely valuable to the Scientific Council.

Protocol for Scientific Data Collection

Under the current Conservation and Enforcement Measures (FC Doc. 96/1; 97/1), Part VI item 3(b) (c) and (d). Observers shall:

"b) collect catch and effort data on a set-by-set basis. This data shall include location (latitude/longitude), depth, time of net on the bottom, catch composition and discards; in particular the observer shall collect the data on discards and retained undersized fish as outlined in the protocol developed by the Scientific Council;

c) carry out such scientific work (for example, collecting samples) as requested by the Fisheries Commission based on the advice of the Scientific Council;

d) '**within 30 days** following completion of an assignment on a vessel, provide a report to the Contracting Party of the vessel and to the Executive Secretary, who shall make the report, available to any Contracting Party that requests it. Copies of reports sent to other Contracting Parties shall not include location of catch in latitude and longitude as required under 3 b), but will include daily totals of catch by species and division."

Item 3 b) from above was addressed at the September 1996 Meeting of the Scientific Council as a request of the Fisheries Commission in that a sampling scheme was developed to collect appropriate data on catches and discards.

In consideration of Item 3 c) above STACREC struck an *ad hoc* Working Group to develop a more detailed protocol on scientific sampling to provide to the Fisheries Commission, on behalf of the Scientific Council. This was done in accordance with the opportunity provided in 3 c) that the work of the Scientific Council could be further enhanced if the Fisheries Commission would implement the protocol to carry out scientific sampling under the Pilot Observer Program given that 100% coverage is mandatory. The group consisted of M. Showell (Canada), E. Cárdenas (EU-Spain), R. Alpoim (EU-Portugal), O. Hagström (EU-Headquarters), V. Shibanov (Russia), A. Vaskov (Russia).

STACREC noted that in principle, the introduction of 100% observer coverage should improve the provision of data to Scientific Council. To date this has regrettably not been the case. In the case of EU-Spain the quality of information has deteriorated. This has been due to the inability of vessels to carry a trained scientific observer to collect biological sample information in addition to the observer required by the NAFO Pilot Observer Project. STACREC recognizes that any deterioration in the quality of information supplied to Scientific Council is undesirable, but that in principle the data required could be collected by the observers in the Pilot Project suitably trained in biological sampling. STACREC suggested that collection of additional data under the Pilot Project, e.g. length composition data, is potentially very useful and that observers be trained in the appropriate methodology.

Recognising potential difficulties and delays, STACREC compiled the following list of additional data requirements, based on the report of the *ad hoc* Working Group, that should be collected under the Pilot Observer Program and made available to the Scientific Council on a timely basis.

- There is a need for additional scientific sampling information in these fisheries.

- In particular, length frequency data, by sex where appropriate for a species, should be collected from the unculled catch.

- Length frequencies of the portion of the catch discarded would be useful to estimate total removals under certain circumstances.

- To ensure length frequencies are representative of the catch, training in the collection of unbiased samples would be critical.

- Collection of ageing material should be possible, but will impose an additional burden on the observers time and may require prioritization of sampling tasks; training would also be required.

- Sampling data must be linked to set, catch, and gear information currently collected.

- Collection should be by means of NAFO standard forms and codes.

- Observers in the Canadian domestic program currently perform scientific data collection duties, and might be useful as a model for the scientific sampling.

Sampling Levels

- Optimal level: sampling levels of approximately 2 samples (200 fish each) per day, with one sample of the directed species and a second of by-catch or discards depending on circumstances.

- Alternative level: an alternative sampling scheme of 1 sample/commercial species/week was suggested.

- A simulation was suggested, where anticipated fleet activity and catch by species could be examined to estimate proper distribution of samples, by area over time.

- After an initial 1 year period, the distribution of sampling between scientific observers and NAFO pilot observers, within and between countries, should be examined to identify possible over or under sampling.

Timing of Data Availability

- For stock assessment purposes, length frequency and associated data for the previous year should be made available to the Scientific Council through the National Representatives ready for analysis, on 1 April.

The enhanced collection of scientific information from these fisheries was regarded as important, and it was recommended that protocols to ensure it's collection should be implemented as soon as possible.

c) **Conversion Factors**

STACREC noted the international interest in the need for increased transparency in the factors used to convert differing fish presentations and fish products to landed whole weight, and that there may be a desire to harmonise the factors used in different countries. STACREC further noted that three major initiatives are currently underway:

i) A Joint Norwegian/Russian study to develop agreed methods for the measurement and calculation of conversion factors.

ii) EUROSTAT is currently compiling the conversion factors supplied by national authorities to FAO on the FISHSTAT CFI questionnaire and supplemented by data obtained through direct contacts with national authorities. EUROSTAT and FAO are considering publication of these data.

iii) An EU-financed study, coordinated with that of EUROSTAT, concentrating on the situation in Denmark, France and the United Kingdom.

The latter two studies have revealed that many national authorities have been applying the same factors without review for many years (in, at least one case, for over 50 years). Very few national authorities appear to be using factors developed by means of recent technical investigations.

STACREC noted the Norwegian/Russian work in developing agreed methods of deriving conversion factors and pointed out that an evaluation of the reliability of conversion factors would be much enhanced if they were accompanied by full information on their method of derivation.

STACREC recognized that the use of accurate and appropriate conversion factors is essential for the compilation of catch statistics and that a better knowledge of the factors in use is paramount. It was noted that whereas harmonization of factors for relatively unprocessed products might be feasible, another application of this procedure should be approached with caution because differing national practices in processing fishery products could give rise to justifiably different factors.

d) **Fishing Effort**

STACREC was informed that the Secretariat had informed all Contracting Parties of its recommendation during the September 1996 Meeting, that the definition of fishing effort for gill nets had been changed. Also at its September 1996 Meeting, STACREC noted that the definition of effort for several other static gears may not be appropriate and that comments on this point should be solicited. To date the Secretariat had received no comments on this matter. STACREC was informed that if any changes are to be made to definitions of fishing effort for fixed gears, or any other gears, it would be timely to do so at the earliest opportunity because a chapter on fishing effort measures for inclusion in the FAO Handbook of Fishery

Statistics is currently being finalized, and because EUROSTAT is finalizing a revision of the technical annexes of the EU legislation on catch data for the Northwest Atlantic.

Accordingly STACREC **recommended** that *members examine current fishing effort definitions and notify the Chairman of STACREC of any suggested changes*. Proposals will be discussed at the September 1997 Meeting of STACREC.

e) **Canadian Stratification Scheme**

STACREC was informed that Canada is currently revising its research survey stratification scheme and that when finalised, STACREC will be advised of the amendments in order that other Contracting Parties can adjust their survey design to take into account the revised stratification.

8. Acknowledgements

The Chairman expressed his thanks to the Secretariat, the rapporteur and all participants for their assistance in compiling the information necessary for the meeting.

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

Chairman: M. Stein Rapporteur: A. Vazquez

The Committee met at Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada on 7, 9, 12 and 16 June, 1997. In attendance were H. P. Cornus (EU-Germany, on 7 and 12 June 1997), J. Morgan (Canada), V. A. Rikhter (Russian Federation), F. M. Serchuk (USA, on 9 and 12 June 1997), M. Stein (EU-Germany, A/Chairman), A. Vazquez (EU-Spain) and the Assistant Executive Secretary (T. Amaratunga).

1. Opening

The Acting Chairman, M. Stein, was welcomed by the Committee, noting the Chairman, H. P. Cornus, was occupied as STACFIS Chairman during this meeting. The agenda as presented in the Provisional Agenda was **adopted**. A. Vazquez was appointed rapporteur.

2. Review of STACPUB Membership

The Scientific Council was informed that K. H. Nygaard (Denmark/Greenland) was unable to attend NAFO Meetings because of added responsibilities at his Institute, and wished to withdraw from STACPUB membership.

Upon the request of the Council, STACPUB reviewed its membership at a brief meeting on 7 June 1997. F. Serchuk (USA) was nominated by STACPUB and appointed by the Council.

The Committee welcomed F. Serchuk to STACPUB, and also conveyed its appreciation to K. Nygaard for his valuable services and expertise to STACPUB since 1994.

3. Review of Scientific Publications Since June 1996

a) Journal of Northwest Atlantic Fishery Science

Volume 19, containing 11 papers presented at the 1993 Symposium on 'Gear Selectivity/Technical Interactions in Mixed Species Fisheries', Report of Symposium, List of Participants and Documents, and 1 notice (145 p.) was published with a publication date of September 1996.

Volume 20, Special Issue, containing 1 paper by R. G. Halliday and A. T. Pinhorn entitled 'North Atlantic Fishery Management Systems: A Comparison of Management Methods and Resource Trends', and 1 notice (143 p.) was published with a publication date of September 1996.

Volume 21, containing 5 miscellaneous papers and 2 notices (83 p.) was published with a publication date of April 1997.

Of the 28 papers presented at the NAFO/ICES 1995 Symposium on 'The Role of Marine Mammals in the Ecosystem', 9 papers are in-house for technical editing. Nineteen papers are in final review stages and should be received at the Secretariat soon. This issue is expected to be completed by mid-1997.

There are 7 miscellaneous papers in the process of being reviewed. STACPUB agreed that the papers that have been under review for some time should be recalled from the editors, and a course of action developed for them in consultation with the authors.

b) NAFO Scientific Council Studies

Studies Number 25, containing 5 miscellaneous papers and 3 notices (91 p.) was published with a publication date of July 1996.

Studies Number 26, Special Issue titled 'Selected Papers on Harp and Hooded Seals', containing 11 papers presented at the Joint ICES/NAFO Working Group on Harp and Hooded Seals held during 5-9 June 1995, 2 notes and 1 notice (129 p.) was published with a publication date of December 1996.

Studies Number 27, containing 5 miscellaneous papers, 1 note and 2 notices (81 p.) was published with a publication date of December 1996.

Studies Number 28 titled 'Assessment of Groundfish Stocks Based on Bottom Trawl Survey Results', containing 6 papers presented at the Workshop held during 4-6 September 1996, Program, Introduction and Objective of the Workshop, List of Participants, and 1 notice (105 p.) was published with a publication date of December 1996.

Studies Number 29 titled 'Selected Studies Related to Assessment of Cod in NAFO Divisions 2J+3KL', containing 11 papers presented at 5-19 June 1996 Meeting of Scientific Council, and 2 notices (125 p.) was published with a publication date of May 1997.

Studies Number 30, containing 8 miscellaneous papers is in the final galley stages of preparation. Publication of this issue is expected to be completed in late-1997.

There are presently no outstanding Studies papers.

c) **NAFO Statistical Bulletin**

Deadline for submission of STATLANT 21B reports for 1993 was 30 June 1994. As of May 1997, data were still outstanding from Faroe Islands and USA.

Deadline for submission of STATLANT 21B reports for 1994 was 30 June 1995. As of May 1997, data were still outstanding from Cuba, Faroe Islands, Korea, Lithuania, and USA.

Deadline for submission of STATLANT 21B reports for 1995 was 30 June 1996. As of May 1997, data were still outstanding from Cuba, Estonia, Faroe Islands, Iceland, Lithuania and USA.

d) **Index and Lists of Titles**

The provisional index and lists of titles of 118 research documents (SCR Doc.) and 20 summary documents (SCS Doc.) which were presented at the Scientific Council Meetings during 1996 were compiled and presented in SCS Doc. 97/5 for the June 1997 Meeting. The last 5-year compilation for 1990-94 was published in November 1995.

STACPUB noted the large number of publications completed by the Secretariat since its last June 1996 Meeting.

4. **Production Costs and Revenues for Scientific Council Publications**

a) **Review of Cost and Revenues**

The distribution list of scientific publications was reviewed. It was noted that as a result of the Secretariat review process there has been a decrease of the number of persons included in the list of free distribution. However STACPUB expressed its concern on the superfluous distribution of NAFO documents. It was agreed that National Representatives be encouraged to periodically review the free distribution list for their respective country, and to update the mailing list at the Secretariat to make it more effective.

STACPUB noted that as a common practice, many extra copies of each volume of the Journal and Studies are printed, and a substantial portion of them remains at NAFO stores for years. It was felt that a reduction of number of copies printed is not necessarily practical when the cost of binding is considered. In order to reduce the accumulated stocks it was proposed to explore the option of offering complete sets of these publications free of charges to Universities and public institutions, but they be required to cover the mailing cost. STACPUB agreed this wider circulation may publicise NAFO scientific work and improve the profile of the Journal and the Studies.

Present prices of Journal and Studies was considered. STACPUB agreed that increasing the copy prices substantially would not be advantageous, taking into account that most of potential buyers are students and beginners.

The number of free reprints offered to authors was also considered. At present the numbers offered are: fifty for the first author and twenty-five for each co-author. There is not an uniform criterion among various journals on the number of reprints that authors receive. STACPUB considered that thirty copies of free reprints is an adequate amount, irrespective of the number of authors.

b) **Proposal for Publications of 1997 Symposium Proceedings**

With respect to the scientific papers to be presented at the Symposium on 'What Future for Capture Fisheries', 10-12 September 1997, at the Marine Institute, Memorial University of Newfoundland, STACPUB agreed they should be published in a regular issue of the Journal after a peer review.

STACPUB **recommended** that *the volume of the Journal with the papers from the 1997 Symposium be published with a special cover which could include some figures related to the Symposium.* This will give the issue a special outside appearance that the convenor has proposed. It was agreed that a hard covered publication will set an unnecessary precedence for the Journal, and it was felt this was not an opportune time to change the looks of the Journal.

STACPUB also **recommended** that *documents distributed outside the main sessions during the 1997 Symposium not be included in the special issue of the Journal, but that those papers be individually considered with peer-review for publication in the Journal or Studies.*

5. **Promotion and Distribution of Scientific Publications**

a) **Invitational Papers**

STACPUB looks forward to the invitational paper by S.A. Horsted on an update and evaluation of catch statistics for West Greenland cod. The Chairman noted S.A. Horsted was working on his proposed invitational paper, and expects to have it completed this year.

STACPUB looks forward to the invitational paper by D.G. Parsons on Flemish Cap shrimp. STACPUB was informed that a draft had been completed, and a revised document will be submitted after internal peer review, in the near future.

Chairman had discussed the possibility for an invitational paper by E.B. Colbourne on a 5 year review of the Flemish Cap oceanography. The author has agreed to prepare and present a paper in 1998.

Further, STACPUB looks forward to an invitational paper by V.A. Rikhter on silver hake. It is anticipated that this would be ready at the end of 1997.

b) **Distribution of Abstracts for Research Documents**

STACPUB noted that NAFO research documents had an uneven reference in databases like ASFA. It had been agreed before by STACPUB that harmonized submissions can be easily done in many countries by sending abstracts to national ASFA representatives, but STACPUB noted there were concerns when the process is not well established in other countries. It was agreed that in those cases STACPUB would propose to establish procedures through NAFO Secretariat. In order to accomplish this STACPUB noted that the guidelines for preparing research documents should be more strongly imposed, so that abstracts are available for all research documents.

c) **New Initiatives for Publications**

STACPUB agreed to encourage authors that electronic versions of their papers be always included to improve the speed and quality of the papers as well as the circulation.

The acceptance of colour figures in publications was discussed. It was considered that their use becomes very useful in many cases and substantially improve the significance of graphics. The Scientific Council currently uses at its meetings colour pictures displayed by several methods, but these cannot be distributed in the SCR documents which commonly uses black and white. STACPUB **recommended** that *the Journal be open to accept colour figures to improve its presentation capacities.*

STACPUB agreed a valuable way of presenting papers containing coloured or elaborate figures, or documents prepared at short notice, would be on poster boards at the meetings.

d) **NAFO Website**

The possibilities of an Internet Website as a means to bring most current information to participants at Committees, and even to other interested public bodies, was considered. The Internet Website is recognized as the current communication method among scientists and a state of the art system for institutional publicity. Therefore, STACPUB **recommended** that *an Internet Website be established at the Secretariat.* STACPUB agreed that the website should be developed in a step-wise manner, and the Secretariat should look into obtaining expertise from outside as well as developing expertise of its own personnel for website management.

6. **Editorial Matters Regarding Scientific Publications**

a) **Review of the Editorial Board**

There were no changes.

b) **Progress report of publication on shrimp in Div. 3M**

As STACPUB noted before, D.G. Parsons had completed the draft for an invitational paper on shrimp on Flemish Cap.

c) **Considerations for Publishing Symposium Proceedings**

STACPUB **recommended** that *proceedings of the Symposia organised by the Scientific Council in St. John's, Newfoundland in 1997 on 'What Future for Capture Fisheries', and in Lisbon, Portugal in 1998 on 'Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish', be published in special issues of the Journal.*

d) **Progress Review of Publication of 1995 Symposium**

STACPUB noted that of the 28 papers presented at the NAFO/ICES 1995 Symposium on 'The Role of Marine Mammals in the Ecosystem', 9 papers are in-house for technical editing and nineteen papers are in final review stages and should be received at the Secretariat soon. The corresponding Journal issue is expected to be completed by mid-1997.

e) **Publication of 1996 Special Session Workbook**

STACPUB noted that the September 1996 Special Session Workbook was published in Studies Number 28, in a very short turn-around time.

7. Papers for Possible Publication

a) Review of SCR Document formats

The research documents (SCR Doc.) containing the assessment results were considered, and it was noted that these are the only Scientific Council reports that reflect the assessments conducted by the Council. Those documents should therefore contain most of the relevant information on the assessments, as well as views presented by the authors. STACPUB **recommended** that *a common format be developed for uniform presentation of the most important information in the assessments, particularly catch tables, to ensure their relevance to the assessment.*

b) Procedures for STACPUB Review

It was noted that Designated Experts and also Committee Chairmen were requested to make their proposals of papers for possible publication to STACPUB. STACPUB would therefore now review papers proposed by them as well as by the authors.

c) Review of Proposals Resulting from the 1996 Meeting

A total of 62 papers were published or are in their final stage of galley preparation (23 in the Journal and 39 in Studies) since June 1996. In addition, a total of 27 papers (mostly Symposium 1995 papers) are currently in various stages of editorial review for the Journal.

Of the 25 papers nominated at the June 1996 Meeting, 19 papers have been submitted, and all have been edited and/or published.

In addition, 7 papers from outside of the STACPUB nomination process were submitted since June 1996. One is in the hands of an Associate Editor, 4 have been published in the Journal series, 1 is in the hands of the author and 1 was not accepted for the Journal.

d) Review of Contributions to the 1997 Meeting

STACPUB considered the SCR Documents suggested by authors as well as 2 SCR Documents suggested by STACPUB members and 1 SCR Document suggested by Designated Experts, and nominated the following 19 including the standard paper on overview of environmental conditions: SCR Doc. 97/4, 5, 6, 13, 17 18, 19 and 20 combined, 21 and 22 combined, 24, 26, 27, 37, 40, 41, 46, 63, 66 and 77.

At its meetings since 1980, STACPUB has nominated a total of 588 research documents as potential for publication in the NAFO Journal or Studies. This includes 19 documents nominated at the June 1997 Meeting. To May 1997, a total of 490 papers have been published in the Journal (213) and Studies (277).

8. Other Matters

STACPUB expressed gratitude to NAFO Secretariat and, in particular, to NAFO Assistant Executive Secretary for the hard work in finishing so many publications.